


Under Pressure: Managing Manure Application & Field Compaction

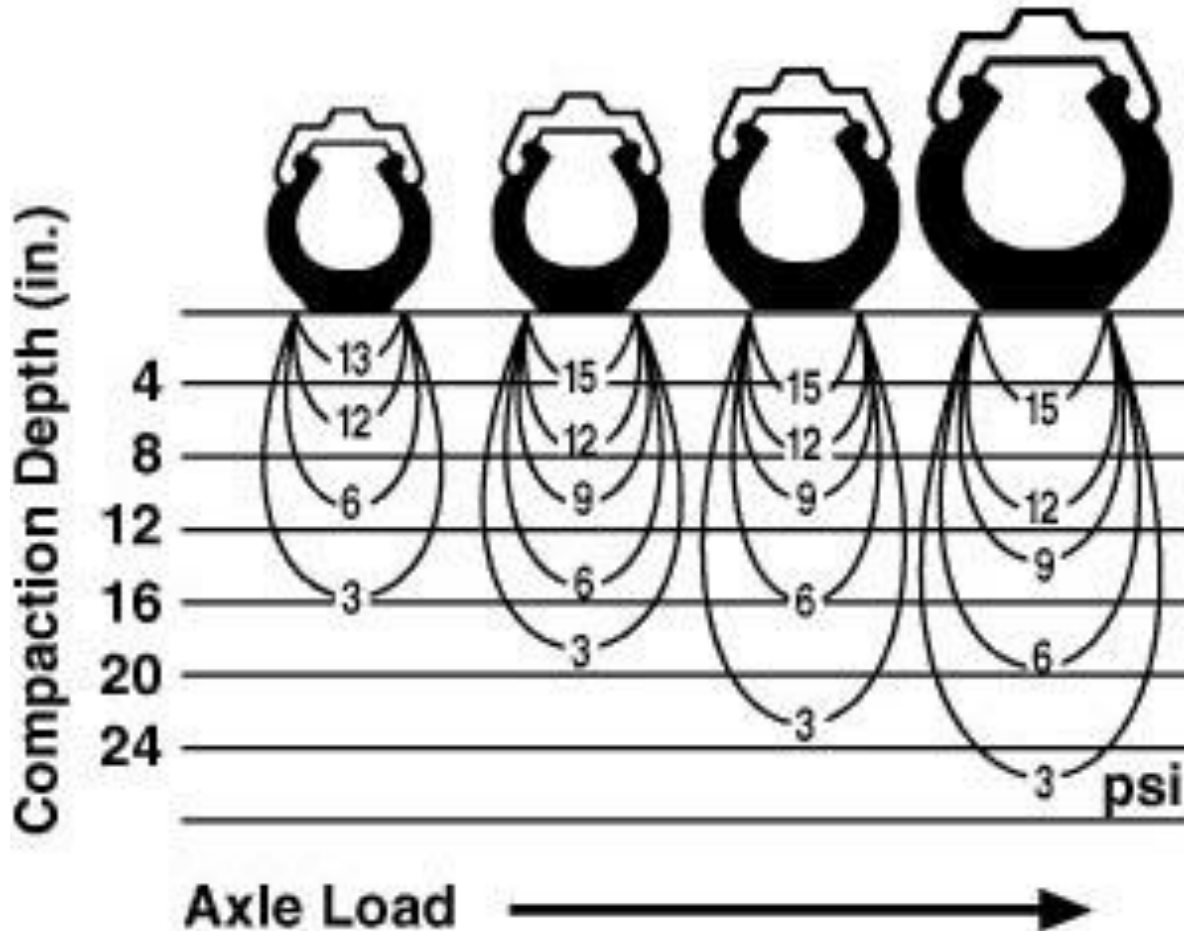


Manure Management Update 2015
Lethbridge, Alberta
January 19, 2015

Scope

- Presentation will discuss methods to manage agricultural equipment to avoid soil compaction
 - Some specific to manure application

