

# Soil Compaction

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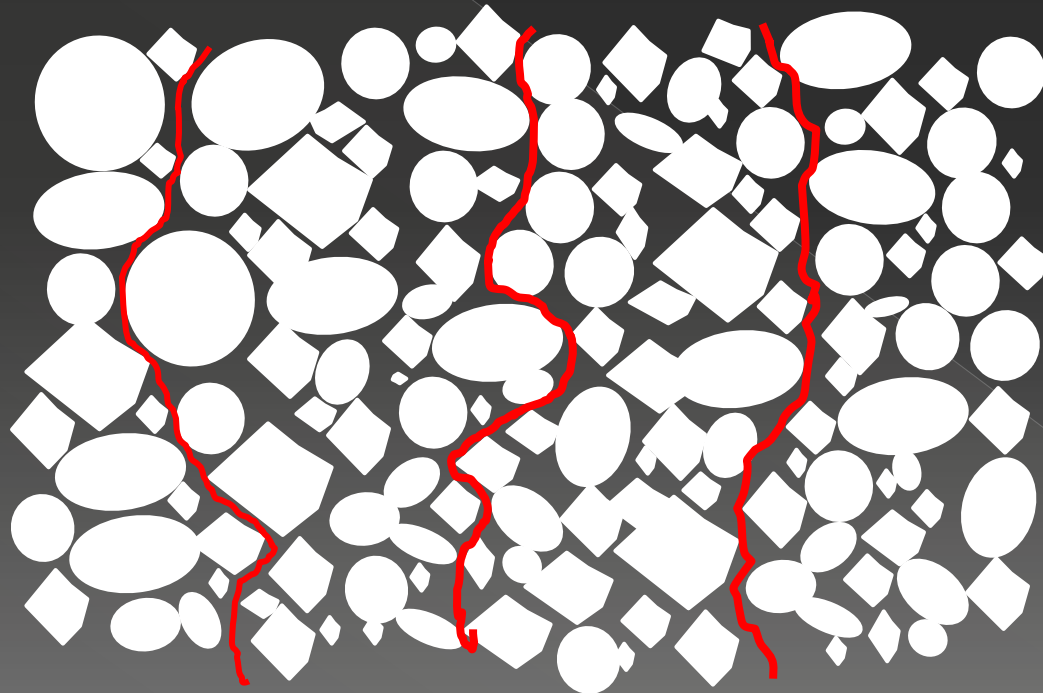
# What is Soil Compaction

- Soil particles are re-arranged and compressed
  - Reducing pore space and increasing bulk density.
- Compaction occurs when applied force is greater than the soils load bearing strength

# Adverse Effects of Compaction

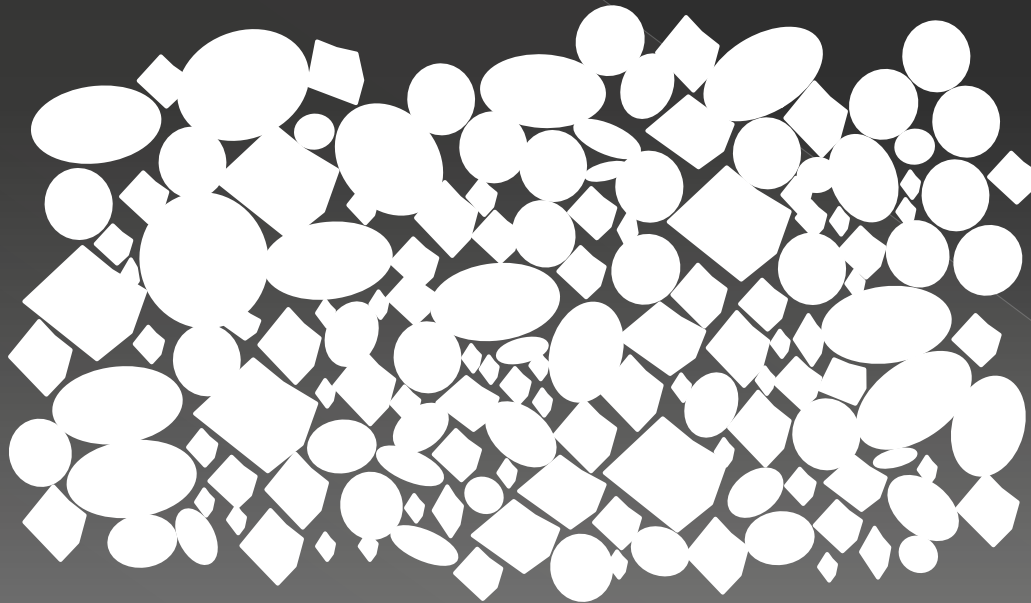
- ⦿ Poor aeration
- ⦿ Poor water infiltration and drainage
- ⦿ Poor root growth
- ⦿ Reduced nutrient uptake and water availability
- ⦿ Difficult to plant into compacted soils!
- ⦿ Emergence limitations
  - › Surface crusts

