

# Practicalities of compaction: building a machinery policy for healthier soils

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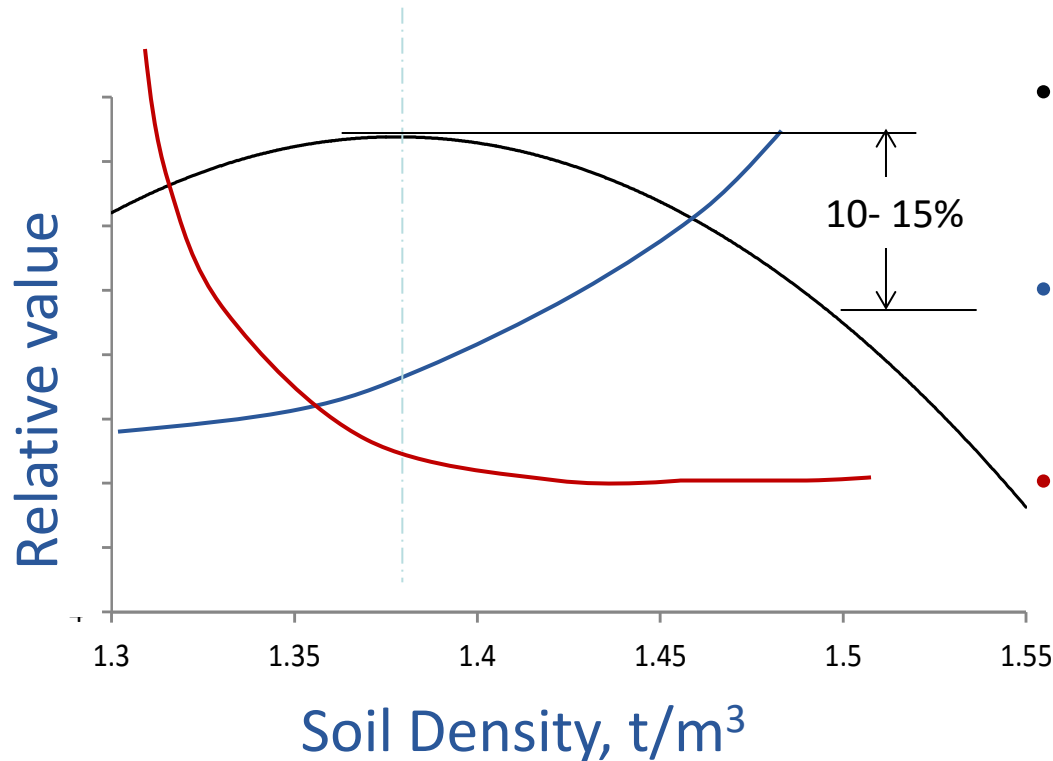


## Topics covered

- Issues relating from soil compaction
- Causes of compaction
- “Prevention is better than cure”
- Remediation methods
- Recommendations



## The effects of soil compaction



- Reduces crop yield  
(Negi & McKyes, 1978)
- Increases draught forces  
(Godwin, 1974; Chamen et al, 1992)
- Reduces infiltration rates  
(Chamen 2011; Chyba, 2012)

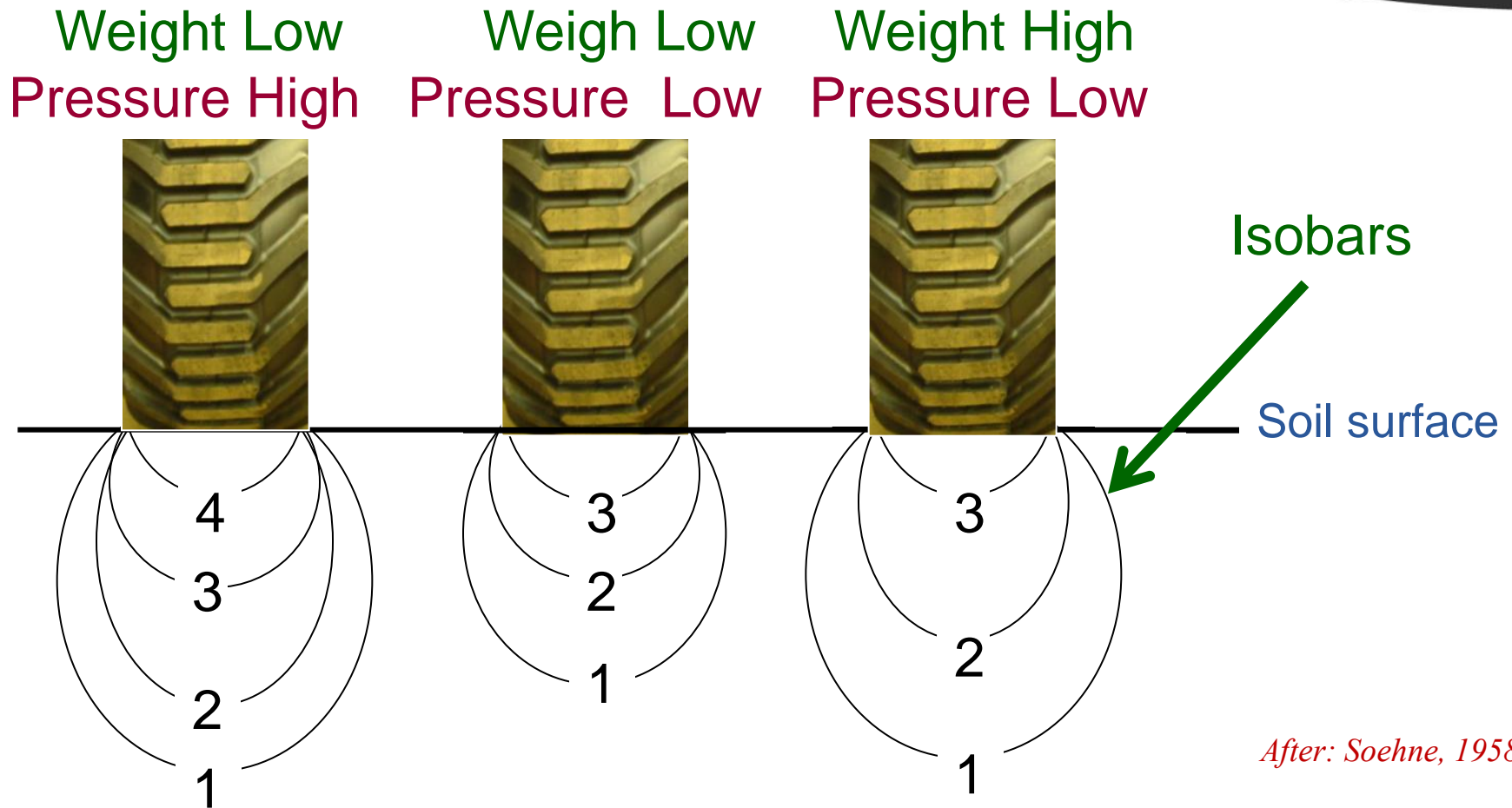


Economic cost of compaction in  
England and Wales :  
c. £0.4 bn/annum

*Morris et al. - Cranfield University, 2011*



# Effects of load and inflation pressure on pressure distribution



Pressure has the greatest influence on the degree of compaction and load influences the depth of soil compaction