Axle Load



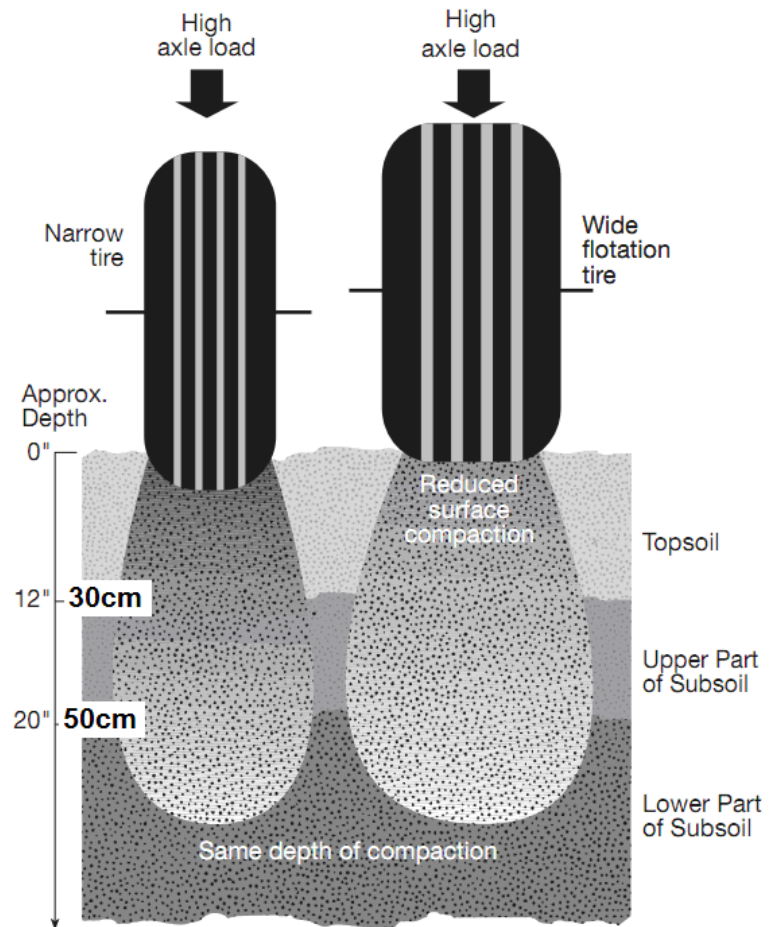
Source: University of Minnesota

Limit axle loads

- Limit axle loads to 10 tons and preferably 6 tons
- Increase the number of axles on implements to reduce the load on each axle

Contact Pressure

- Lower contact pressures reduce soil surface compaction
- 10 psi



Source: Penn State University

850/50R-30.5 Tire



Michelin Cargo XBib
850/50R 30.5
16 psi
4749 cm²

Michelin Cargo XBib
850/50R 30.5
25 psi
3719 cm²

16 psi

25 psi

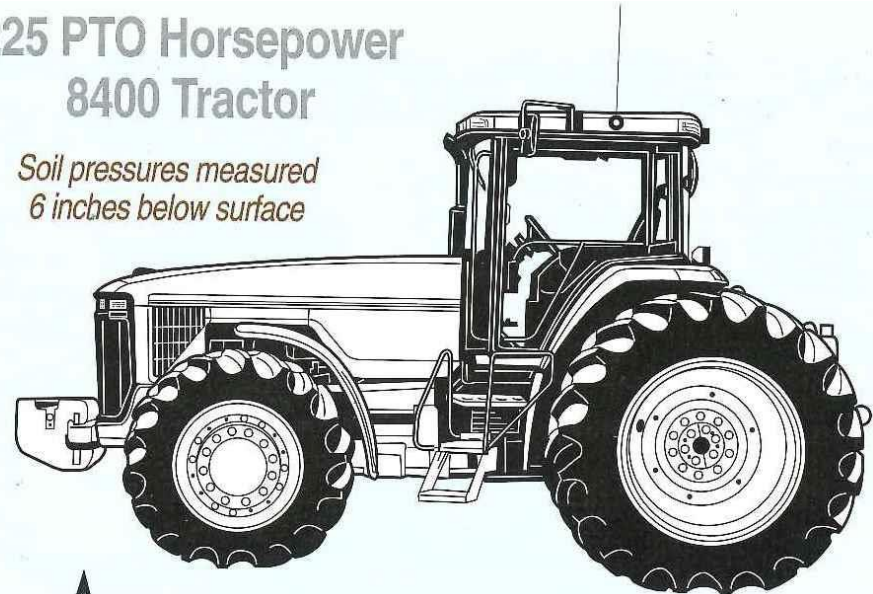
Limit contact pressure by using

- Lowest allowable tire pressure
- Flotation tires
- Radial ply instead of bias ply tires
- Larger diameter tires to increase tire footprint
- Tractors with 4WD, FWA, Tracks or Duals.
- Tractors that are properly ballasted