# Normal Soil



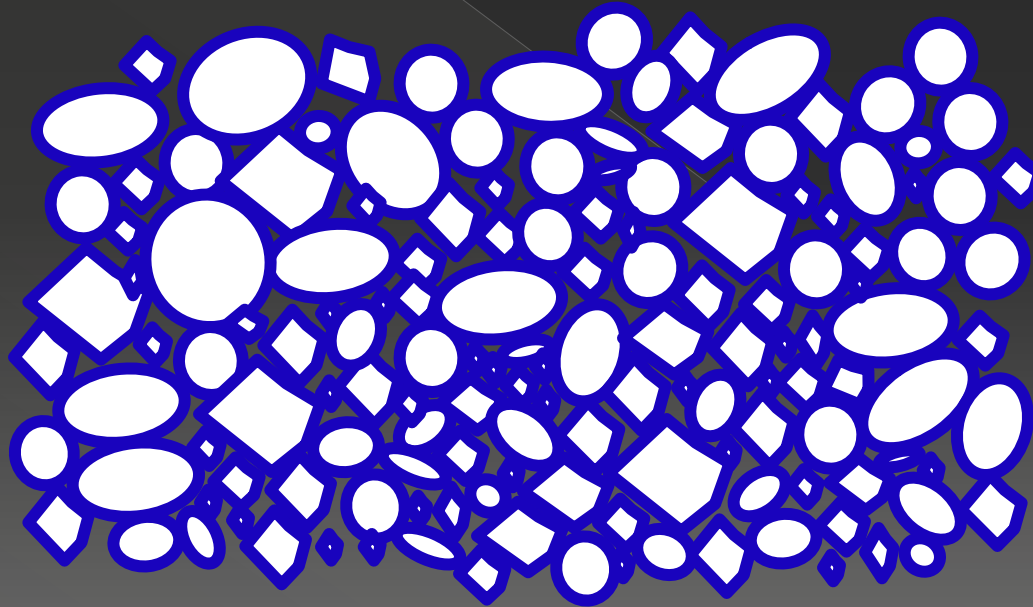
# Compacted soils

- Compaction reduces number and volume of macropores
- Reduced aeration, drainage and root growth



# Compacted Soil

- Compacted soils can have more significant aeration problems when wet.



# Hard vs. Compacted Soils

- Are hard soils always compacted?
  - > No!
  - > Dry soils are hard!
  - > Clayey soils can be hard but not necessarily compacted.
    - Clays can have production limitations similar to compacted soils
- Hard= resists penetration or forms clods that are difficult to break apart.

# Hard vs. Compacted Soils

- Compacted soils will always resist penetration
  - › Even when moist.
- These distinctions are important when trying to diagnose and alleviate compaction.





# Evaluating Soil Compaction

- Using a Penetrometer.
  - Sensitive to soil moisture
  - Dry soils will have high resistance to penetration
  - Used when soils are at field capacity
  - Root growth is restricted at 300psi



# Evaluating Soil Compaction

- Best tools are a shovel and your eyes
- Look for horizontal soil structure and root growth
- Evaluate root growth of tap rooted plants. Fibrous roots can also show compaction.

