

Zone Tillage for Sugarbeets – How Deep?

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Zone Tillage Has Become Popular In Certain Sugarbeet Growing Areas

- An estimated 60% of sugarbeets grown in Nebraska and Colorado in 2010 used zone tillage.
- Interest and acres increasing in Idaho.
- But, some areas with other conditions and issues use almost no zone tillage.

Why Zone Tillage?

- Maintains surface residue
- Controls wind erosion
- Provides tillage in row area, only
- Usually is fertilizer application method
- Reduces trips across field
- Reduces input energy, costs

What Is “Zone Tillage”?

- A close cousin to “Strip Tillage”.

What Is “Strip Tillage”?

- Initiated by no-tillers 30+ years ago.
- Moves surface residue from a narrow band where crop row will be.
- Soil warms & dries faster in row area for earlier planting, faster crop emergence.

“Strip Tillage” Evolution

- Then some found very shallow tillage to loosen soil surface helped more.
- Then some decided good way for shallow placement of fertilizer.
- Then some decided to do deeper tillage, maybe to 6 in.
- Equipment designed relatively light to move residue and only shallow tillage.

What Is “Zone Tillage”?

- Focus is on deeper tillage (8-12 in.) in narrow band where row will be.
- Moving residue aside from row area ‘happens’.
- Fertilizer usually applied.
- Seedbed in row area emphasized.
- Equipment robust for higher power input.

Primary Differences

- Residue mover Vs. deeper shank tillage
 - Power requirement per row
 - Equipment 'strength' and weight
 - Shank mark closing
-
- Purposes and equipment are moving closer together for the two systems.

Zone Tillage Current Trends/Issues

- Wider equipment – 16 rows and up
- Trip back shanks – auto reset
- Closing shank marks
- ‘Better’ seedbed in row
- From 30 in. to narrow rows (residue, tracking)
- Tracking behind zone tillage

Frequent Zone Tillage Question:

- How deep should I operate the shanks?
 - Originally, some set depth at 12 in. and “went”.
 - Now more are changing the depth between 8 and 12 in.
 - Does it matter??

Too Deep:

- Wastes power, fuel, input cost
- Requires too large of tractor
- Takes too long
- Brings up too many clods to deal with
- Harder to close the shank mark completely deeper in the soil

Too Shallow:

- Won't alleviate soil compaction, if there is any.

Project Objective

- Determine sugarbeet yield response to different zone tillage shank depths within different soil compaction levels to help provide a recommendation for shank depth.

Procedure:

- 4 shank depths
 - 0, 5, 10, 15 in. deep
- 3 'levels' of surface applied soil compaction
 - None, moderate, high
- 6 reps; 3 years

Procedure:

- Sandy loam soil
- Fields already had a “hard” soil layer below about 12 in.
- The applied soil compaction was surface applied.

Field Operations:

- Moldboard plowed 12 in. deep
- Roller harrowed 2X when soil was dry with floatation tires on tractor
- Created soil compaction when soil was dry
- Carefully tilled 2 in. deep
- Applied zone tillage treatments (5, 10, 15 in.)
- Planted (22 in. rows)

Surface Applied Soil Compaction

- **None**
 - No additional
- **Moderate**
 - Unloaded tandem axle truck
- **Heavy**
 - Loaded tandem axle truck (52,000 lb)





Measurements

- Established plant populations
- Soil cone penetrometer resistance (August, in row)
- Visual rating of root shape at harvest
- Harvested crop yield

Established Sugarbeet Plant Population

(averaged over 3 years)