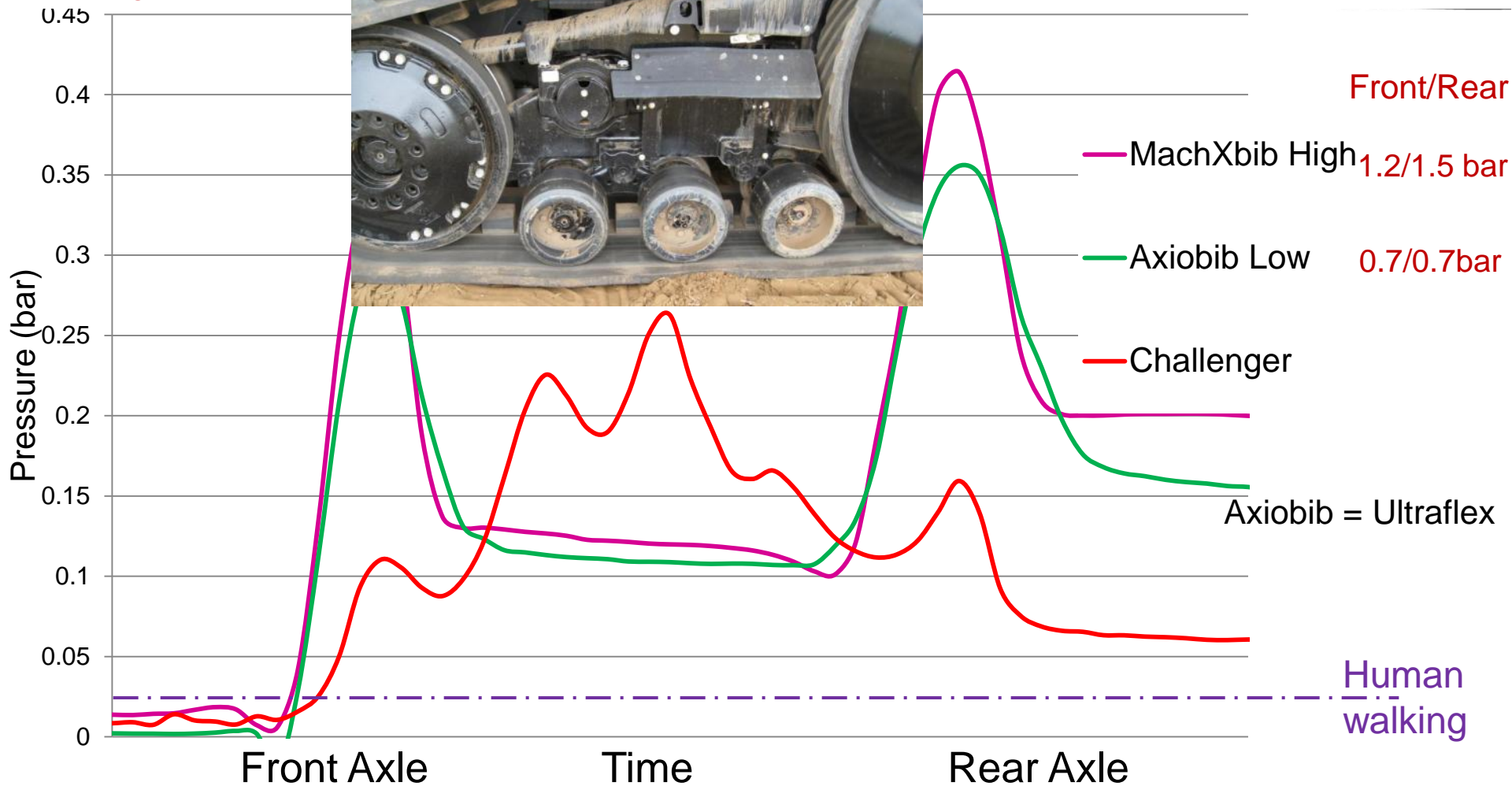


# Sub-soil pressure at 0.3m deep

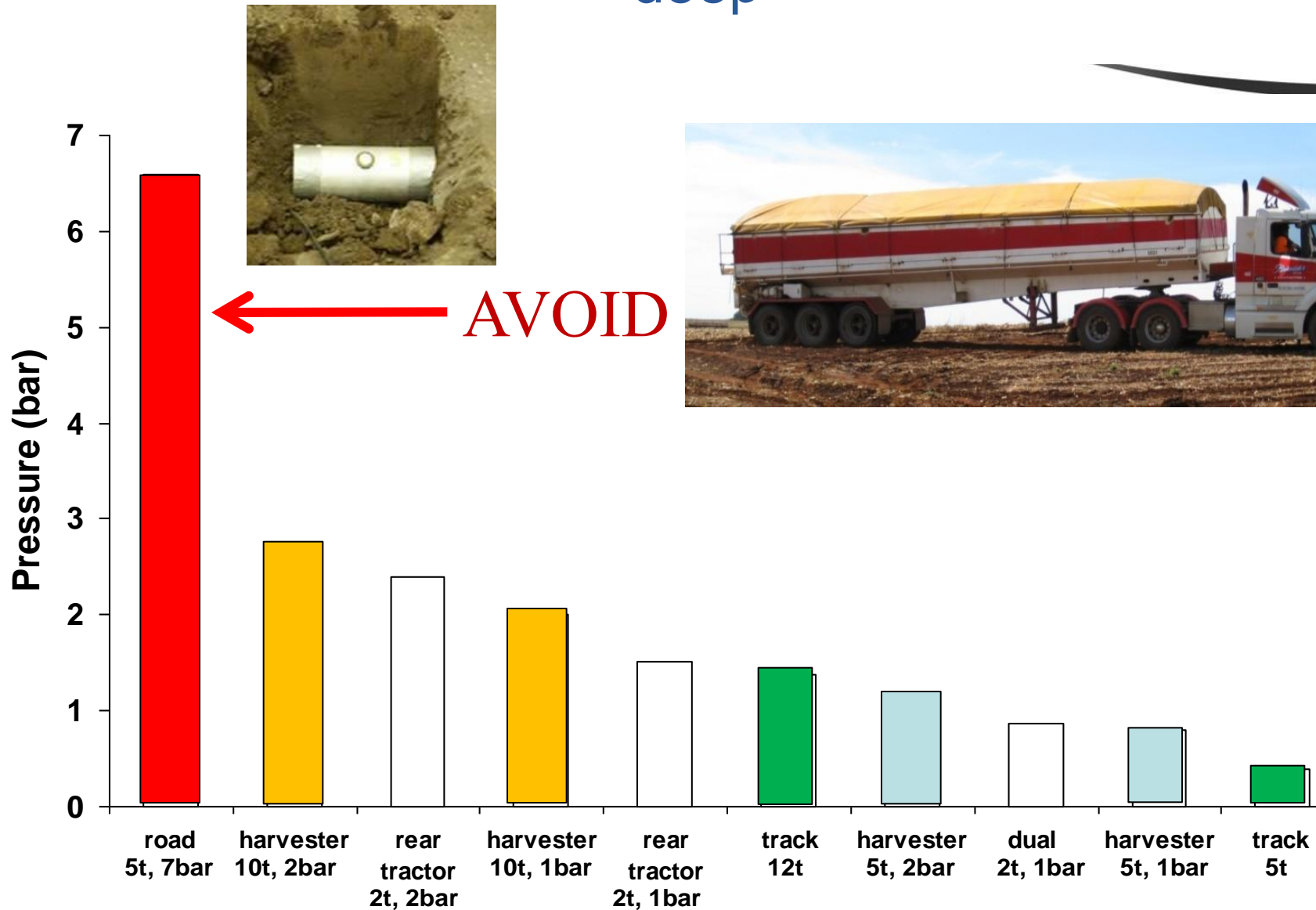


Challenger 765C 16t

MF 8480 Tractor 12.2t



# Effect of wheel/track system on pressure at 250mm deep



# ~~Random~~ traffic problems

*Non-controlled*

Extensive areas of the field are  
exposed to trafficking

Random Traffic

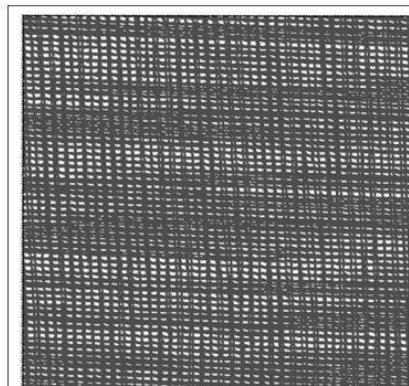
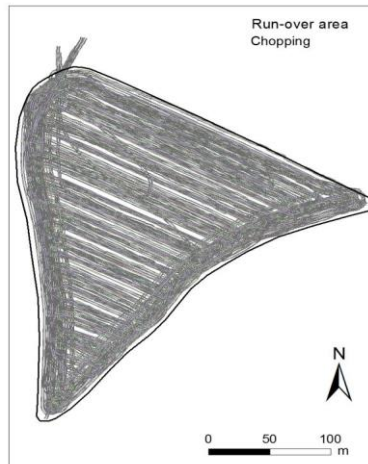
+ Plough = 85% covered

+ Minimum Tillage = 65% covered

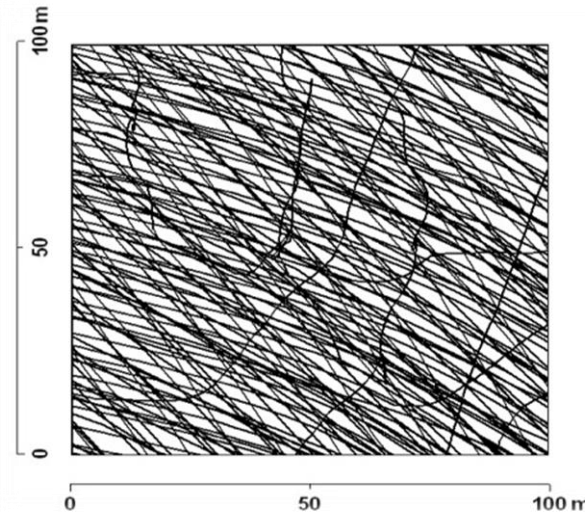
+ Direct Drilling = 45% covered



Wheat, Czech Republic



Potatoes, UK establishment



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

Grass, UK 65% for one cut



# Options for compaction reduction

Reduced pressure tyres, tracks, reduce axle weight and central tyre inflation pressure systems



## Controlled traffic





# Lower ground pressure:

## Tyres and Rubber Tracks

- + Simple
- + Relatively inexpensive
- + Less working time and improved fuel economy, improved trafficability and manoeuvrability
- Pressure is applied (but lower)



### Extra costs tyres

Tractor - 280 hp : Ultraflex tyres extra = £1.50/ha

Combine: Ultraflex = £0.75/ha

Price offset by fuel savings (c.20%)