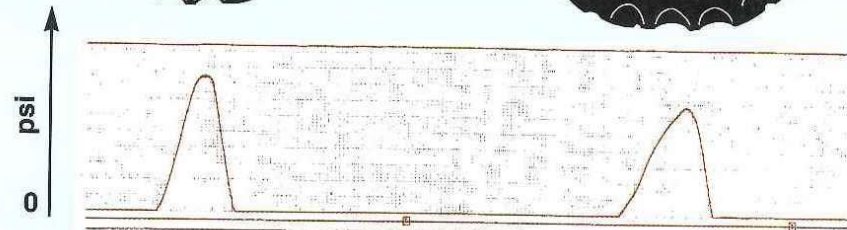
Wheel Tractor

225 PTO Horsepower
8400 Tractor

*Soil pressures measured
6 inches below surface*



Each axle
causes a
pressure spike



Front Tires

16.9R-30

Inflation pressure: 21 psi

Ballasted weight: 25,300 pounds

Rear Tires

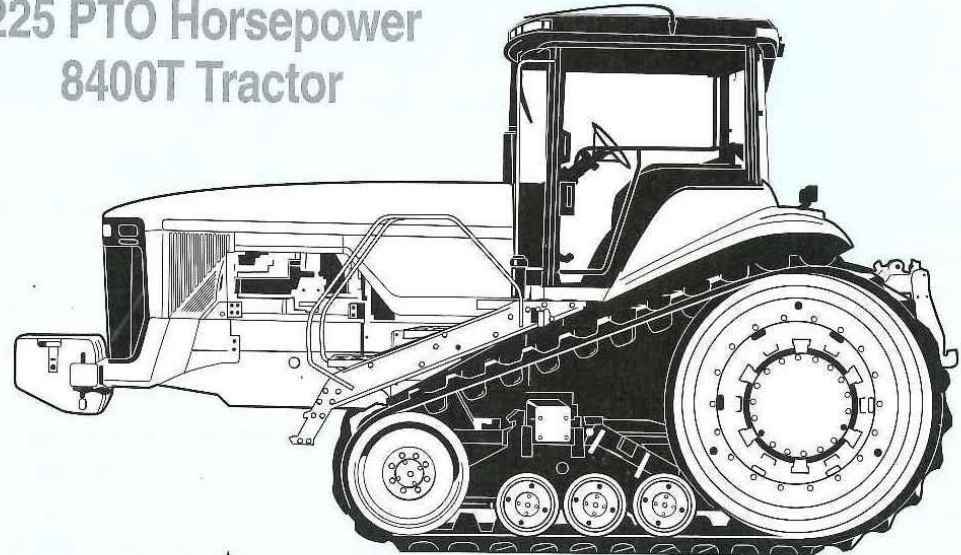
18.4R-46 Duals

Inflation pressure: 10 psi

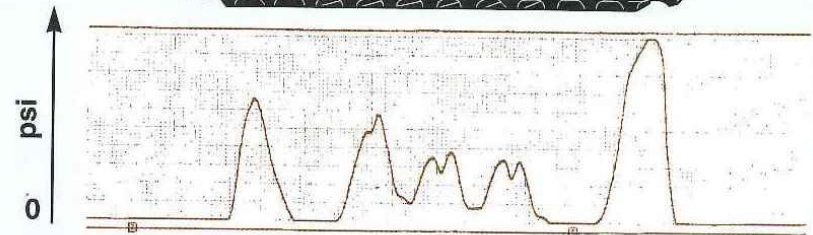
Source: Modern Corn and Soybean Production