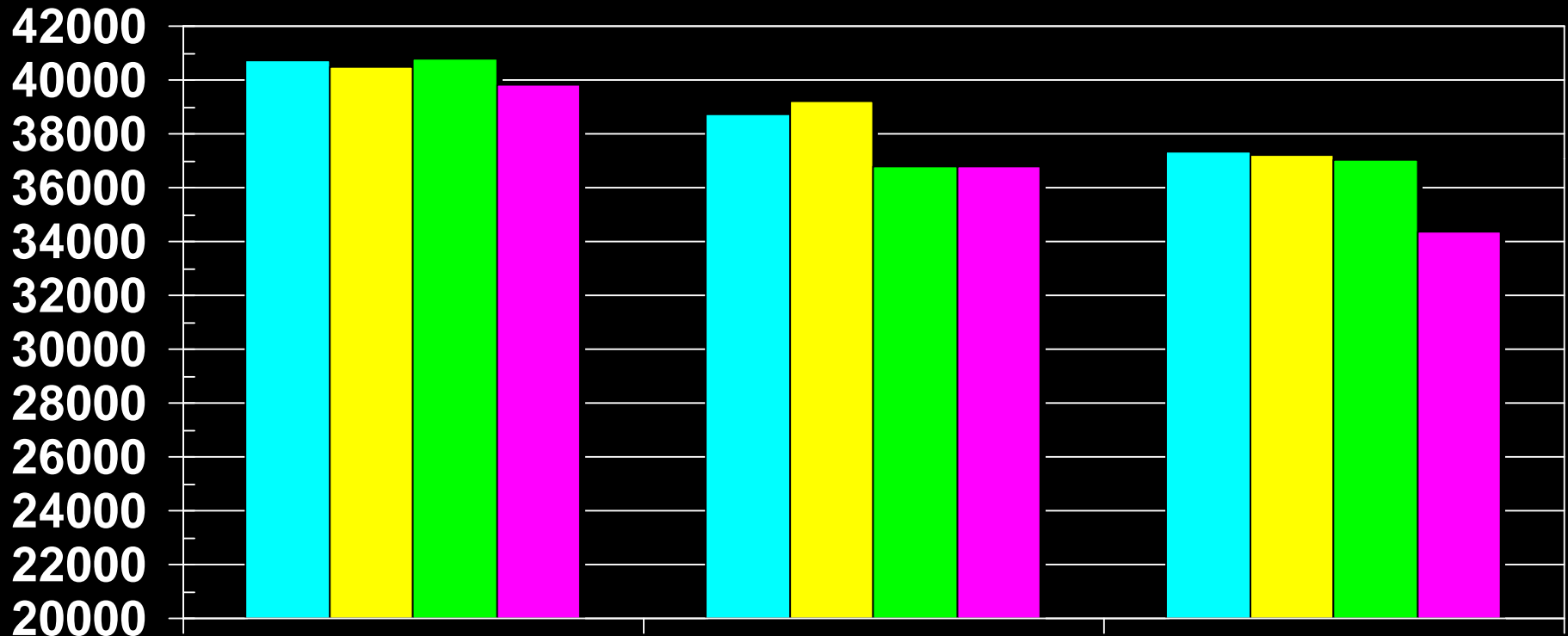
Plant Pop. (plants/A)

■ None

■ 5 in.

■ 10 in.

■ 15 in.