*Personal communication: Brooks, Michelin*



### Extra costs tracks

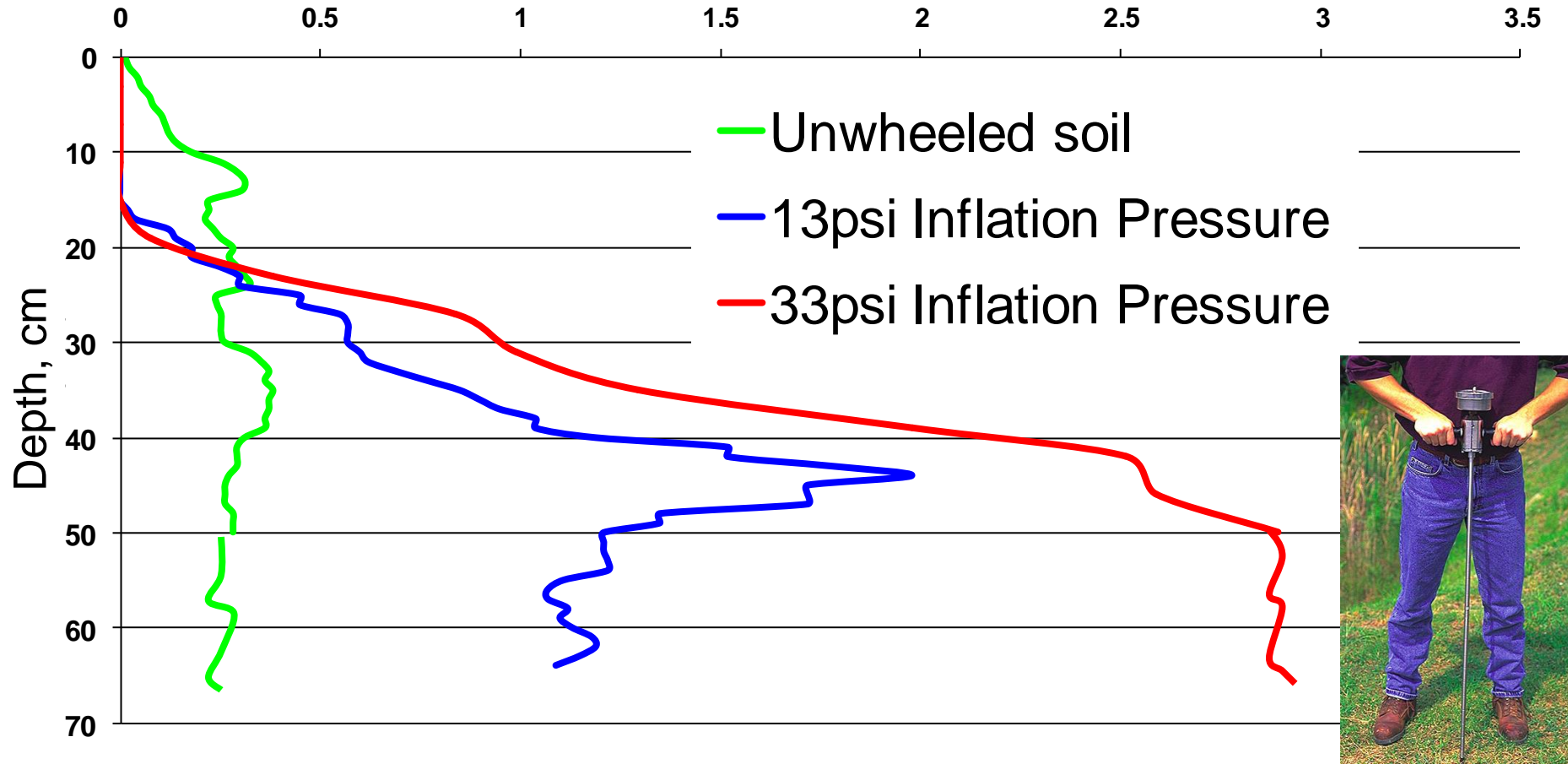
Combine: + £4 to £5/ha for 5 - 7 year life

Price offset by improved trafficability, narrower operating widths & operating up and down hills

