Farming Implements in Action:

Impacts on the soil, erosion potential of tillage systems, and economics

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What we'll cover today

Impacts of Farming Implements on the Soil

- Identify the types of soil disturbance
- Examples of farm implements that demonstrate specific types of soil disturbance

A look at different Corn-Bean tillage systems

- "Conventional" tillage system
- "Reduced" tillage system (CPS 345)
- "No-Till" system (CPS 329)

Economics

- Fuel/Energy consumption
- Other things to consider

Types of Soil Disturbance

- Inversion (some mixing)
- Mixing (only)
- Mixing and some inversion
- Lifting, fracturing
- Compression

STIR – Soil Tillage Intensity Rating

$$STIR = (0.5S) \times (3.25T) \times (D) \times (A)$$

Where:

S = Speed (mph)

T = Tillage type modifier

D = Tillage depth (inches)

A = area disturbed (0-1.0)

TILLAGE TYPE	MODIFIER
Inversion	1
Mixing	0.7
Mixing and some Inversion	0.8
Lifting/Fracturing	0.4
Compression	0.15

Inversion (some mixing)

"A champion ploughman from The Powerhouse Museum Collection" by Unknown - 'Rural Life' Pictures from The Powerhouse Museum. Licensed under Public Domain via Commons - https://commons.wikimedia.org/wiki/File:A_champion_ploughman_from_The_Powerhouse_Museum_Collection.jpg#/media/File:A_champion_ploughman_from_The_Powerhouse_Museum_Collection.jpg

