



CELUP Research

Changing Pressure on Our Soils

Nutrient management course 2011

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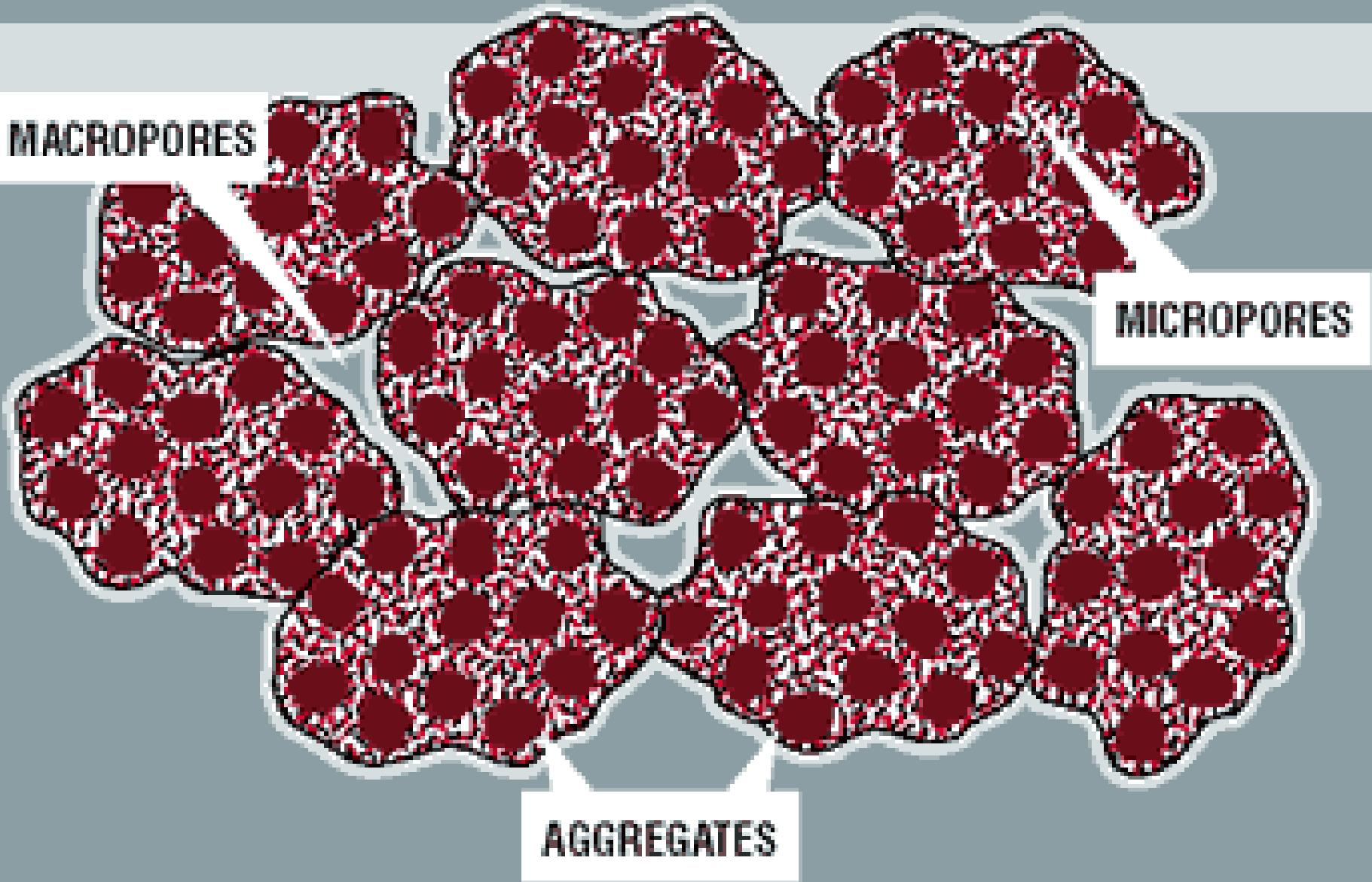
Soil Structure