None

Moderate

Heavy

Surface Applied Compaction

Plant Stand – Averaged Over Shank Depths & 3 Years

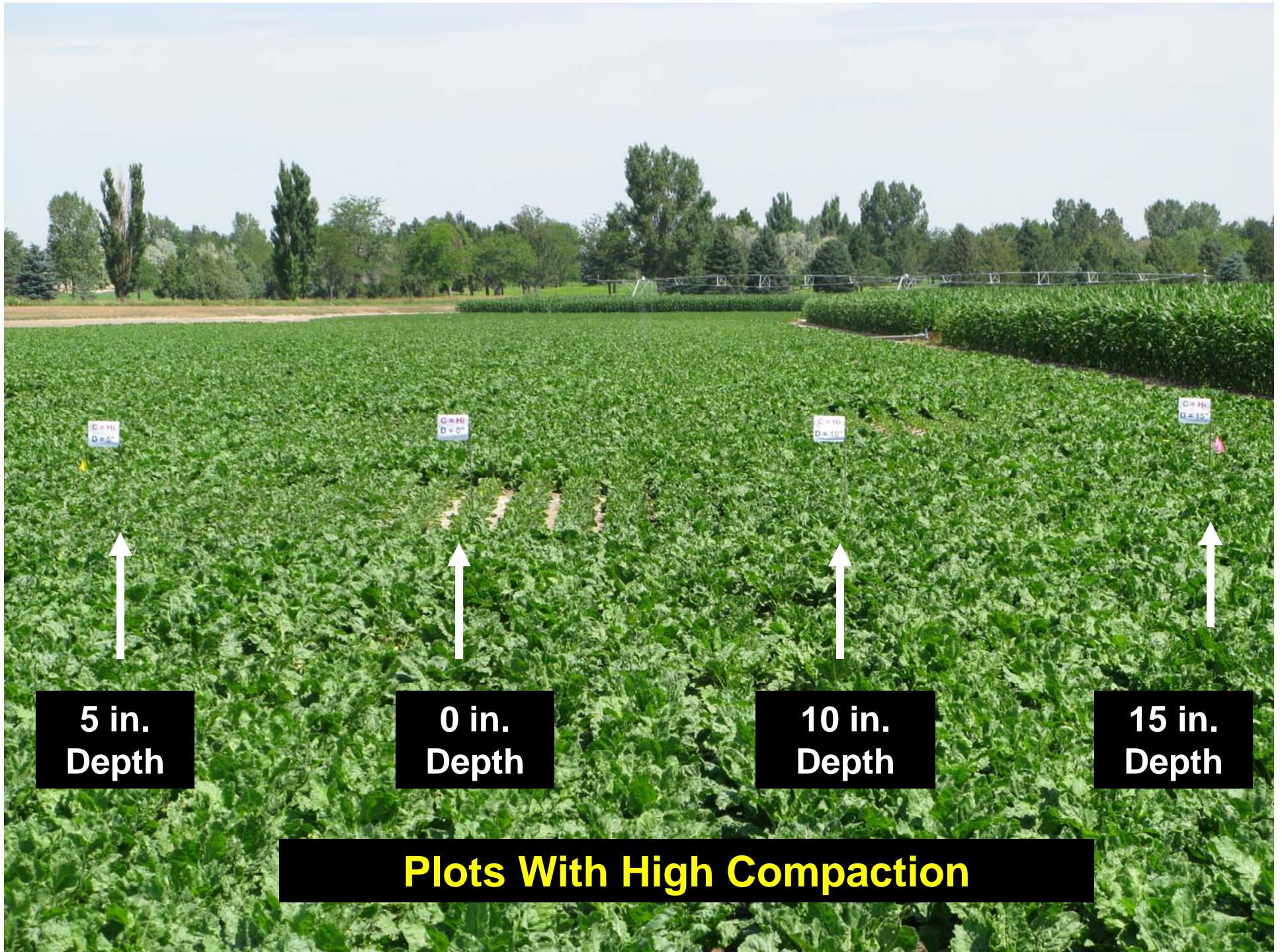
Compaction Treatment	Plant Stand Averaged Over Shank Depths (plants/A)
None Applied	40,500 a
Moderate	37,900 b
High	36,500 c

Plant Stand – Averaged Over Compaction Levels & 3 Years

Shank Depth (in.)	Plant Stand Averaged Over Compaction Levels (plants/A)
0	38,900 a
5	39,000 a
10	38,200 a
15	37,000 b



July 20, 2010



C=H
D=5

C=H
D=0

C=H
D=10

C=H
D=15

5 in.
Depth

0 in.
Depth

10 in.
Depth

15 in.
Depth

Plots With High Compaction

Measure of Soil Compaction

Soil Cone Penetrometer

- Measured maximum penetration force within four soil depth zones:
 - 0 – 3 in.
 - 3 – 8 in.
 - 8 – 13 in.
 - 13 – 18 in.

Maximum Soil Cone Penetrometer Resistance Where No Zone Tillage Shank Had Operated

Measurement Depth Range (in.)	<u>No</u> Compaction Applied (psi)	<u>Moderate</u> Compaction Applied (psi)	<u>High</u> Compaction Applied (psi)
0 - 3	146	443	483
3 - 8	243	705	812
8 - 13	634	689	843
13 - 18	731	635	682

Maximum Soil Cone Penetrometer Resistance Where 5 in. Shank Depth Was Used (in row)

Measurement Depth Range (in.)	<u>None</u> Applied (psi)	<u>Moderate</u> Applied (psi)	<u>High</u> Applied (psi)
0 - 3	60	95	103
3 - 8	166	534	659
8 - 13	539	659	887
13 - 18	707	748	803

Averaged over years.