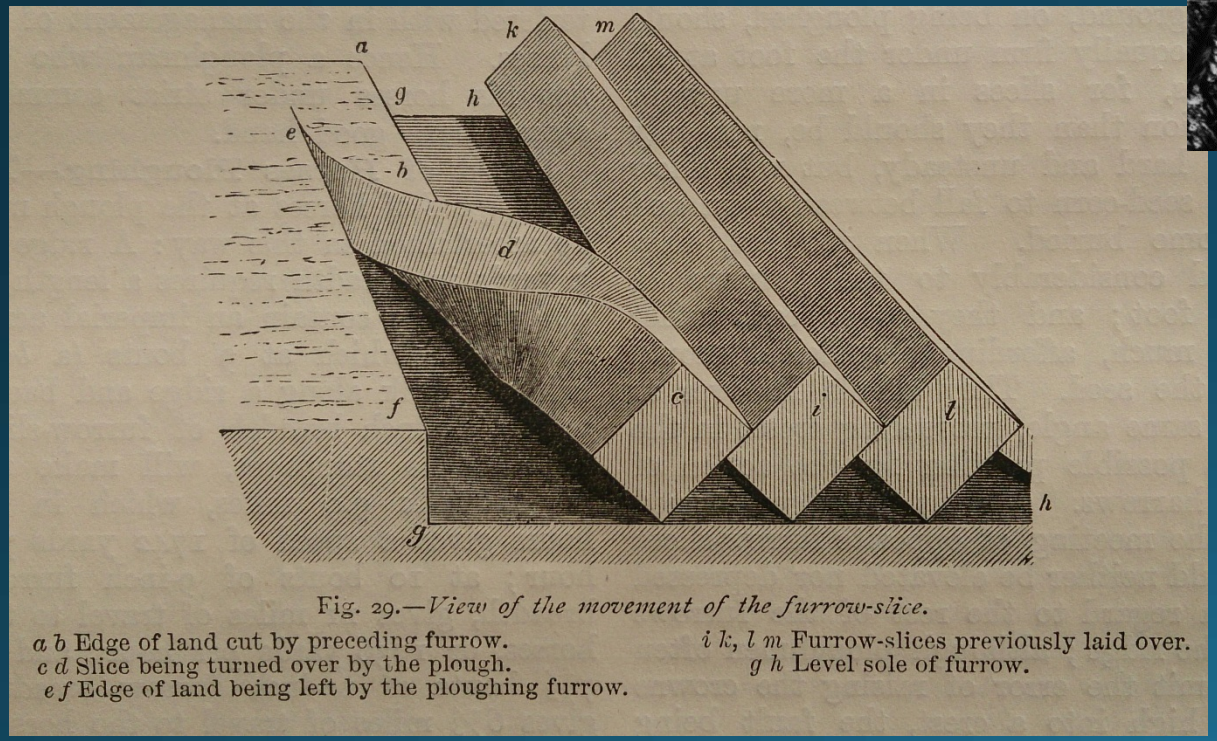


Fig. 29.—*View of the movement of the furrow-slice.*

a b Edge of land cut by preceding furrow.
c d Slice being turned over by the plough.
e f Edge of land being left by the ploughing furrow.
i k, *l m* Furrow-slices previously laid over.
g h Level sole of furrow.

gressenhallfw.wordpress.com

Oklahoma Conservation Commission (www.ok.gov)

Moldboard Plow – Inversion (some mixing)

Marlon Winger-NRCS

STIR = 65

Moldboard Plow – Inversion (some mixing)

Marlon Winger-NRCS

STIR = 65

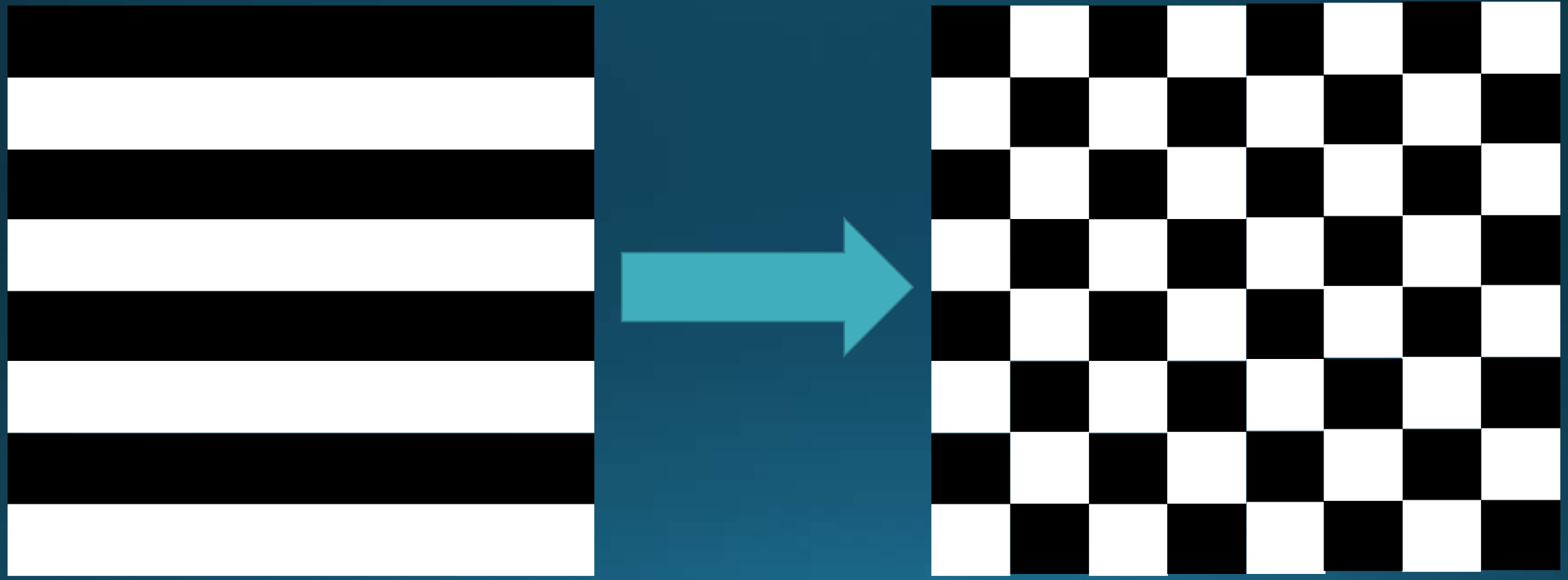
www.instructables.com from You Tube

Inversion (some mixing)

Examples in RUSLE2

- Bulldozer, clearing/cutting
- Plow, moldboard
- Plow, moldboard 10 inch depth
- Plow, moldboard 6-7 inch depth