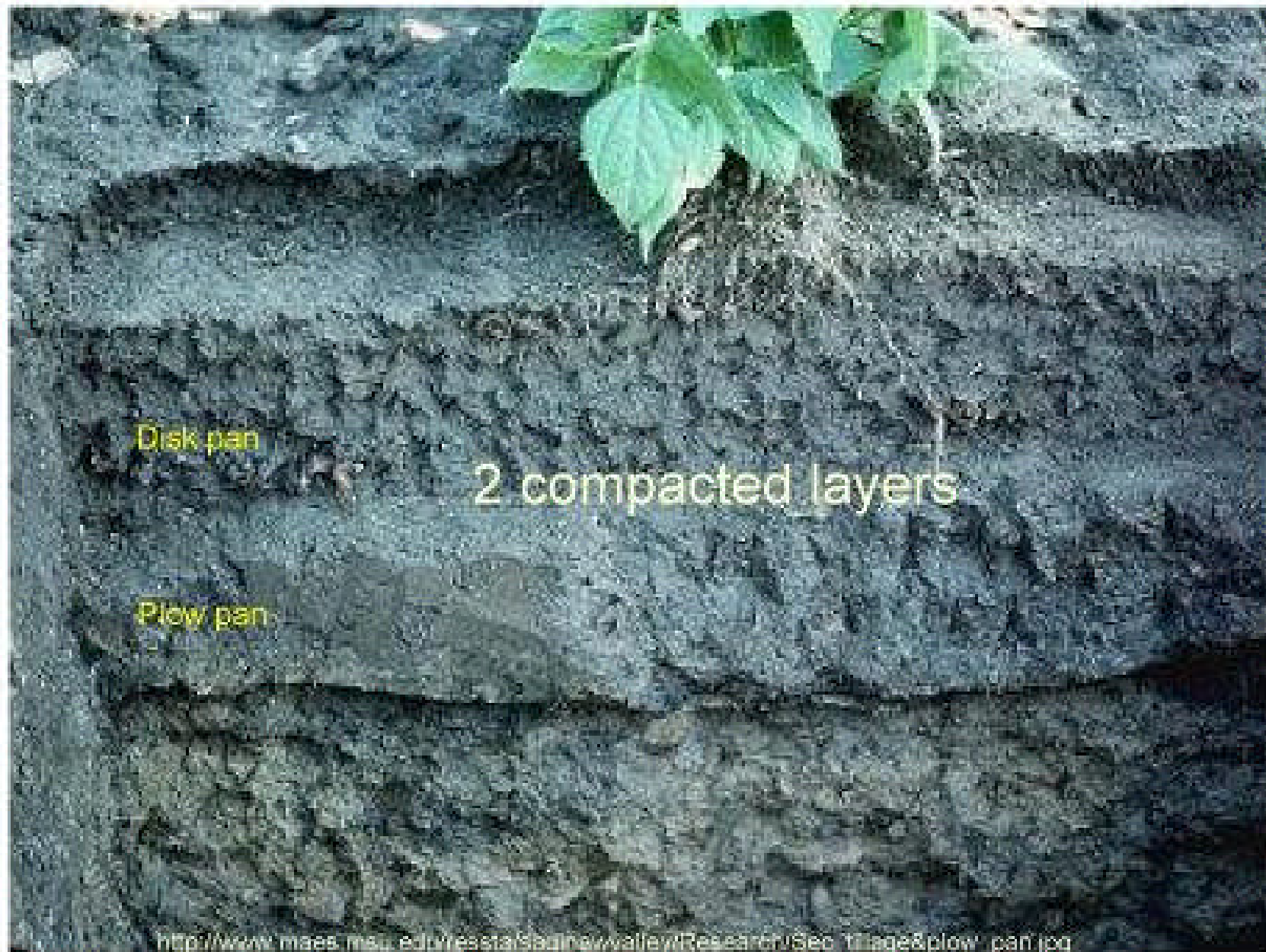
Arrangement of soil particles and pore spaces

Damage: Compaction, Smearing, Puddling

- Reduces pore space
- Impedes root growth
- Impedes water movement
- Restricts oxygen availability
- Restricts uptake
- Reduces growth and yield

SOIL STRUCTURE COMPONENTS







Compaction Research

- Response variable
- Water status critical

Yield Reductions

- | | |
|-----------|----------|
| ➤ Cereals | 0 to 20% |
| ➤ Maize | 0 to 50% |
| ➤ Grass | 8 to 30% |

Subsoiling is not the answer !

Damage Factors

- **Soil type (texture, structure, OM)**
- **Soil moisture ++**
- **Crop or crop residue**
- **Cultivation / looseness**
- **Machinery**
 - **Traffic, weight, tyres**

Developments in Machinery







Ferguson 20

vs.