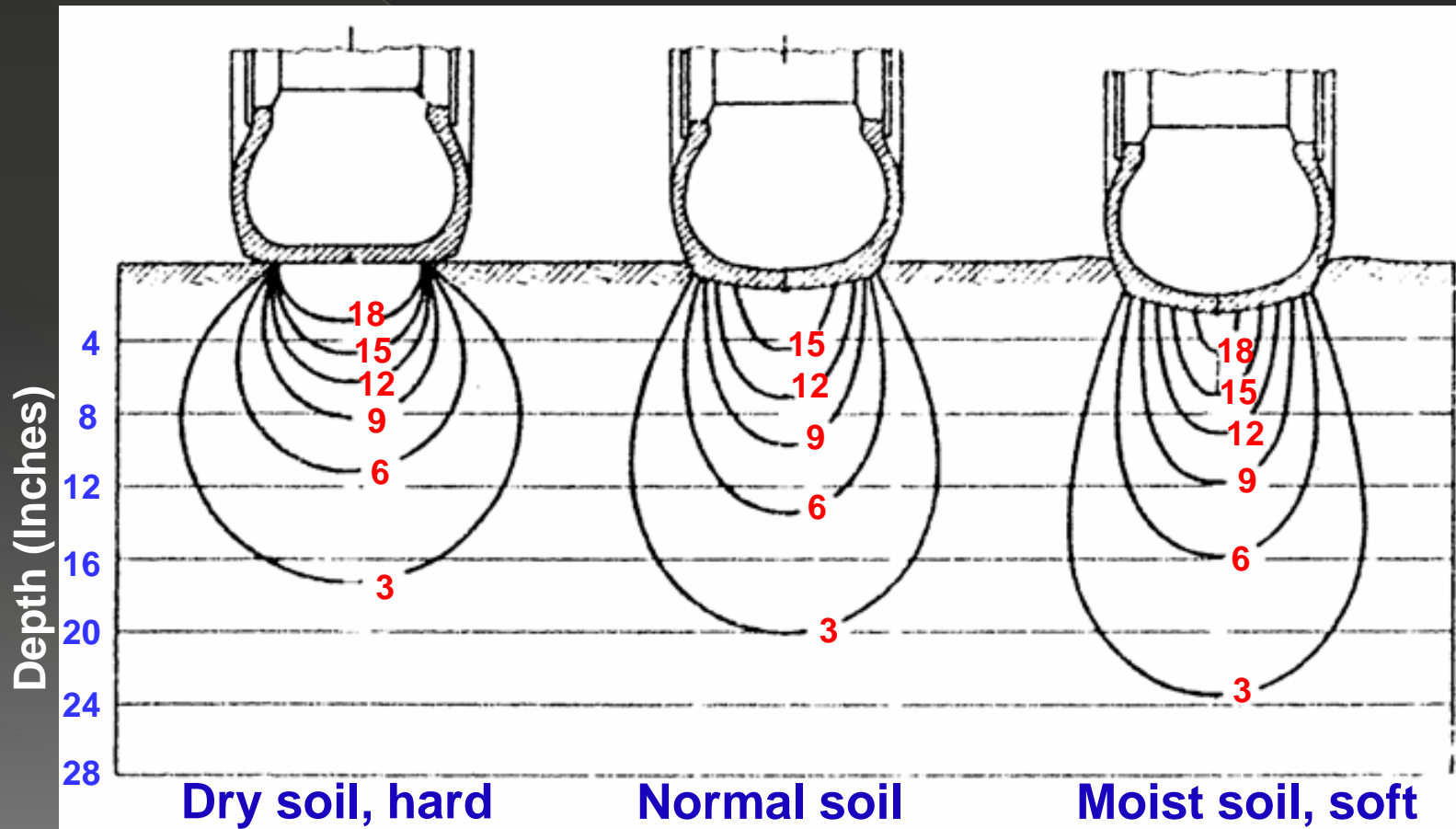


# Influence of Soil Texture on Compaction

- Moderately course soils such as Sandy loams are most susceptible to compaction.
  - Large pores between sand grains fill with smaller silt and clay.
- As the clay content increases, potential for compaction decreases.
  - Less air filled pore space under moist conditions (must move water out to compress soil)
  - Clays are more cohesive, (more difficult to move around).

# Soil Moisture and Compaction

- At field capacity, water lubricates soil particles.
- Pressure is distributed deeper into profile.