Mixing



Rototiller-Mixing

STIR = 18

www.deere.com

Rototiller-Mixing

www.deere.com

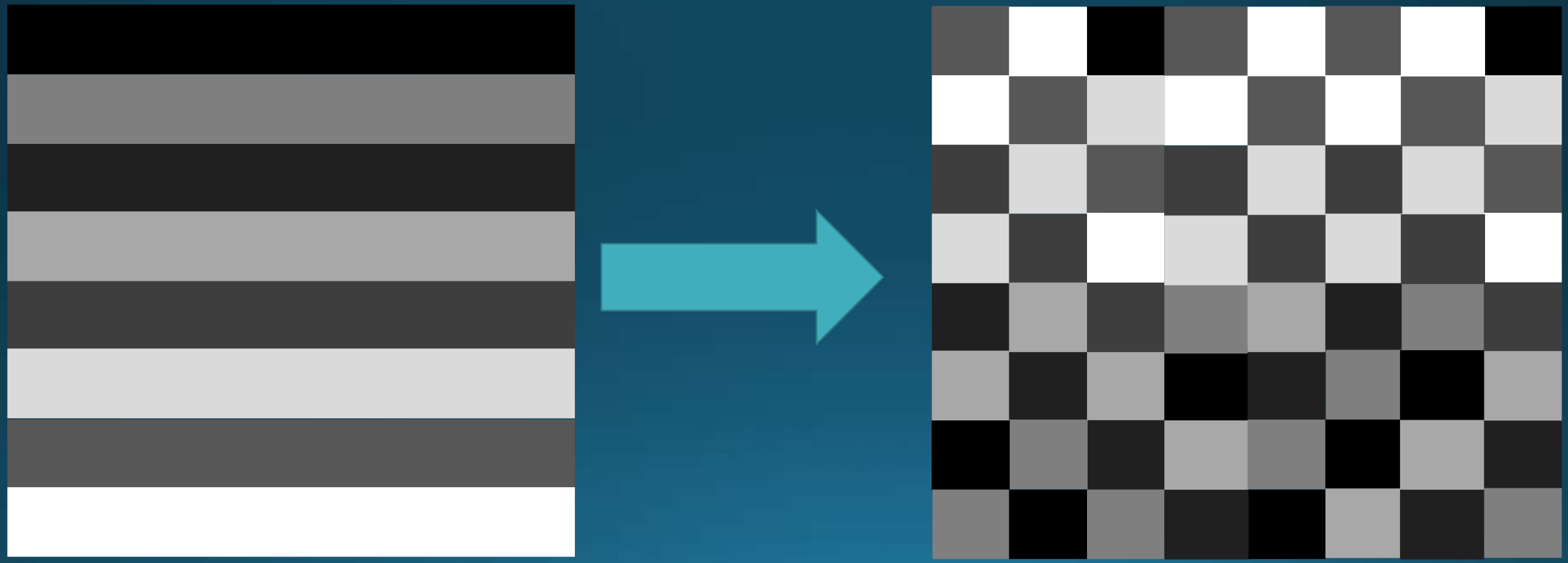
STIR = 18

Mixing

Examples in RUSLE2

- Harrow, rolling
- Harrow, rotary
- Harrow, rotary, light, fluff fragile residue
- Harvest, sprig rototiller digger
- Residue, row cleaner
- Rodweeder
- Rolling basket incorporator
- Rototiller, field
- Rototiller, field, add residue
- Rototiller, on beds
- Rototiller, row cult add residue
- Rototiller, row cultivator
- Subsoiler, in row strip conditioner
- Subsoiler, in row strip conditioner, 40 in row