*Personal communication: Tyrell, Claas UK*

# Effect of inflation pressure on soil strength

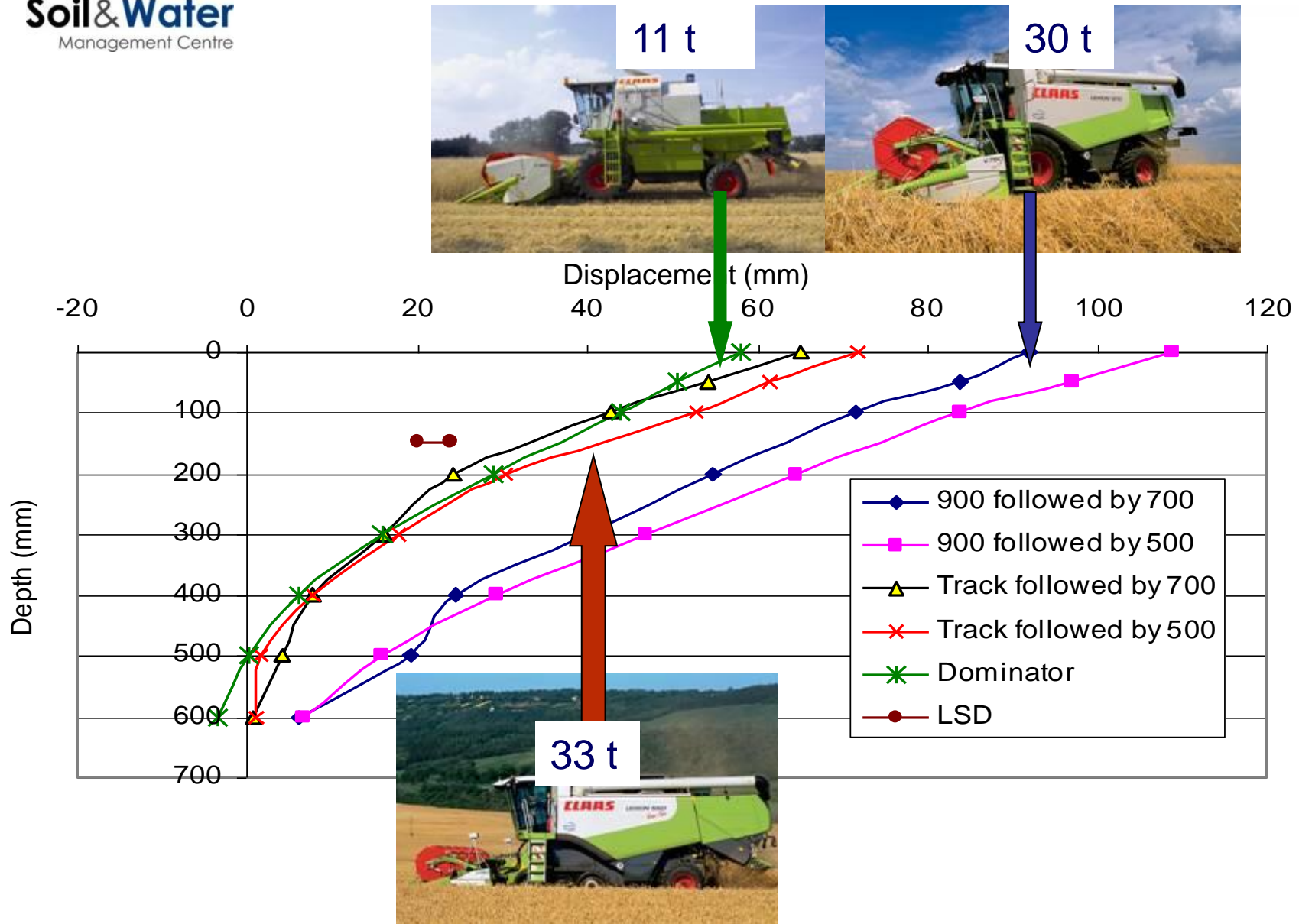
Penetration resistance, MPa





**Soil & Water**  
Management Centre

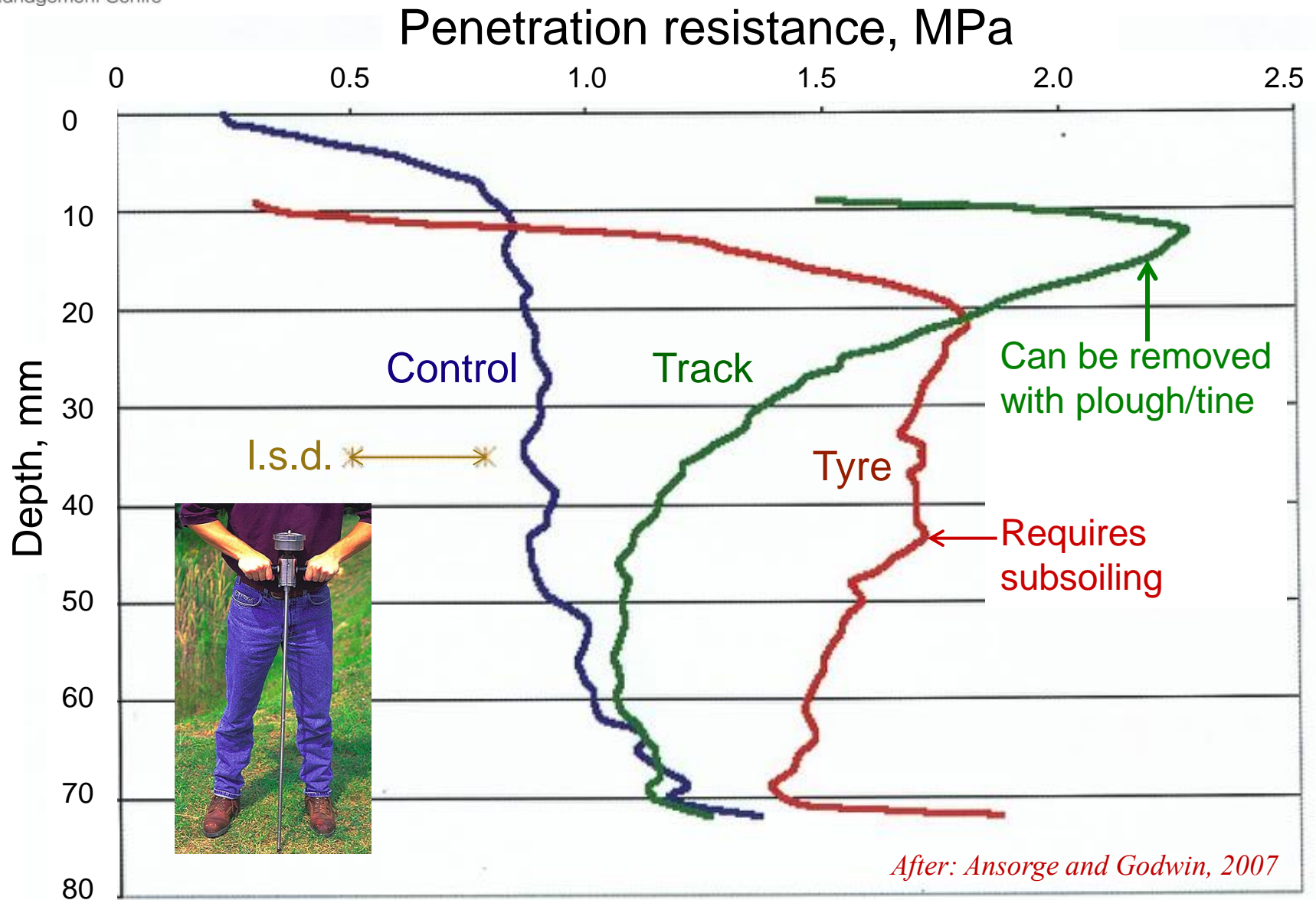
# Compaction reduction - Rubber tracks



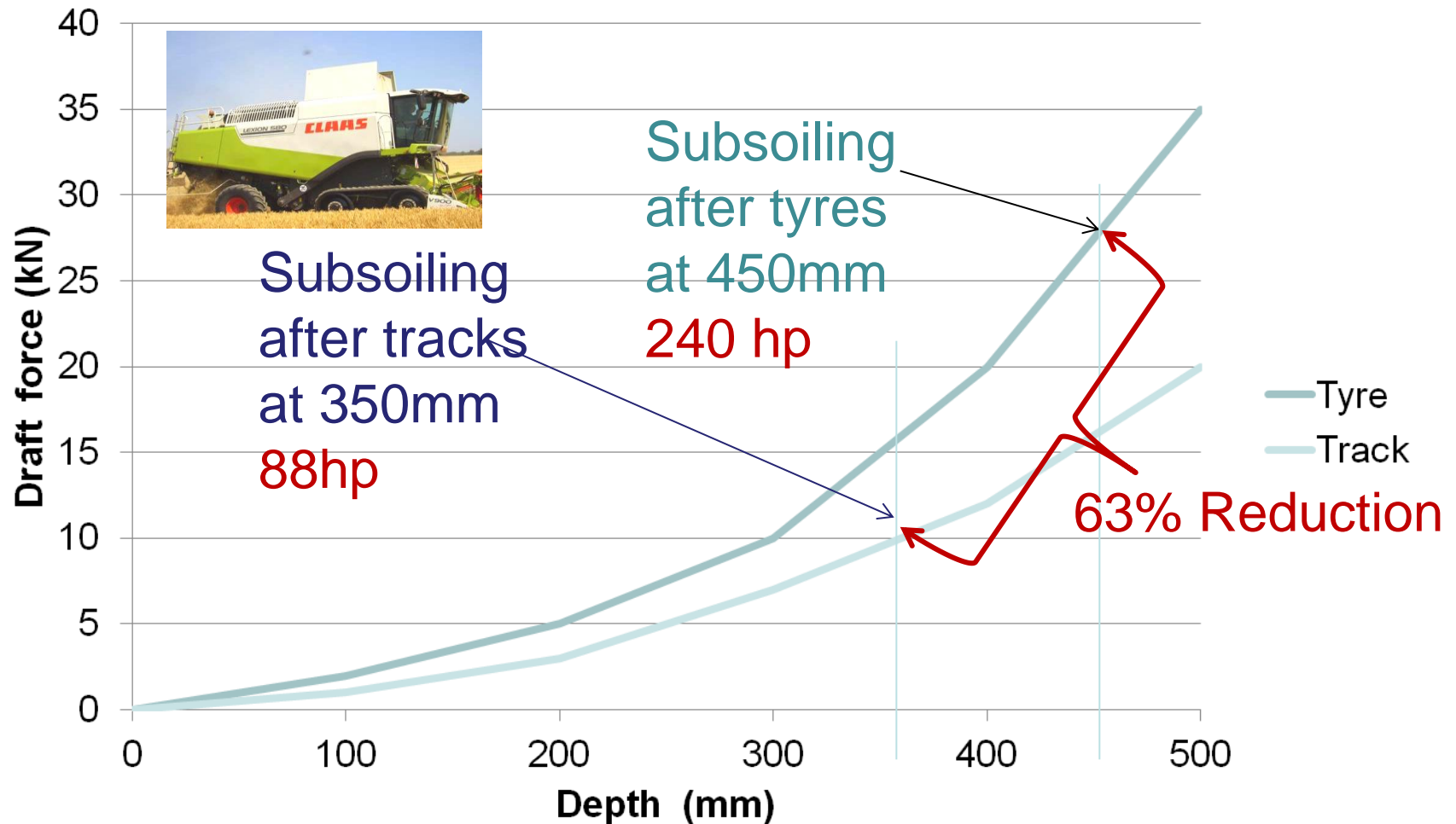
*After: Ansorge and Godwin, 2007*