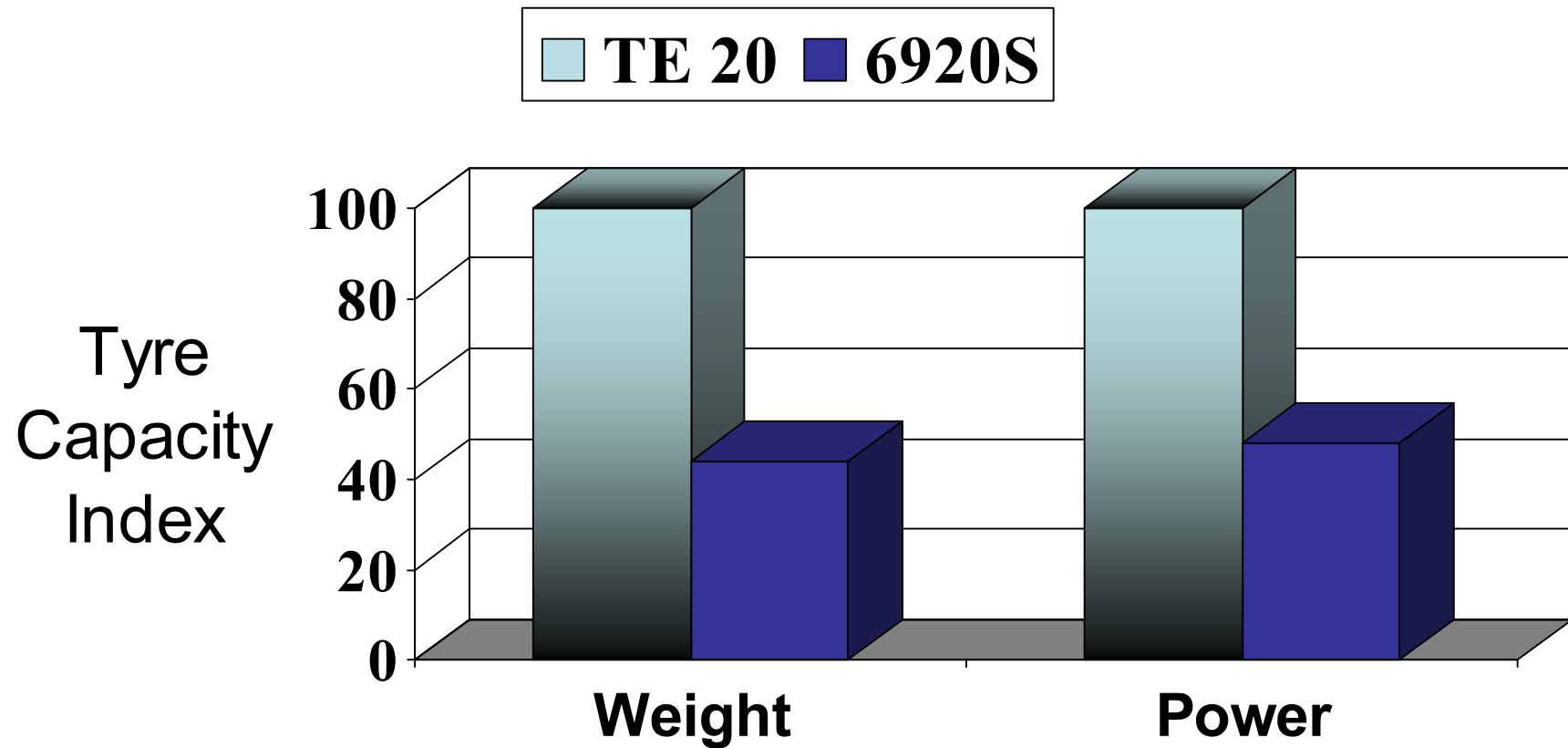
JD 6920s



TE 20 vs JD 6920s

	TE 20	6920S
Power (kW)	19	119
Weight (t)	1.2	6.8
Axle Load (t)	1.2	8.0
Tyres	10-28	20.8R38

Tyre capacity: Weight; Power



Tyres

Contact between machine and soil

Functions:

- Power Transmission
- Weight Support

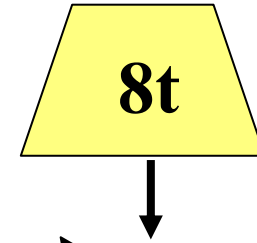
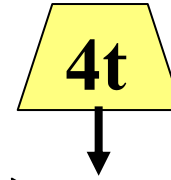
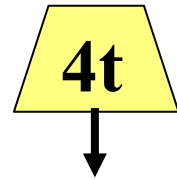
Standard tyres not big enough