Mixing and some Inversion



Tandem Disc- Mixing with Inversion

STIR = 39

Marlon Winger-NRCS

Tandem Disc-Mixing with Inversion

Marlon Winger-NRCS

STIR = 39

Case IH

Agriculture Belgrade

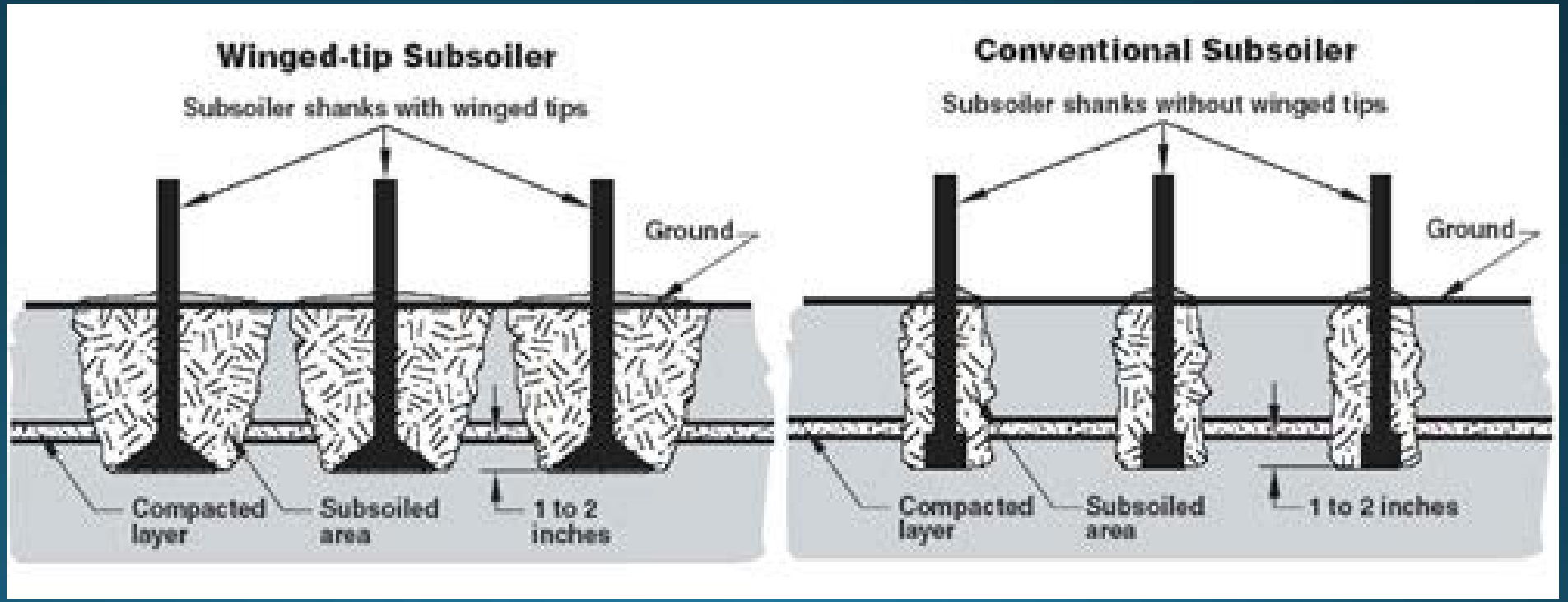
Mixing and some Inversion

Examples in RUSLE2

Many Operations Including:

- Chisels
- Cultivators
- Disks
- Drills
- Planters
- Etc.

Lifting and Fracturing



USDA-FS

Subsoiler / Ripper-Lifting and Fracturing

STIR = 33

Marlon Winger-NRCS

Subsoiler / Ripper-Lifting and Fracturing

Marlon Winger-NRCS

STIR = 33

Dave Koening Enterprises Inc.