# Effect of tracks and tyres on soil strength



# Subsoiler – Draught forces in combine ruts

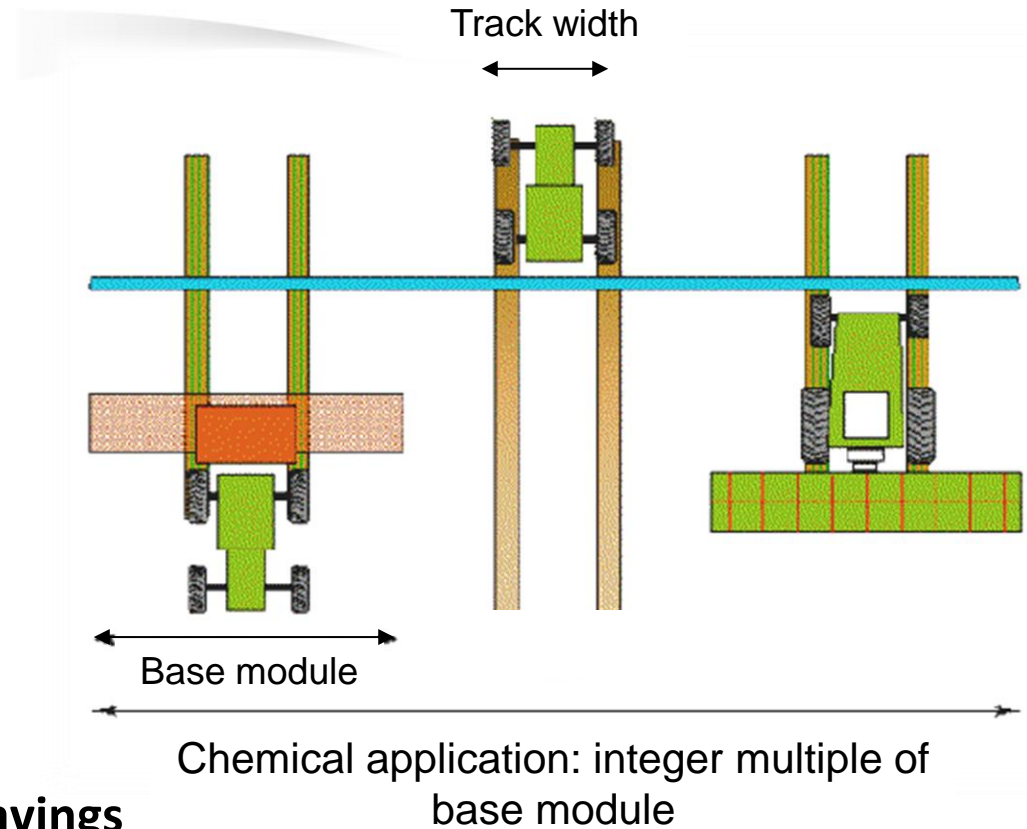




# Controlled Traffic Farming

- ✓ **Simple** concept
- ✓ **Soil** structure
  - ✓ **Infiltration** + 400%
- ✓ **Crop yields**
  - "CTF (+LGP) = +10 to 15% yield"*
- ✓ **Fuel, time and machinery cost savings**
  - "70% reduction between trafficked & untrafficked"*
- ✓ **GPS guidance** and steering