Ground Pressure

- **Weight / contact area**
- **Can be physically measured**

Weight



Air in tyre supports load

Inflation pressure = ground pressure

**Large tyres - big volume - low
pressure**

2.0 bar GP

1.0 bar GP

2.0 bar GP

Tyre sizes and Pressure

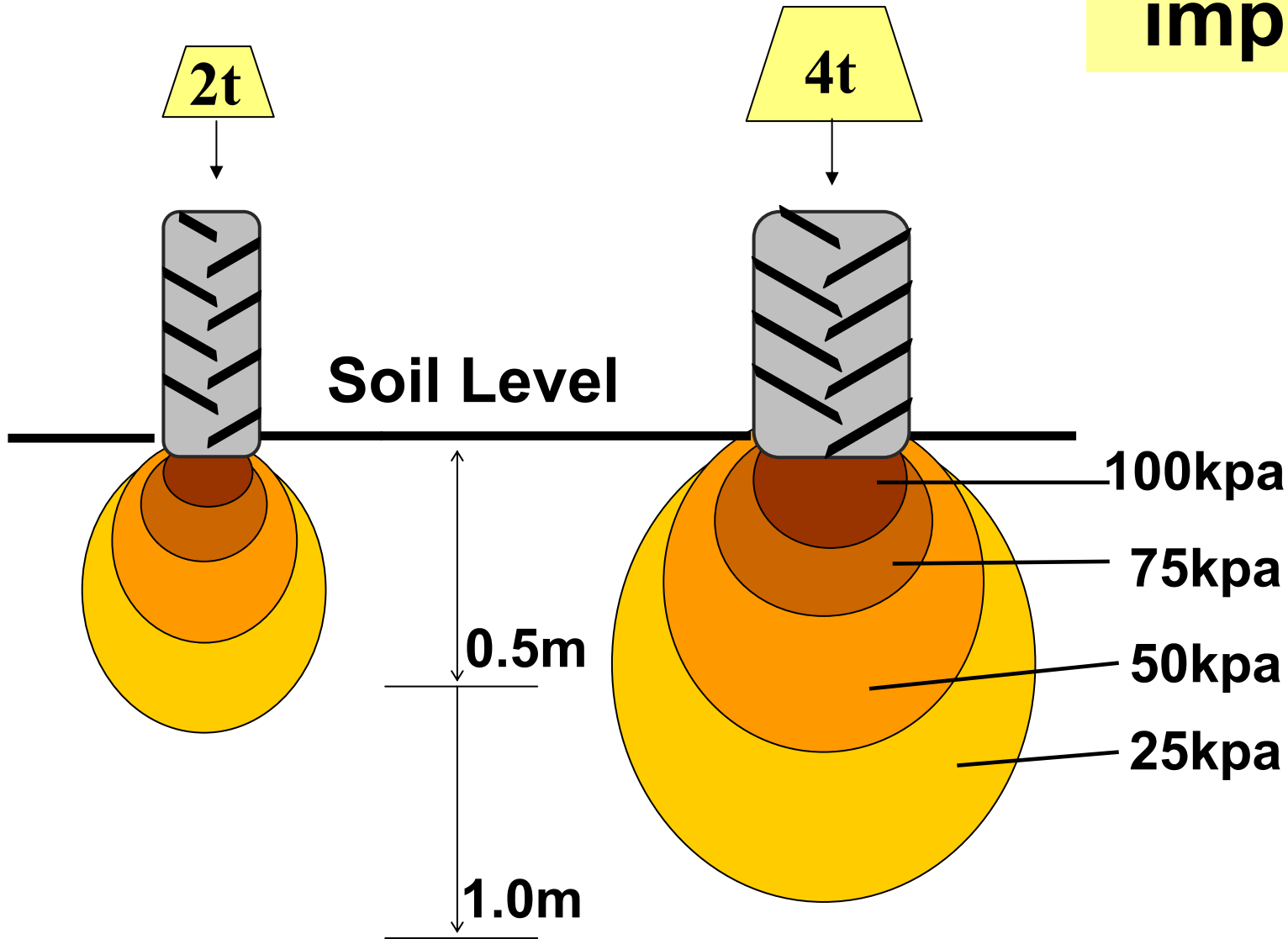
2.5 t Wheel load

	Volume	Inf. press (bar)
16.9 R 38	411	1.4
18.4 R 38	574	1.0
650/65 R 38	840	0.6

1.0 bar GP

1.0 bar GP

Axle load is important



What Pressure ?

Depends on conditions

- Moisture
 - Soil
 - Looseness
 - Machine load and traffic
- **0.35 bar to 4.0 bar (5 to 60psi)**

Tyre size Guidelines

< 0.5 bar

Very weak soils: LGP work

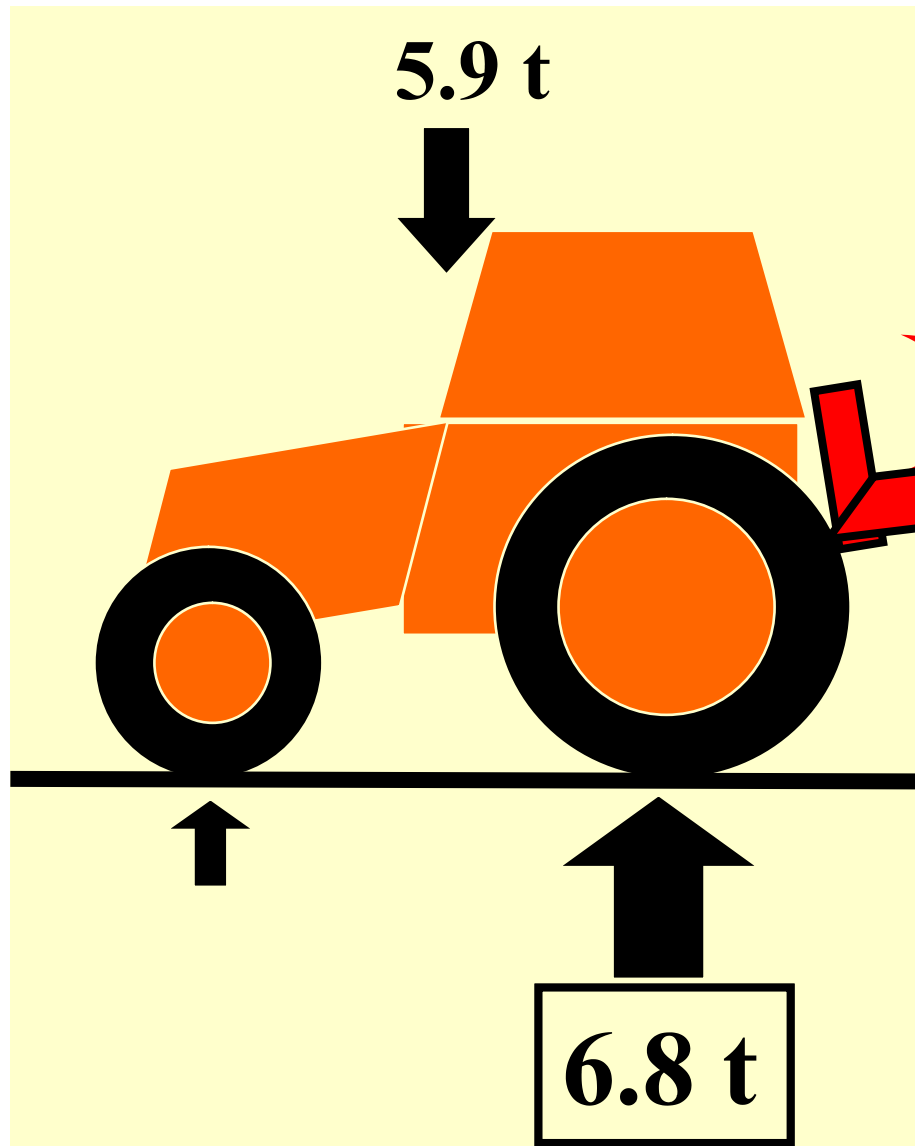
0.5 - 0.8 bar

Work on cultivated soil:
one-pass, min-till

Tyre size Guidelines

- | | |
|------------------|--|
| 0.8 - 1.0 | Ploughing
Lighter machines - cultivated soil
Combines - moist conditions |
| 1.0 - 1.5 | Lighter combines - good conditions
Field trailers - moist conditions |
| > 1.5 | Restricted access |