Lifting and Fracturing

Examples in RUSLE2

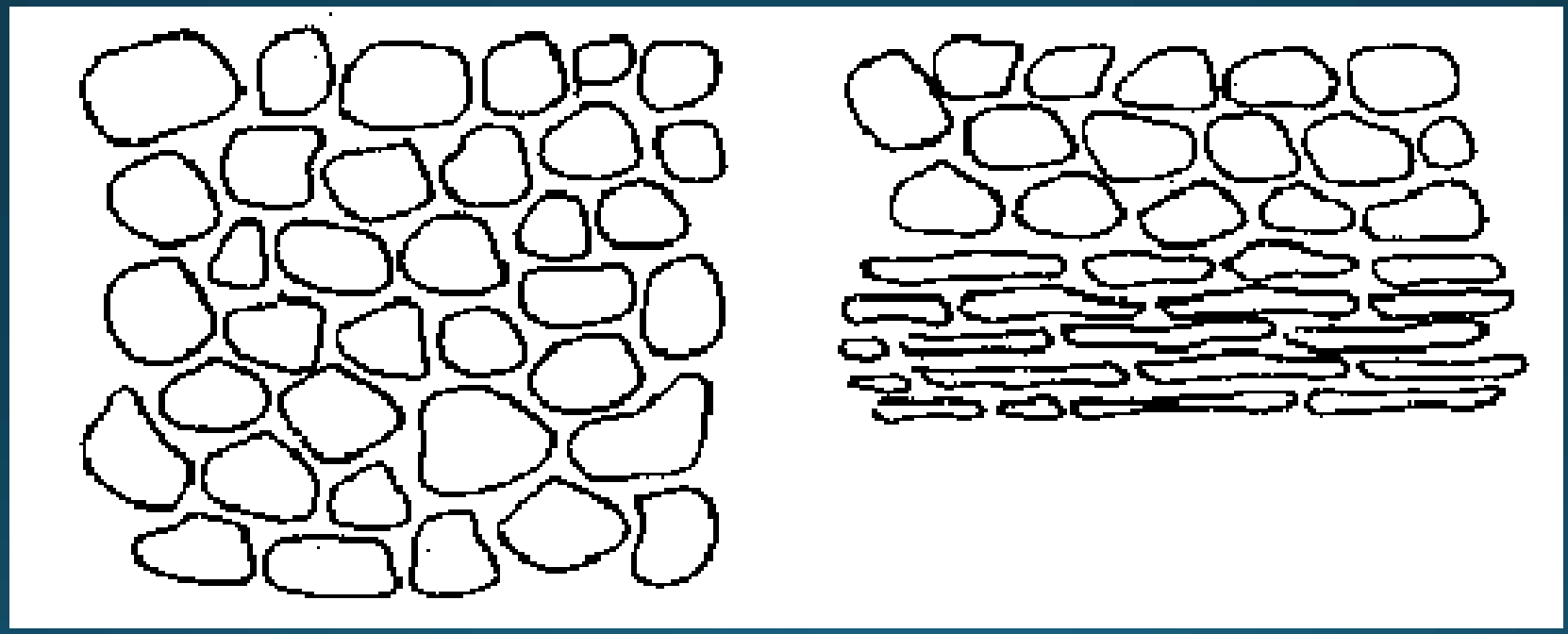
Several Operations Including:

- Hoe Drills
- Fertilizer Applicators
- Manure Injectors
- Subsoilers
- Sweep Plows
- Etc.

Compression

Loose Soil

Compacted Soil



www.dpi.nsw.gov.au

Roller-Compression

nwdistrict.ifas.ufl.edu

STIR = 0.098

www.extension.umn.edu

STIR = 0.98

Roller-Compression

STIR = 0.098

nwdistrict.ifas.ufl.edu

www.extension.umn.edu

STIR = 0.98

www.agshield.com

www.uworganic.wisc.edu

Compression

Examples in RUSLE2

Many Operations Including:

- "Graze" operations
- Manure Spreaders
- Rollers

Combo-Operations

STIR ≈ 20

www.summersmfg.com

www.kuhnnorthamerica.com

STIR ≈ 20

Combo-Operations

Examples in RUSLE2

Many Operations Including:

- Seedbed conditioners
- Seedbed finishers
- Some Chisels with harrows
- Some Cultivators with harrows
- Some Disks with rollers

Tillage Systems

- Conventional Corn-Soybean
- Reduced Till Corn-Soybean
- No-Till Corn-Soybean

Tillage Systems

Conventional Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
11/1/2001	Fert applic. surface broadcast		
11/1/2001	Plow, moldboard		
5/1/2002	disk, tandem light finishing		
5/5/2002	Cultivator, field 6-12 in sweeps		
5/5/2002	Sprayer, pre-emergence		
5/5/2002	planter, double disk opnr	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
11/1/2002	Plow, moldboard		
5/5/2003	disk, tandem light finishing		
5/10/2003	Cultivator, field 6-12 in sweeps		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or airseeder, double disk	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/5/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 231 Avg. Annual STIR = 115.5