Maximum Soil Cone Penetrometer Resistance Where 10 in. Shank Depth Was Used (in row)

Measurement Depth Range (in.)	<u>None</u> Applied (psi)	<u>Moderate</u> Applied (psi)	<u>High</u> Applied (psi)
0 - 3	58	105	121
3 - 8	86	165	206
8 - 13	341	517	689
13 - 18	591	582	700

Averaged over years.

Maximum Soil Cone Penetrometer Resistance Where 15 in. Shank Depth Was Used (in row)

Measurement Depth Range (in.)	<u>None</u> Applied (psi)	<u>Moderate</u> Applied (psi)	<u>High</u> Applied (psi)
0 - 3	84	142	104
3 - 8	123	195	161
8 - 13	186	241	251
13 - 18	581	594	517

Averaged over years.





Root Shape Rating

(1=normal, 2=moderate, 3=sprangled)
(averaged over 3 years)

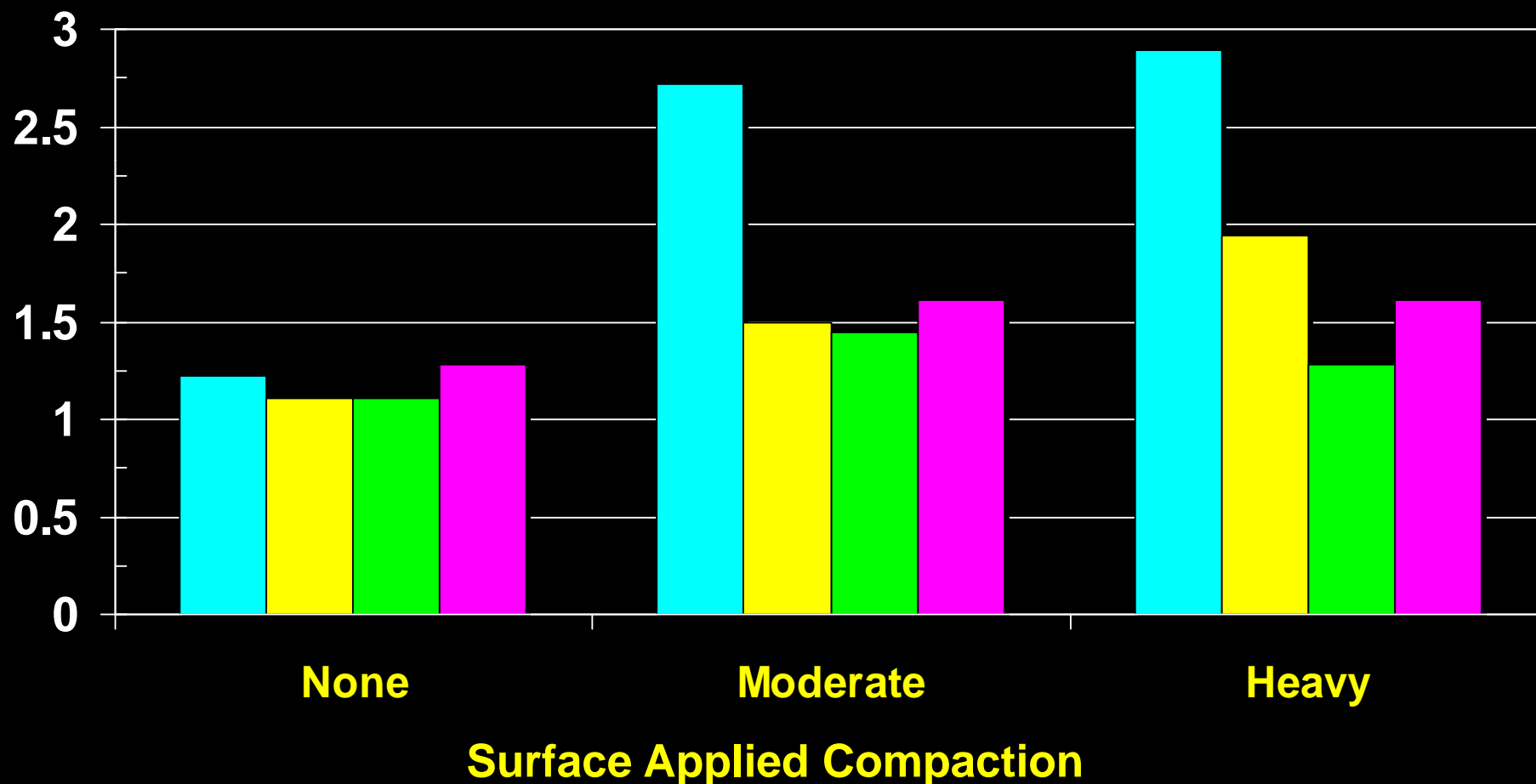
Root Shape Rating

0 in.