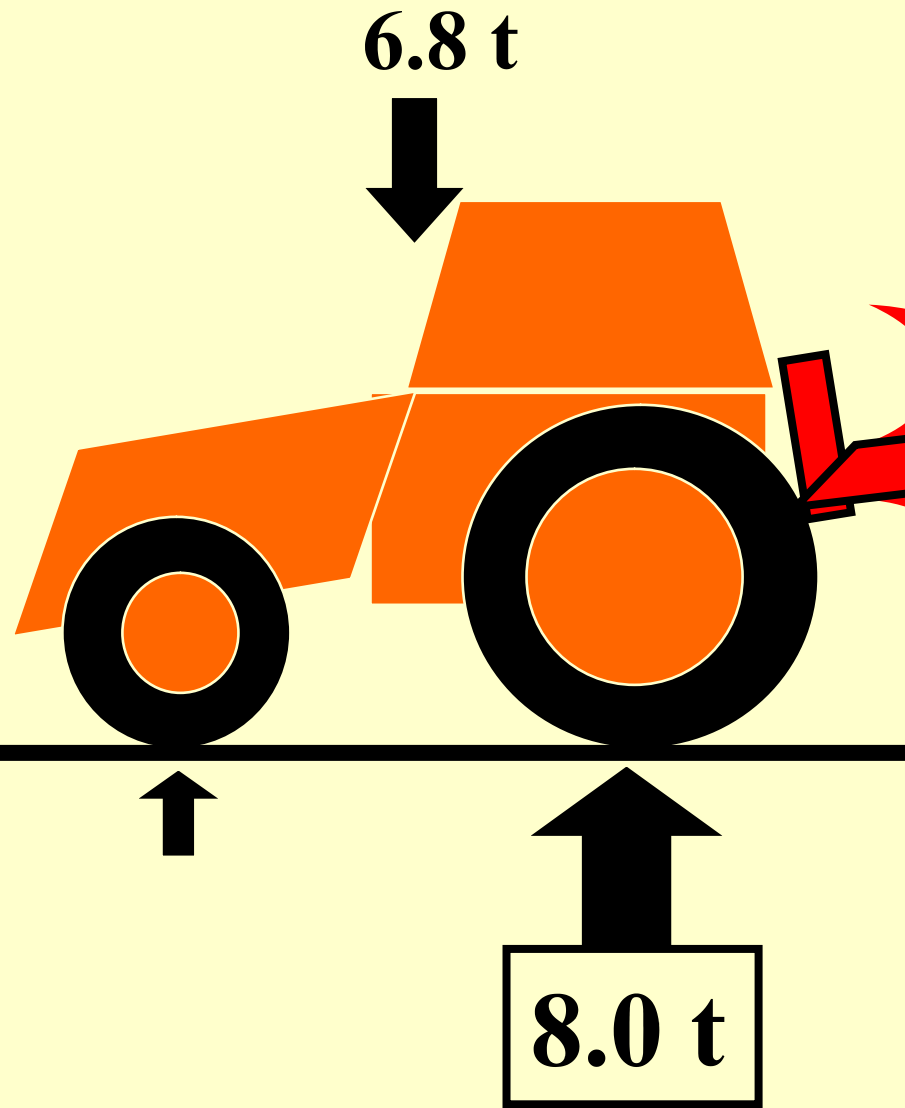




Options (30km/h)