Tillage Systems

Conventional Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
11/1/2001	Fert applic. surface broadcast		
11/1/2001	Plow, moldboard		
5/1/2002	disk, tandem light finishing		
5/5/2002	Cultivator, field 6-12 in sweeps		
5/5/2002	Sprayer, pre-emergence		
5/5/2002	planter, double disk opnr	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
11/1/2002	Plow, moldboard		
5/5/2003	disk, tandem light finishing		
5/10/2003	Cultivator, field 6-12 in sweeps		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or airseeder, double disk	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/5/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 231 Avg. Annual STIR = 115.5

Reduced -Till Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
4/28/2002	Fert applic. surface broadcast		
5/1/2002	Cultivator, field 6-12 in sweeps		
5/1/2002	Sprayer, pre-emergence		
5/1/2002	planter, double disk opnr	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
11/1/2002	Chisel, st. pt.		
5/5/2003	Cultivator, field 6-12 in sweeps		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or airseeder, double disk	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/10/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 107 Avg. Annual STIR = 53.7

Tillage Systems

Conventional Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
11/1/2001	Fert applic. surface broadcast		
11/1/2001	Plow, moldboard		
5/1/2002	disk, tandem light finishing		
5/5/2002	Cultivator, field 6-12 in sweeps		
5/5/2002	Sprayer, pre-emergence		
5/5/2002	planter, double disk opnr	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
11/1/2002	Plow, moldboard		
5/5/2003	disk, tandem light finishing		
5/10/2003	Cultivator, field 6-12 in sweeps		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or airseeder, double disk	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/5/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 231 Avg. Annual STIR = 115.5

Reduced -Till Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
4/28/2002	Fert applic. surface broadcast		
5/1/2002	Cultivator, field 6-12 in sweeps		
5/1/2002	Sprayer, pre-emergence		
5/1/2002	planter, double disk opnr	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
11/1/2002	Chisel, st. pt.		
5/5/2003	Cultivator, field 6-12 in sweeps		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or airseeder, double disk	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/10/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 107 Avg. Annual STIR = 53.7

No -Till Corn-Soybean Rotation

Date, m/d/y	Operation	Vegetation	Yield (bu/ac)
11/1/2001	Fert applic. surface broadcast		
5/1/2002	Sprayer, pre-emergence		
5/1/2002	Planter, double disk opnr w/fluted coulter	Corn, grain	140
6/7/2002	Sprayer, post emergence and fert. tank mix		
10/20/2002	Harvest, killing crop 50pct standing stubble		
5/10/2003	Sprayer, pre-emergence		
5/10/2003	Drill or air seeder single disk openers 7-10 in spac.	Soybean, mw 7in rows	40
6/7/2003	Sprayer, post emergence		
8/1/2003	Sprayer, insecticide post emergence		
10/10/2003	Harvest, killing crop 20pct standing stubble		

Management STIR = 6.08 Avg. Annual STIR = 3.04

Tillage Systems – Erosion Impacts

Description	Contouring	Contour Buffer Strips	Conservation Planning Soil Loss, t/ac/yr	Soil Conditioning Index (SCI)	SCI OM subfactor	Average Annual STIR value	Fuel cost, US$/ac *
Plowed rotation	rows up-and-down hill	(none)	12.7	-0.79	0.18	115	$26.70
Reduced tillage rotation	rows up-and-down hill	(none)	5.95	0.013	0.24	53.7	$17.90
No-till rotation	rows up-and-down hill	(none)	0.707	0.67	0.36	3.04	$11.90

* based on $2.50/gallon of diesel.