5 in.

10 in.

15 in.



Visual Root Shape Ratings Taken On The Harvester (1 = normal, 3 = very sprangled)

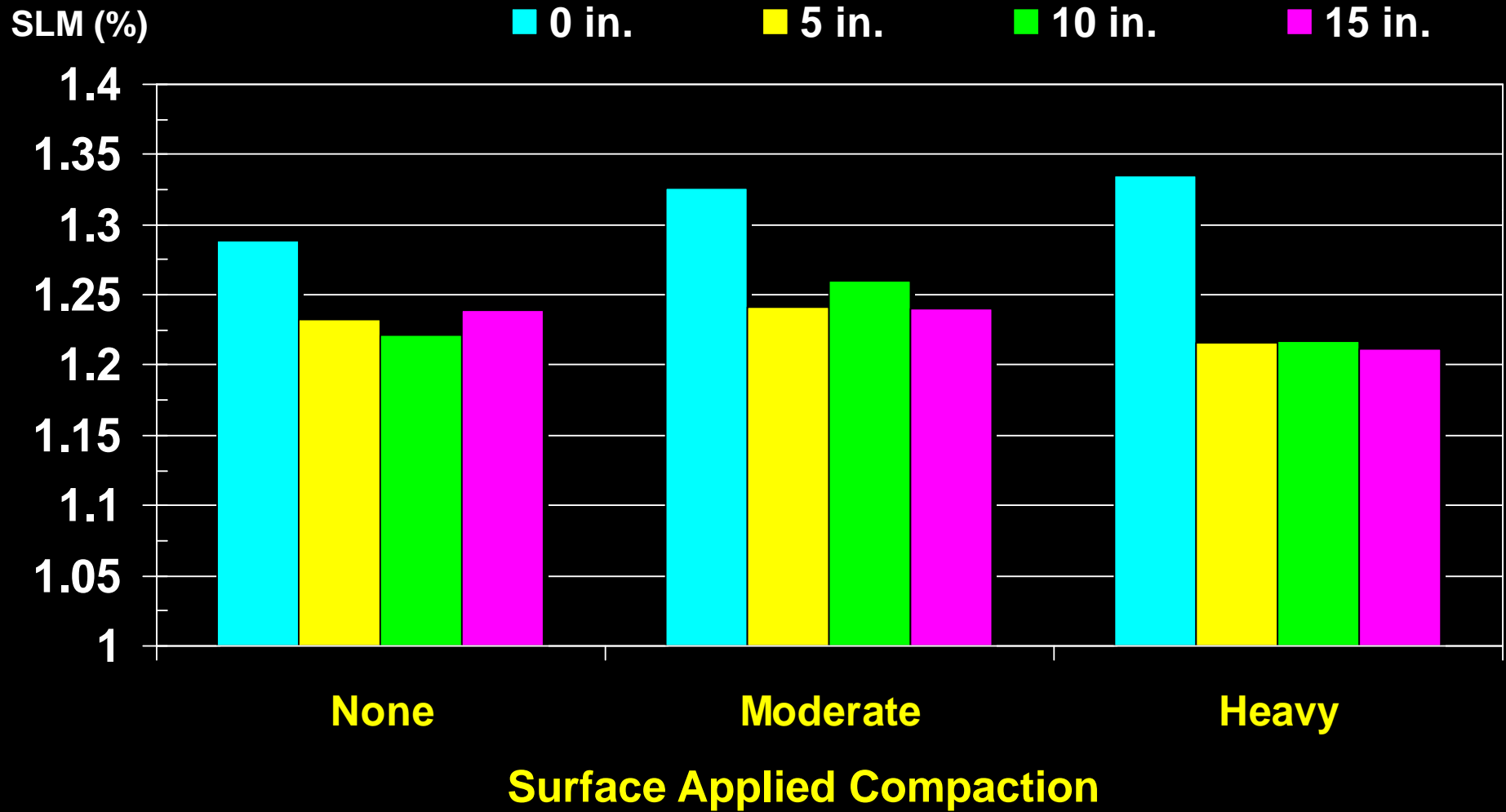
Shank Depth (in.)	No Compaction Applied	Moderate Compaction Applied	High Compaction Applied
0	1.2	2.7	2.9
5	1.1	1.5	1.9
10	1.1	1.4	1.3
15	1.3	1.6	1.6

Isd within a column or within a row = 0.3

Averaged over 3 years.