Tracked Tractor

225 PTO Horsepower
8400T Tractor



Each axle and roller causes a pressure spike



*Soil pressures
measured 6 inches
below surface*

Track Width

16 Inches

Inflation pressure: NA

Ballasted weight: 25,300 pounds

Source: Modern Corn and Soybean Production

Tracked Tractor

- Tracked tractors cause the same compaction at the same total vehicle load as tire-mounted tractors
- Advantage of tracks
 - Flotation
 - Pulling power
- Advantage of tires
 - Steering
 - Cost

Other ways to avoid compaction

- Travel over a lower percentage of the field
- Concentrate repeat traffic in travel lanes
- Drive faster to shorten load dwelling time

Solid Manure Spreaders



Vertical Beaters

Hose Drag System



Automatic Air Inflation Deflation (AAID) System

- Allow operator to lower pressure in field and raise pressure on road
- Rapid deflation to limit idle time



PTG



AgriBrink

Flotation Tires

Load, inflation and speed table for 710/40R22.5 flotation tire

Recommended load (lbs)								
	Speed (mph)							
Pressure (psi)	Static	6	16	19	25	31	37	40
15	10680	8370	7330	7030	6320	5620	4980	4650
36	18280	14320	12560	12000	10810	9630	8500	7950
44	20310	15900	13960	13350	12000	10680	9450	8830

Key Points

- Limit Soil Compaction
 - Keep axle loads below 10 tons and preferably below 6 tons to prevent subsoil compaction
 - Keep tire pressures as low and tire footprints as large as possible to prevent topsoil compaction – 10 psi
 - Use a drag hose system to inject liquid manure
 - Use an automatic AAID System

Resources



October 2010

Agdex 510-1

Agricultural Soil Compaction: Causes and Management

Soil compaction can be a serious and unnecessary form of soil degradation that can result in increased soil erosion and decreased crop production.

Compaction of soil is the compression of soil particles into a smaller volume, which reduces the size of pore space available for air and water. Most soils are composed of about 50 per cent solids (sand, silt, clay and organic matter) and about 50 per cent pore spaces.

Compaction concerns

Soil compaction can impair water infiltration into soil, crop emergence, root penetration and crop nutrient and water uptake, all of which result in depressed crop yield.

Human-induced compaction of agricultural soil can be the result of using tillage equipment during soil cultivation or result from the heavy weight of field equipment. Compacted soils can also be the result of natural soil-forming processes. Solonchets soils are an example of natural soil compaction (see Alberta Agriculture's factsheet Agdex 518-8, *Management of Solonchets Soils*).

This factsheet reviews several topics: the various types of human-induced compaction, the causes and consequences of soil compaction and prevention and management.

Effects of soil compaction

The various forces of soil compression by agricultural equipment can cause soil particles to become compacted closer together into a smaller volume. As particles are compressed together, the space between particles (pore space) is reduced, thereby reducing the space available in the soil for air and water. The compaction force may cause the crushing of

soil aggregates, which has a negative effect on soil aggregate structure.

Soil compaction can have a number of negative effects on soil quality and crop production including the following:

- causes soil pore spaces to become smaller
- reduces water infiltration rate into soil
- decreases the rate that water will penetrate into the soil root zone and subsoil
- increases the potential for surface water ponding, water runoff, surface soil waterlogging and soil erosion
- reduces the ability of a soil to hold water and air, which are necessary for plant root growth and function
- reduces crop emergence as a result of soil crusting
- impedes root growth and limits the volume of soil explored by roots
- limits soil exploration by roots and decreases the ability of crops to take up nutrients and water efficiently from soil
- reduces crop yield potential

Compacted soil will restrict root growth and penetration into subsoil. This situation can lead to stunted, drought-stressed plants as a result of restricted water and nutrient uptake, which results in reduced crop yield.

In wetter than normal years, soil compaction can decrease soil aeration and lead to the increased loss of nitrate nitrogen by denitrification, which is the conversion of plant available nitrate-nitrogen into gaseous nitrogen forms that are lost to the atmosphere. This process occurs when soils are in an anaerobic condition and soil pores are mostly filled with water. Reduced soil aeration can affect root growth and function, and lead to increased risk of crop disease. All these factors result in increased crop stress and yield loss.

Soil compaction can be a serious form of soil degradation.

Government of Alberta

Avoiding Soil Compaction



PENNSTATE



College of Agricultural Sciences
Agricultural Research and Cooperative Extension

Source: ARD

Source: Penn State University