# Soil Moisture and Compaction

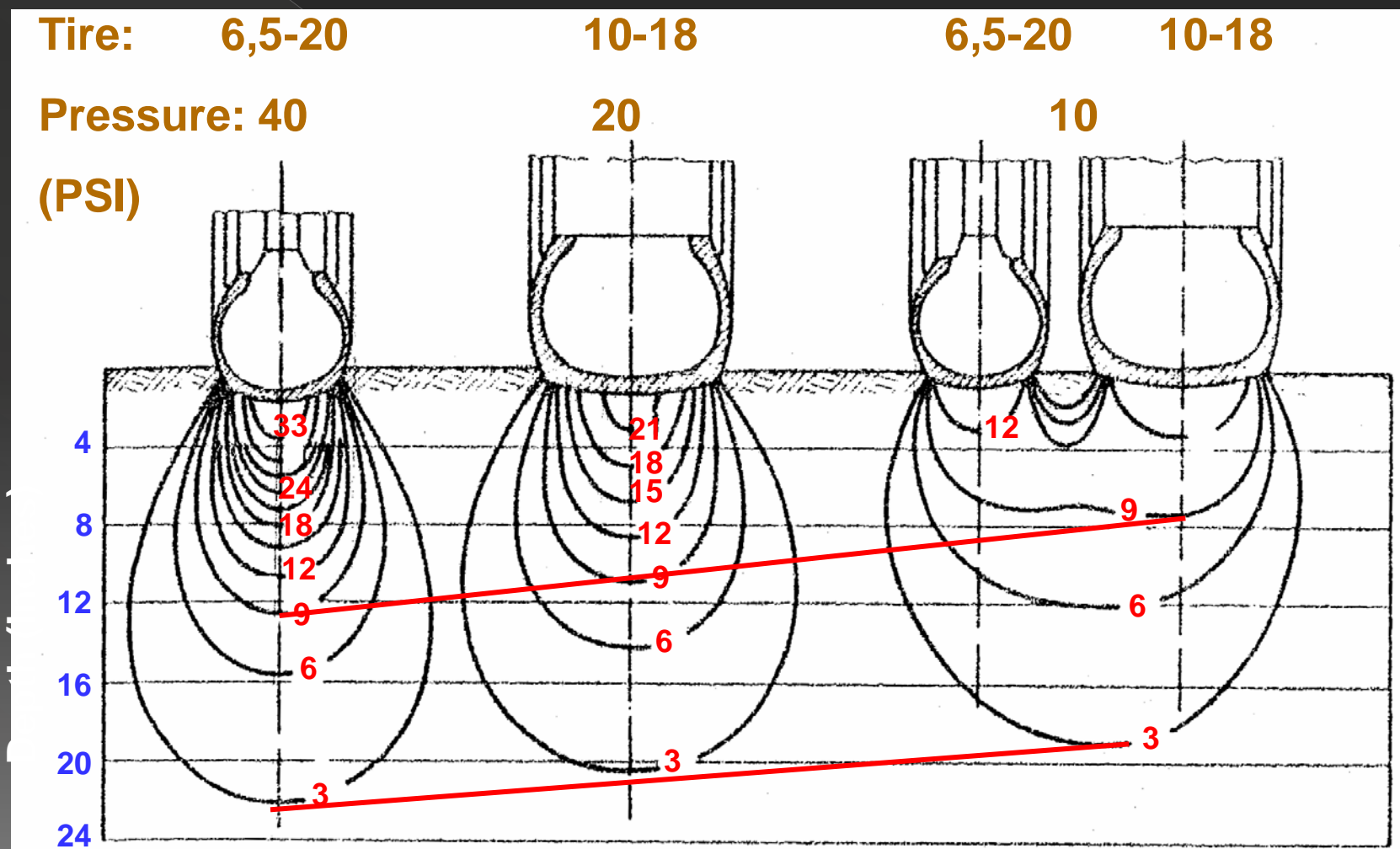
- Traffic on wet soils causes ruts and significant subsurface compaction
- Of course, compaction occurs without ruts too!





# Tire width and inflation

- Wide tires reduce surface compaction
- Less effective at reducing subsurface compaction



# Compaction in No-till vs Conventional tillage

- Surface tillage provides short term reduction of compaction at surface:
  - › Provides ideal seed bed
  - › BUT can create a plow pan
- Heavy traffic and grazing can compact soils in both systems
- No-till can alleviate plow pan but surface compaction can still be a problem.