SLM (%)

(averaged over 3 years)



SLM (Combined over compaction Levels)

Shank Depth (in.)	SLM (%)
0	1.32 a
5	1.23 b
10	1.23 b
15	1.23 b

??

Averaged over years.

Clean Root Yield (ton/A)

(averaged over 3 years)

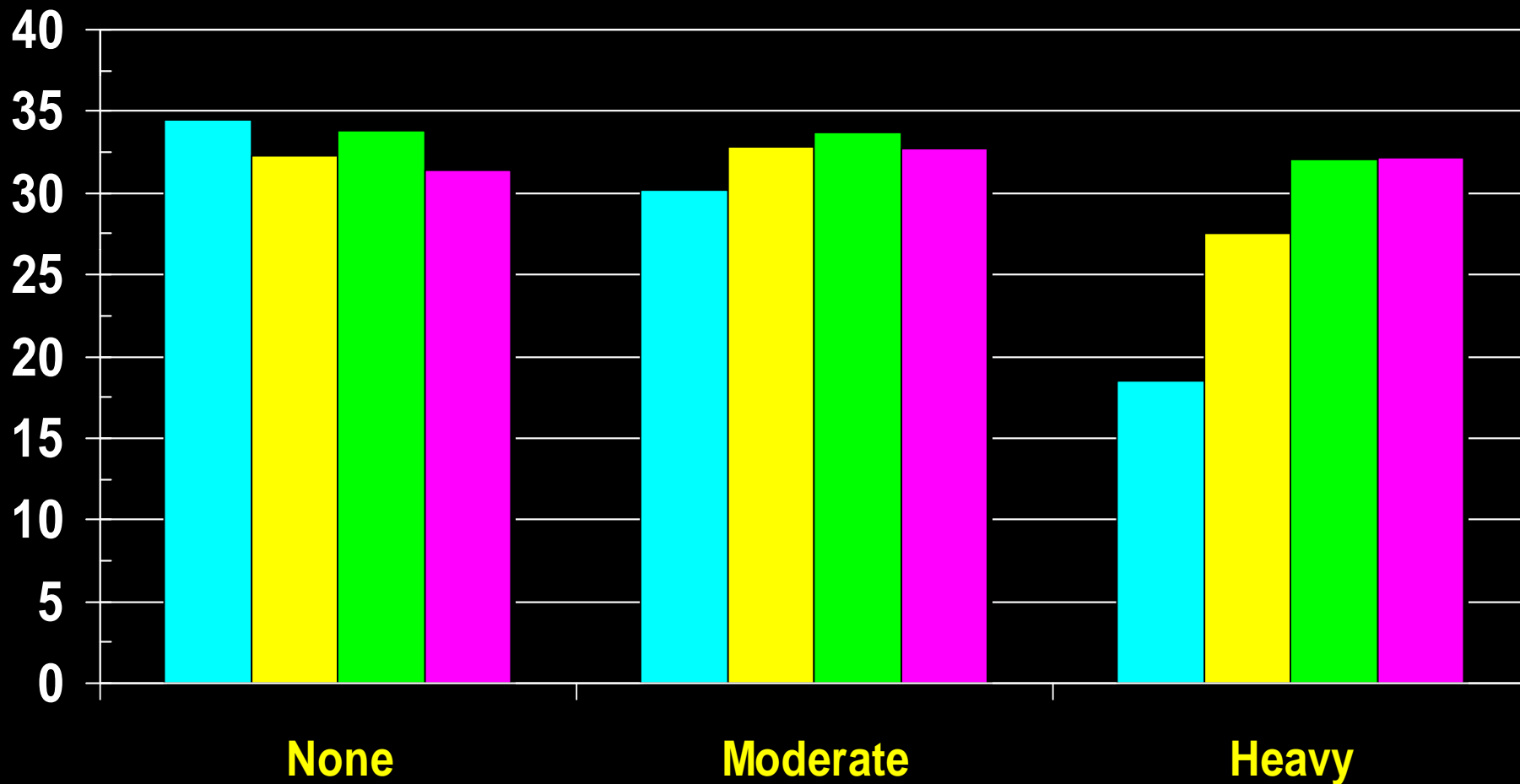
Root Yield (ton/A)

■ 0 in.