**X Track width and harvester width matching**



*Source: CTF Europe*





# CTF/Low Ground Pressure Study

Zero Traffic

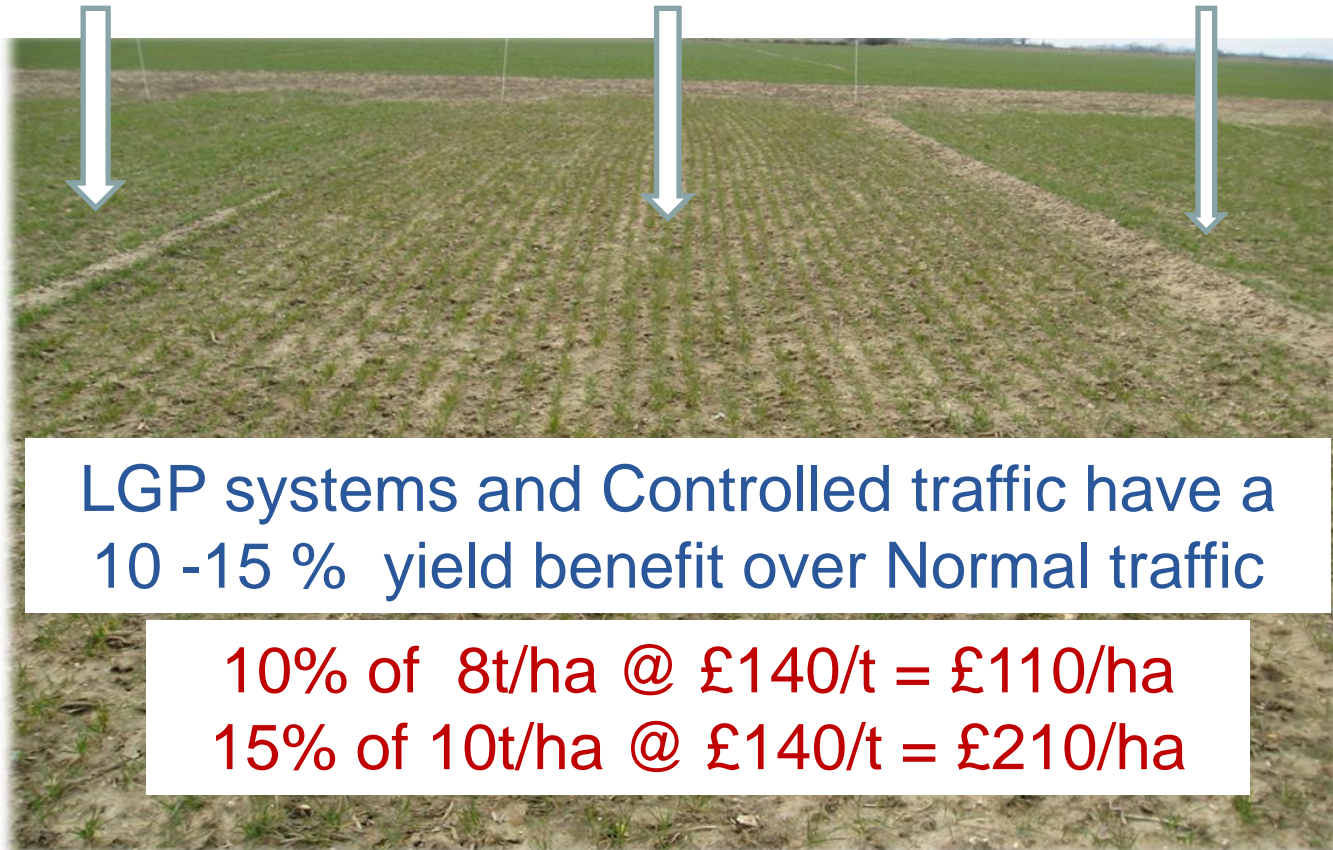
12.52 t/ha

Normal random traffic

10.84t/ha

Zero traffic + tracked vehicle

12.14t/ha





# Traffic and tillage systems study



**Harper Adams University**

**Aim:** To compare the effects of alternative traffic and tillage systems on crop yield, energy and economics, water holding and infiltration rates over an extended period circa 10 years.



- 3 x 3 Factorial
- 4 blocks
- 9 treatments
  - 80m x 4m
- Long term trials
  - 10 years+
- Prepared site

	Random High Pressure Traffic	Controlled Traffic	Random Low Pressure Traffic
Tillage	Deep	Deep	Deep
	Minimum	Minimum	Minimum
	No-Till	No-Till	No-Till