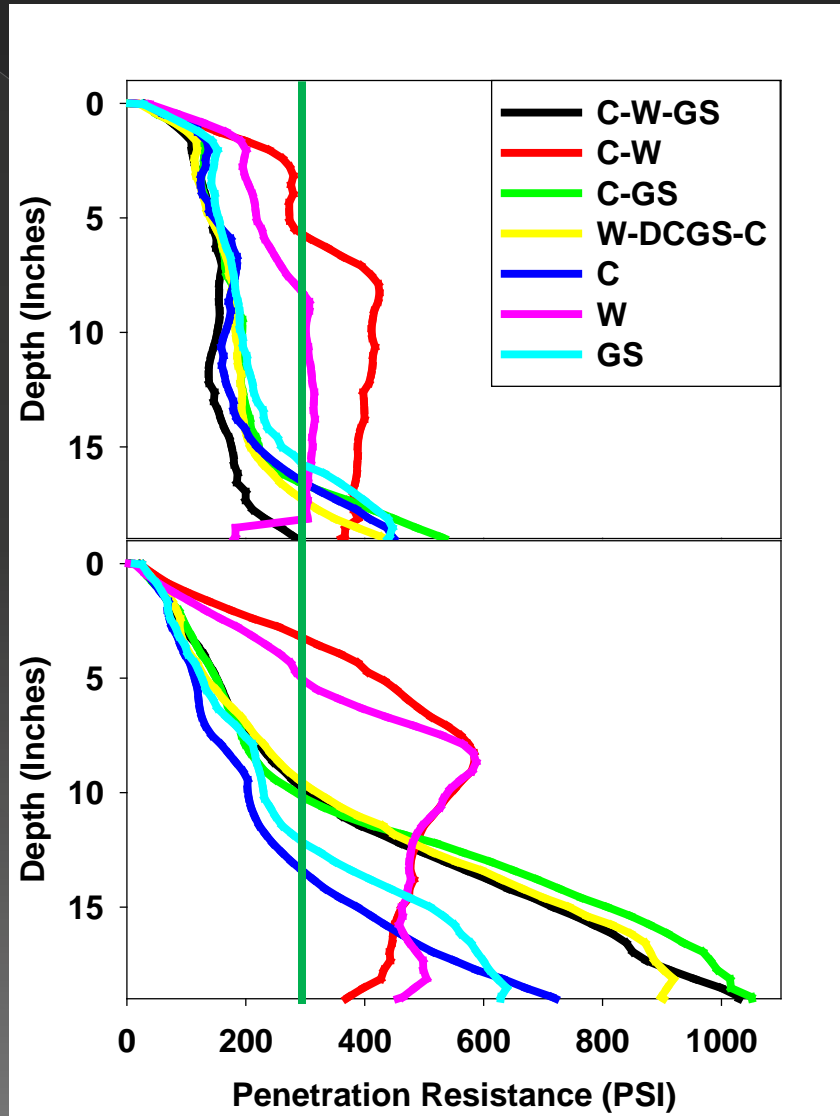


# Effect of No-till on Plow Pans

- Removes pressure applied by tillage implement
  - › Concentrated and uniform pressure at depth causes plow pan.
- Allows soil processes to break plow pan apart
  - › Freeze and thaw cycles??
  - › Shrink and swell during drying and wetting
  - › Root penetration



# No-till effect on Subsurface Compaction



# Effect of No-till on Surface Crusts

- Force of raindrop hitting the soil surface forms surface crusts.
- Crop residues protect soil surface from raindrops
  - > Can improve emergence.



# Alleviating Compaction in No-till

## Sub-Soiling



Generally a short-term solution  
with inconsistent yield response

# Sub-soiling

- ⦿ Soils should be dry when sub-soiled
  - Dry soils will shatter
- ⦿ Sub-soiling a wet soil will simply create a narrow channel.



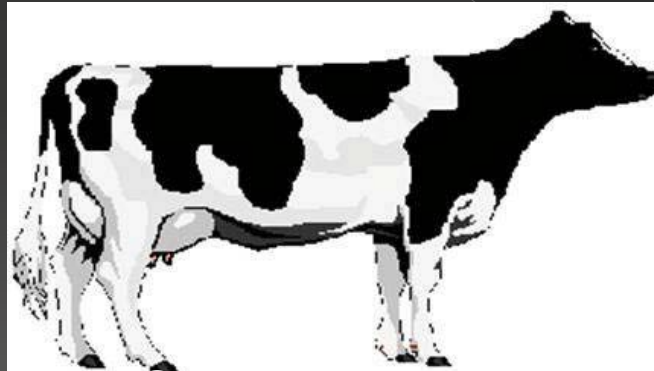
# Alleviating Compaction in No-till

## Control Traffic

- How do we do it?
  - > Limit Grazing
  - > GPS guidance
  - > Tramlines

# Limit Grazing

- ◉ Minimize grazing during wet periods
  - > Spring graze out.
- ◉ Maintain surface residue
  - > OM accumulation will limit shallow compaction



4

8 in.

12

16



# GPS Guidance and Tramlines

- Limits compaction to confined areas of field.
- Return accuracy of GPS will determine size of compacted area



# GPS Guidance and Tramlines

## ● Tramlines:

- › Created during planting by plugging rows
- › Provides accurate return to traffic pattern





# Final Thoughts

- Some level of soil compaction is inevitable in modern crop production.
- If soils are very susceptible to compaction, prevention is the key
  - Control equipment traffic and grazing, and maintain surface residue.
- Deep tillage may be warranted for severe compaction
  - Cause of compaction must be removed



Questions?