■ 5 in.

■ 10 in.

■ 15 in.



(Isd ~ 2 ½ ton/A)

Surface Applied Compaction

Sugarbeet Root Yield (ton/A)

(Combined over three years)

Shank Depth (in.)	No Compaction Applied	Moderate Compaction Applied	High Compaction Applied
0	34.5	30.2	18.5
5	32.3	32.8	27.5
10	33.8	33.7	32.1
15	31.4	32.7	32.1

Isd within a column = 2.5 ton/A

Isd within a row = 2.7 ton/A

Conclusions

- **Soil compaction reduced sugarbeet yield**
 - **Even moderate soil compaction.**
 - **High soil compaction reduced root yield by almost half!**

Conclusions

- 10 in. shank depth helped root yields in moderate and high soil compaction.
- 15 in. shank depth was no better than 10 in. in this study.
- Why? With long season crop & good subsurface soil water content, maybe the plant could 'accommodate' deeper soil compaction much better than shallow compaction???

What 'Level' Of Soil Compaction Reduced Sugarbeet Yield?

- In the top 10 in. yield was reduced by cone penetrometer resistance of about 400 psi.
- Below 10 in., sugarbeet 'tolerated' higher cone penetrometer resistance.

Conclusions:

- Even 10 in. or 15 in. shank depth in moderate and heavy soil compaction did not make yield comparable to where there had been no added soil compaction.

Why Didn't 15 in. Shank Depth Make Up All Yield Lost To Compaction?

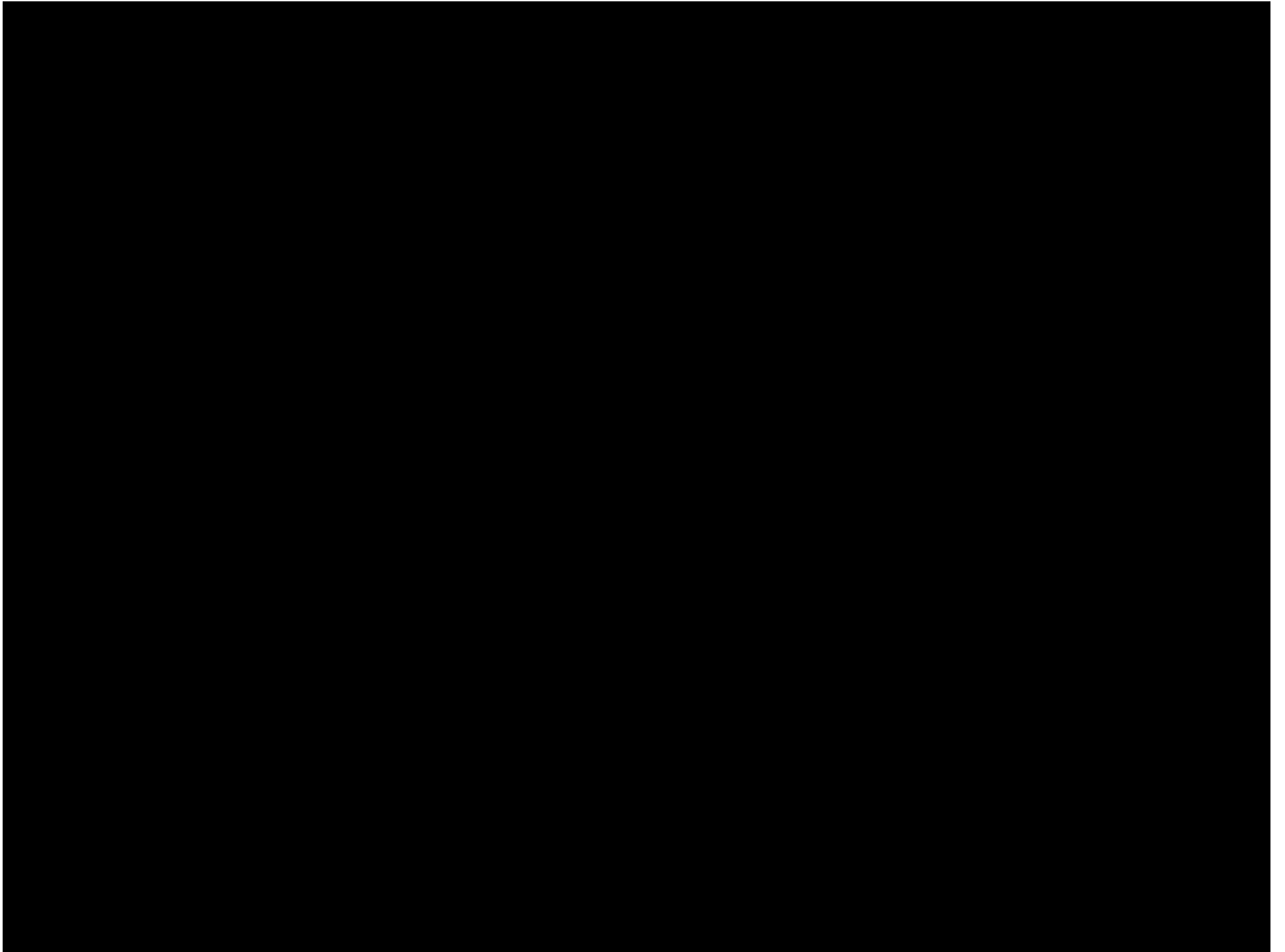
- We didn't shatter all clods in the narrow width we did till.
- We didn't do anything to the soil between the rows.
- Does that suggest we should consider running between rows if we follow zone till behind zone till??