18.4 R 38	1.6 bar
600/ 65R 38	1.1 bar
650/ 65R 38	0.9 bar
710/ 70R 38	0.6 bar

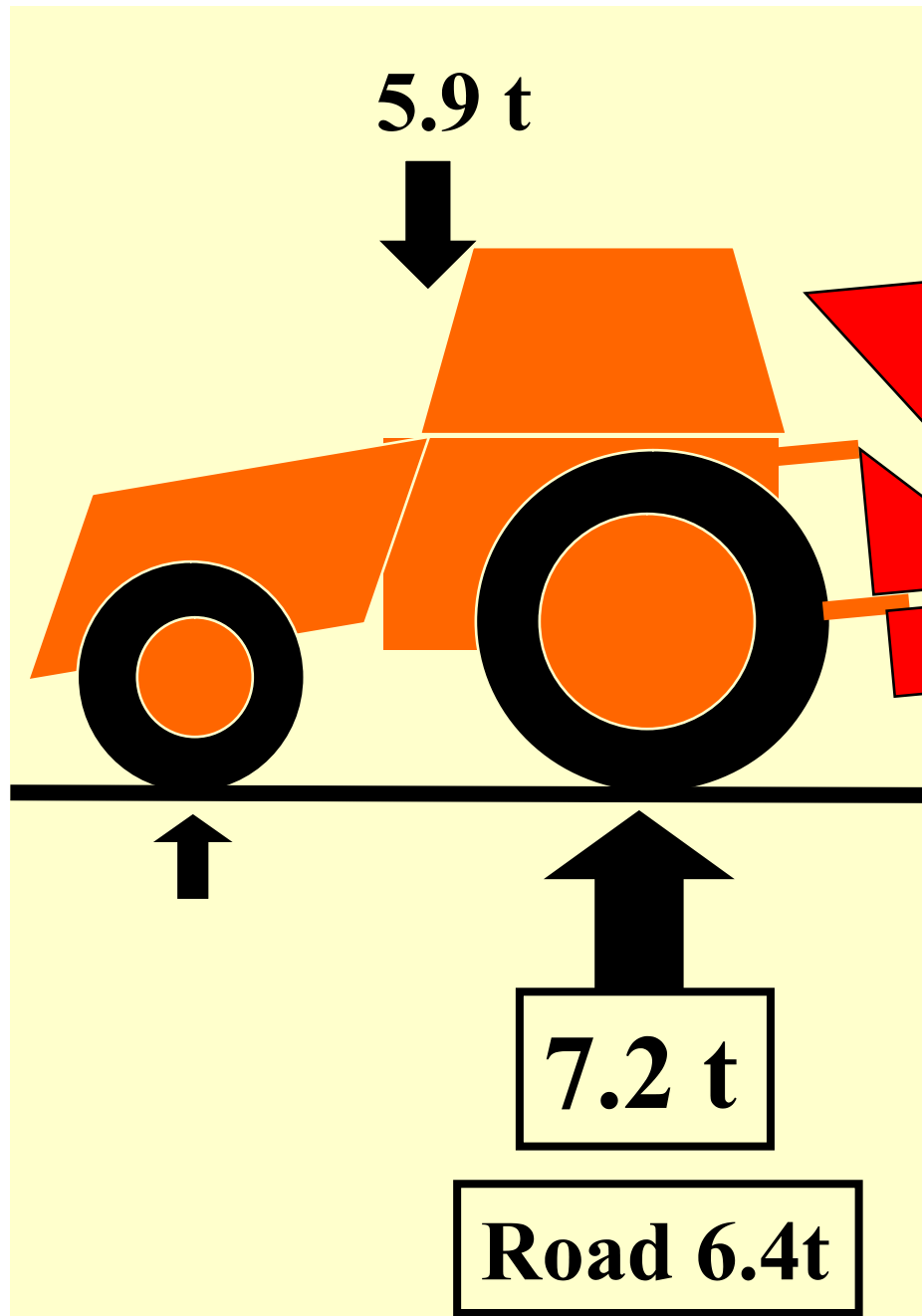
**90 kW Tractor
+ 4F plough**



Options (30km/h)

600/ 65R 38	N.P.
650/ 65R 38	1.2 bar
710/ 70R 38	0.8 bar

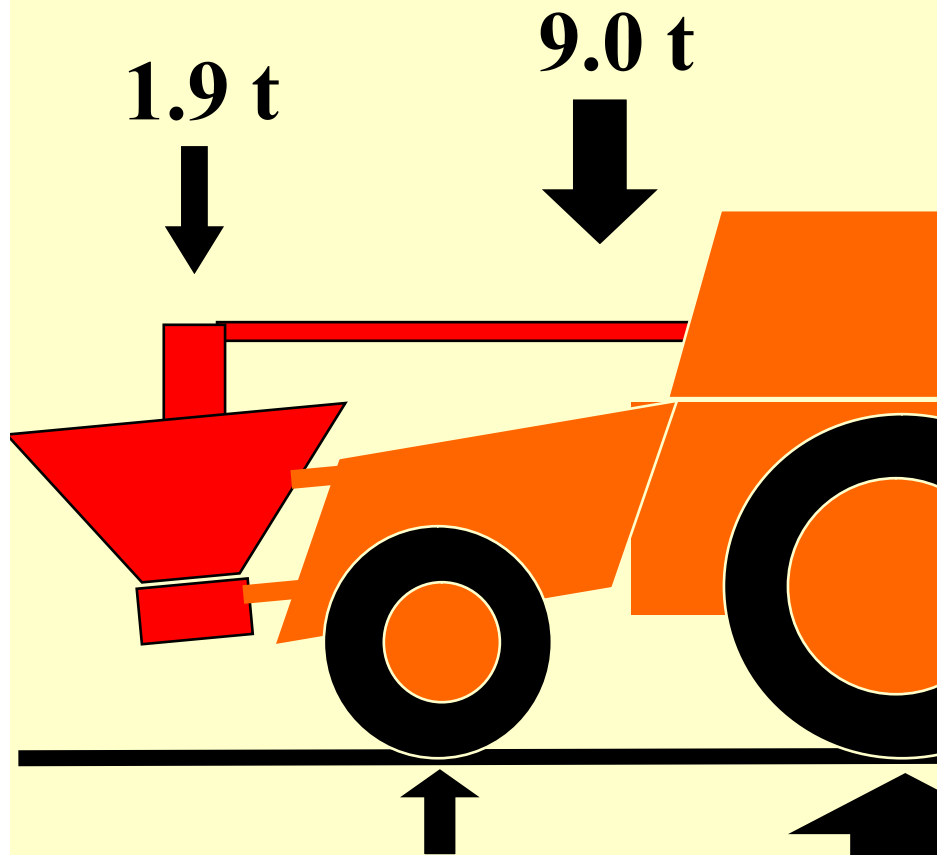
**120 kW Tractor
+ 5F plough**



Options (30km/h)