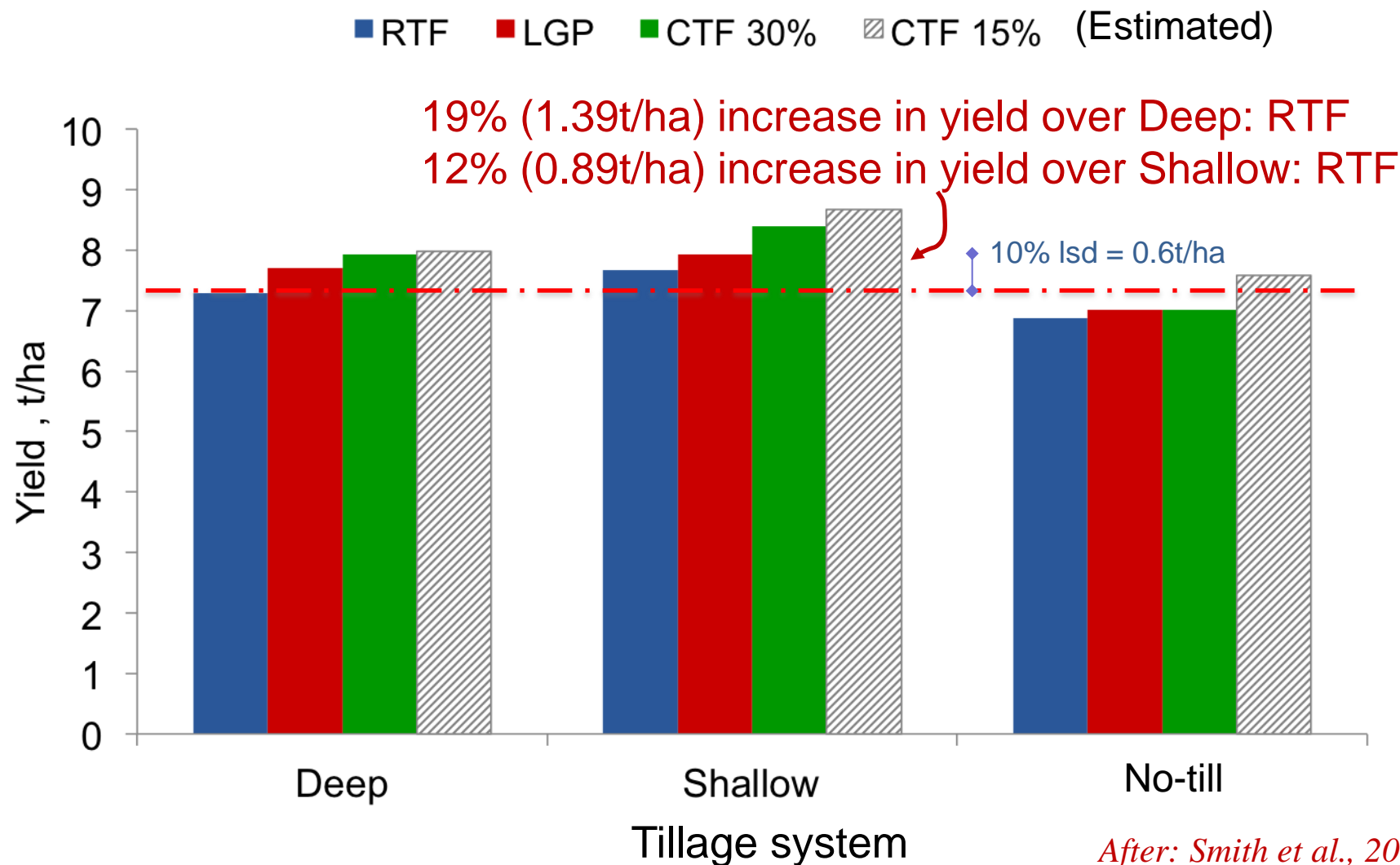


# Tillage and traffic study

## Winter Wheat Yield



Harper Adams  
University



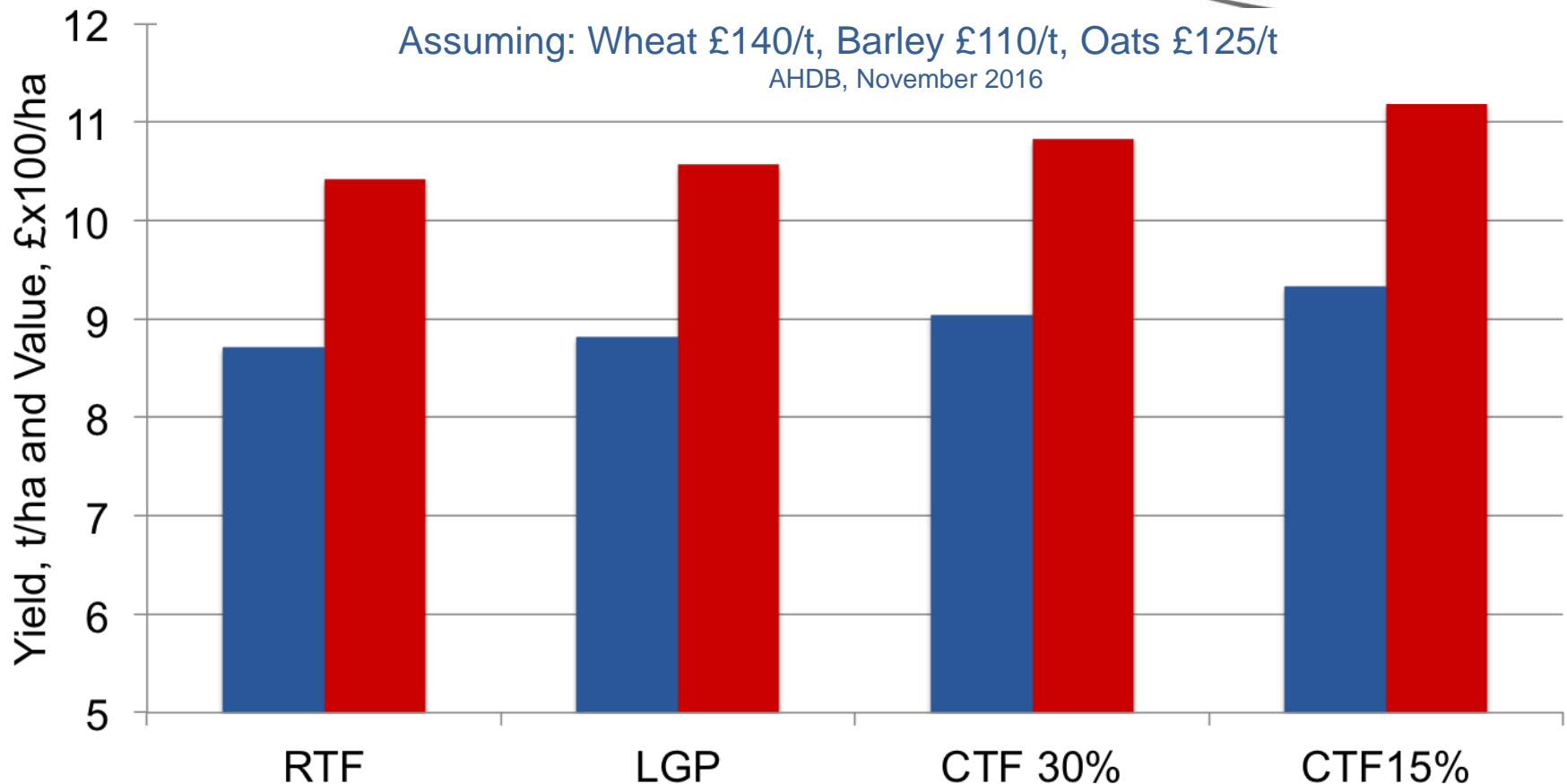
*After: Smith et al., 2014*



# Average traffic system effects over 4 seasons

■ Yield t/ha ■ Value £/ha x100

Assuming: Wheat £140/t, Barley £110/t, Oats £125/t  
AHDB, November 2016



Yield of CTF<sub>30%</sub> & CTF<sub>15%</sub> are 0.32t/ha and 0.61t/ha greater than RTF

Value of CTF<sub>30%</sub> & CTF<sub>15%</sub> are £41/ha and £77/ha greater than RTF

Yield and value of LGP are 0.1t/ha and £15/ha greater than RTF

Limited evidence of crop response to general deep loosening soils unless for spring sown crops in sandy soils in years with low rainfall



## **1. Controlled traffic systems**

General loosening of crop area

Use multi-winged tined implements

## **3. Anticipated heavy loads**

Use non-winged implements – vertical 45° cracks

## **2. Wheel mark removal**

Follow wheel tracks

Use a pair of tines + shallow leading tines

+/- GPS positioning

## **4. Wide spaced row crops**

Use non winged/winged tines

+/- GPS positioning

- **Prevention is better than cure**
- Minimize machine weight and contact pressure
  - Safely reduce inflation pressures and use ultra-flex tyre options
  - Spread the load with multi-axle and tracked vehicles
- **Think about traffic intensity, match wheelings**
  - Concentrate wheel traffic
  - Adopt Controlled Traffic Farming practices
- Target subsoiling operations
  - Chose most effective implements and settings
  - Focus on headlands, gateways and tramlines
  - Use traffic maps to identify hidden wheel/track passes
- **Do not operate on recently loosened soil!**



Thank you for your attention