Soil Compaction Is Expensive

- It reduces plant stand (clods)
- It decreases water infiltration and increases water runoff.
- It reduces yield.
- It is expensive to alleviate.
- It may not be possible to alleviate completely in one year --- with any tillage system.

How Deep Should I Operate Zone Tillage Shanks?

- This study suggests 10 in. is a good starting point.
- 15 in. did not improve yield even though there was high compaction below 10 in.
- Probe your field --- if no compaction at 10 in. don't go that deep.
- Make some strips at different depths in your field – observe the results.



ASSBT Sugarbeet Production Forum

“Tillage Systems – Strip Tillage; Zone Tillage; Stale Seed Bed”

Time: 3:30 pm following this Agronomy Section Session

Location: This room

Please join us to share experiences on current sugarbeet tillage systems.

ASSBT Sugarbeet Production Forum

“Tillage Systems – Strip Tillage; Zone Tillage; Stale Seed Bed”

Forum Goals:

- Learn more about these tillage systems.
- Learn about other popular tillage systems.
- Why these are or are not popular?
- Are there any common research needs?

“Tillage Systems – Strip Tillage; Zone Tillage; Stale Seed Bed”

- 1. How popular are any of these systems in your area (% of crop or acres).**
- 2. Why are these systems popular or not?**
- 3. If none of the above 3 tillage systems is used in your area, what is popular?**
- 4. Are there areas of research that a multi-region group should consider?**

General Definitions

- **Strip Tillage** – Residue moved aside from row area (warm, dry row area), shallow tillage (<6in.), and fertilizer application with shank are optional.
- **Zone Tillage** – Deeper (8-12 in.) tillage with shank, fertilizer usually applied behind shank, prepared seedbed in row with little residue.
- **Stale Seedbed** – Primary tillage and secondary tillage to make a ‘prepared’ seedbed completed in the Fall, then plant directly in spring.

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“Tillage Systems – Strip Tillage; Zone Tillage; Stale Seed Bed”

1. What questions/discussion do we have that will improve these tillage systems for our growers?
2. Where does this lead us, is there some follow-up we should do, to collectively improve our understanding of our tillage systems?

“Tillage Systems – Strip Tillage; Zone Tillage; Stale Seed Bed”

Thank you for your input and participation!