18.4 R 38	1.6 bar
600/ 65R 38	1.1 bar
650/ 65R 38	0.9 bar
18.4 R 38 D	0.6 bar
800/ 65R 32	0.5 bar

**90 kW Tractor
+ 3m One-pass**



Options (40km/h)

710/ 70R 42	2.0 bar
900/ 50R 42	1.8 bar
1050/50R 32	1.4 bar
710/ 70R 42D	0.7 bar

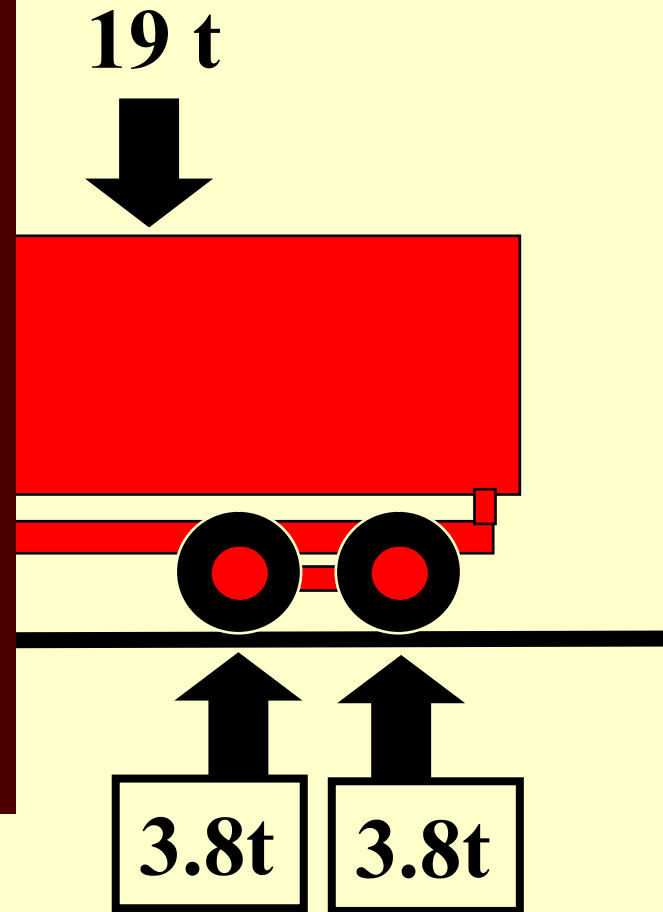
12 t

180 kW Tractor
+ 6m One-pass

5t Tandem Trailer + 14t load

Options (40km/h)

15 R 22.5	4.0 bar
18 R 22.5	3.3 bar
560/ 40R 22.5	2.8 bar
600/ 50R 22.5	2.0 bar
600/ 55R 26.5	1.6 bar



Chaser Bin

800/65 R 32

1.6 to 1.8 bar



Control Traffic

Damage Prevention

- Soil moisture: Only work when dry enough
 - Big ask - Greater understanding of soils needed
- Controlled traffic systems
 - Restrict traffic to certain areas using RTK GPS

Damage Alleviation

- Deep Cultivation / Subsoiling
 - Difficult to get right.
 - Avoid shifting the problem down
- Natural regeneration (swelling shrinking etc, frost)
- Rotation / Crop choice



Subsoiling:

- **Loosens by shattering**
- **350-400 mm depth**
- **Spacing = 2 x depth**
- **Power: 45 kW/leg**

*** Soil must be dry enough to fracture**

SUBSOILING PROBLEMS

- **Loosened soil holds moisture**
 - **Prone to recompaction**
 - **Slower to dry**
 - **Colder Time of subsoiling:
post harvest, pre-sowing?**

Prevention Better Than Cure

Response to Subsoiling

Depends on:

- ▶ **Extent of problem**
- ▶ **Efficiency of loosening**
- ▶ **Rate of re-compaction**
- ▶ **Subsurface drainage**
- ▶ **Subsequent weather**

Avoid making the problem deeper!!

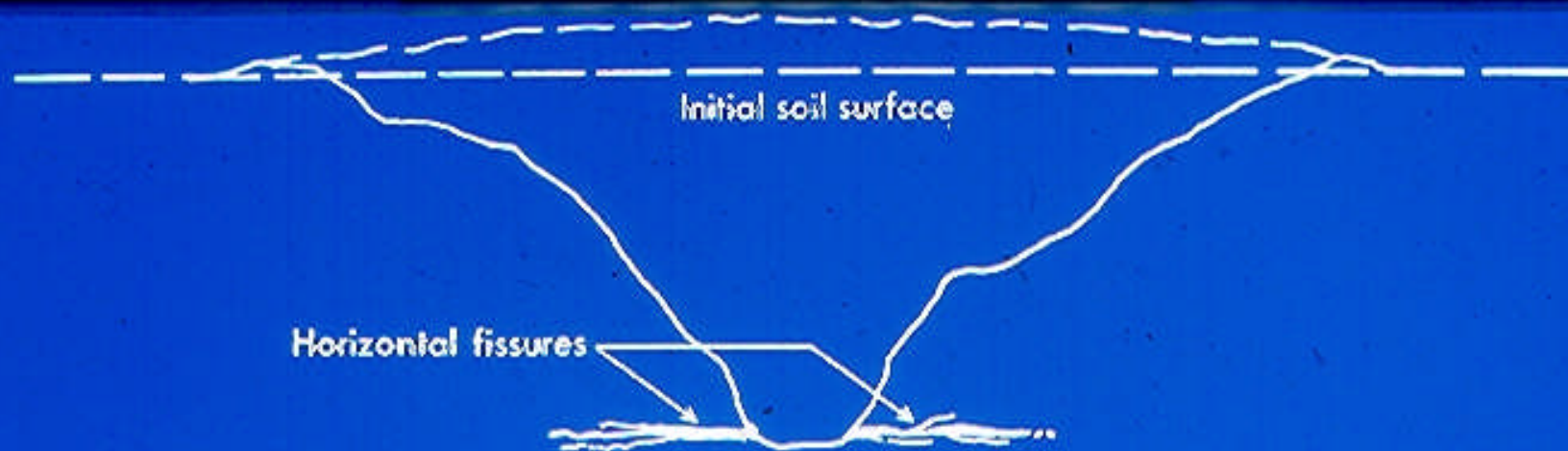
Subsoiling on Sugar Beet Yield

	<u>t/ha</u>
No subsoiling	54.3
Before ploughing	51.4
After ploughing	56.1
Between beet rows	49.5

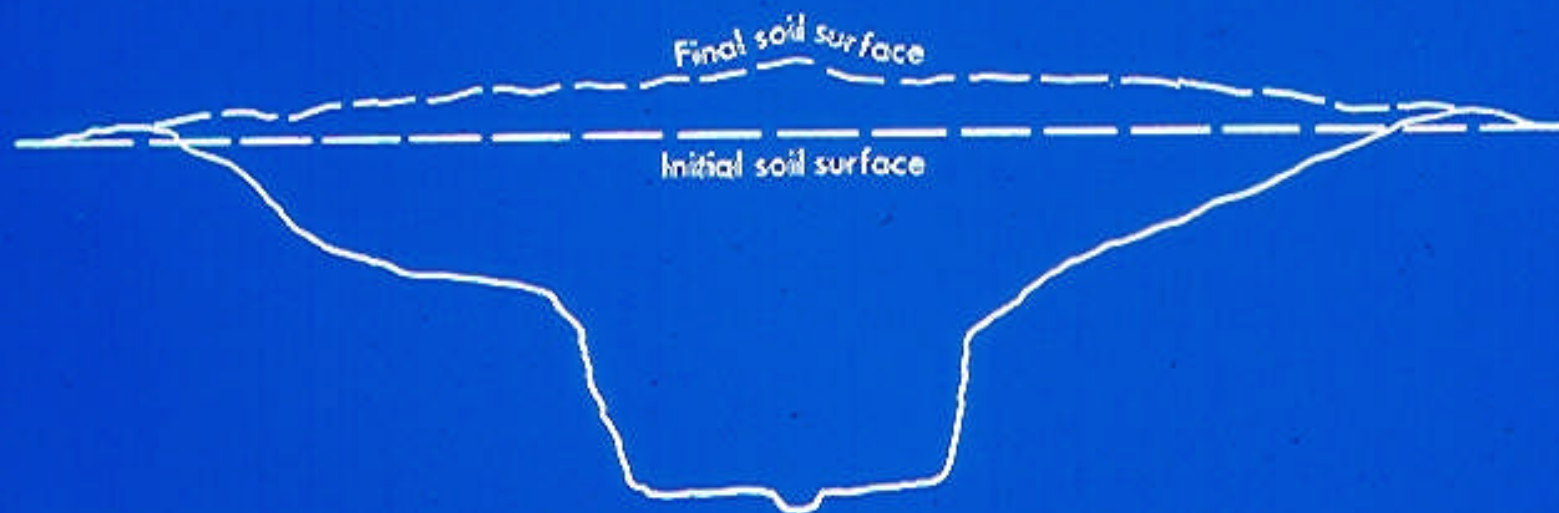
Working Depth

No deeper than necessary

- Draught increases with depth
- Critical depth
- Leg spacing should match depth
 - Std leg: Width = 1 - 1.5 times depth
 - Winged leg: Width = 1.5 - 2 times depth



a. Conventional subsoiler.



b. Winged subsoiler.

2 Cross section showing area of disturbed soil.

Subsoiling

- ◆ Prevention better than cure
- ◆ If necessary do it right!
 - ▶ Soil conditions, depth, spacing
- ◆ Avoid re-compaction

Conclusions

- Machine weight threatens the soil
- Nutrient uptake and yield affected
- Prevention is better than cure
- Ground Pressure and total load are critical
- Tyres sized to work at 0.5-1.0 bar are needed
- Controlled traffic options possible
 - Restrict damaged area
 - Restrict operations at vulnerable moistures
- Subsoiling not the answer
- Greater understanding of soil/machine interaction needed