Tillage Systems – Erosion Impacts

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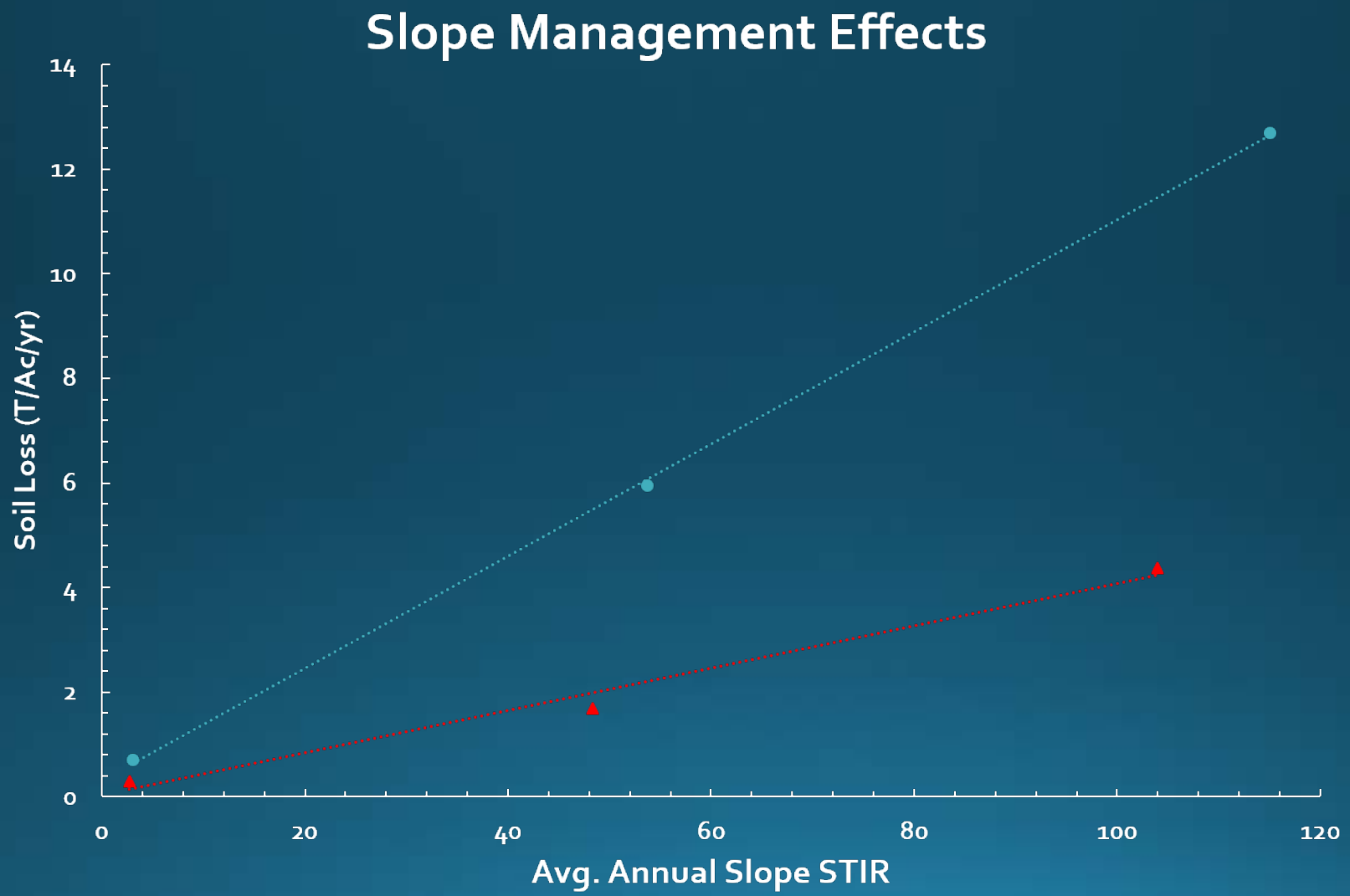
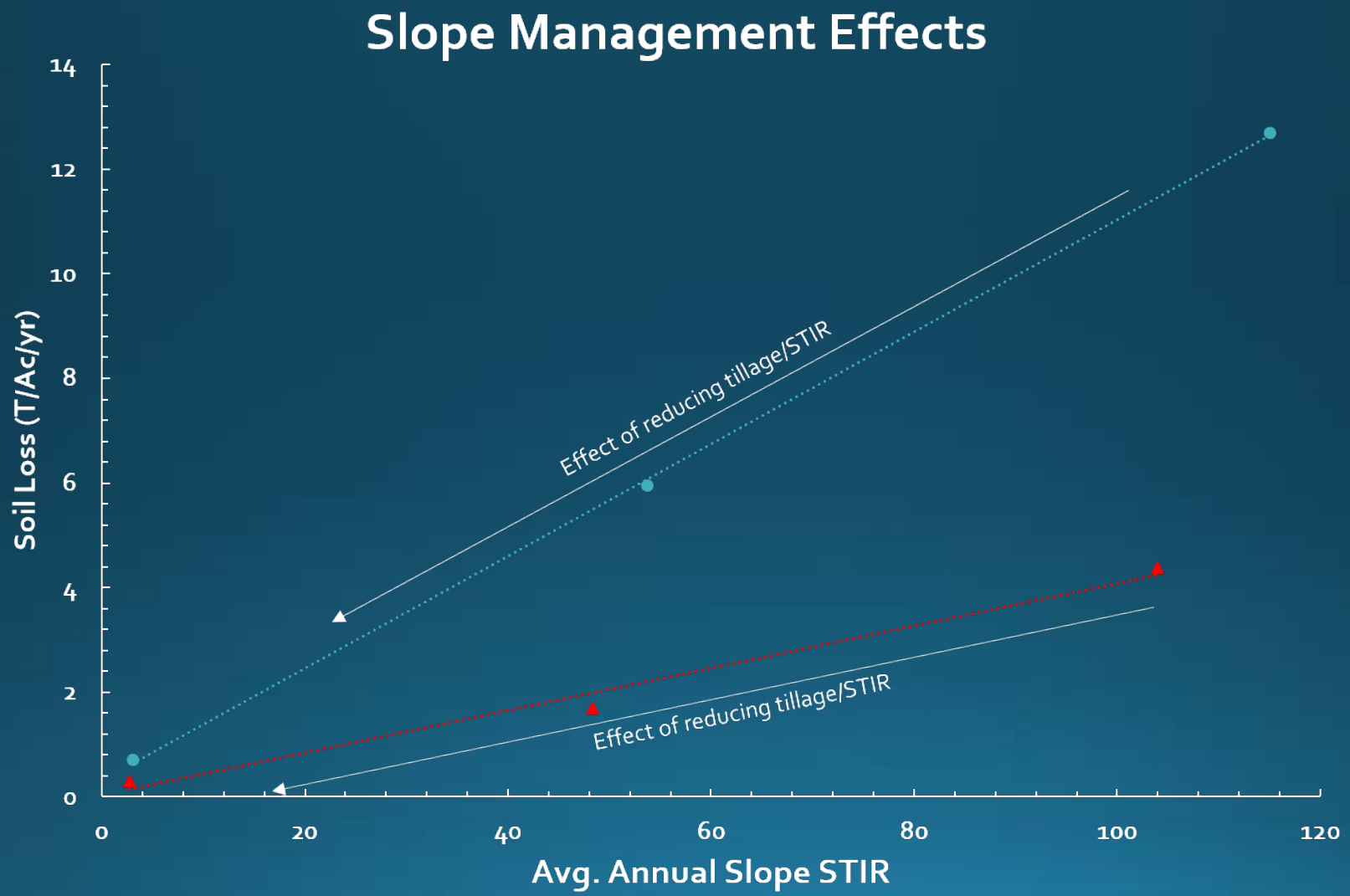
Reduced tillage rotation	rows up-and-down hill	(none)	5.95	0.013	0.24	53.7	$17.90
No-till rotation	rows up-and-down hill	(none)	0.707	0.67	0.36	3.04	$11.90
Plowed rotation + cont + midslope buffer	perfect contouring no row grade	One 15 feet wide Tall fescue buffer midslope	4.37	-0.11	0.39	104	$24.00
Reduced tillage rotation +cont + midslope buffer	perfect contouring no row grade	One 15 feet wide Tall fescue buffer midslope	1.69	0.41	0.43	48.3	$16.10
No-till rotation + cont + midslope buffer	perfect contouring no row grade	One 15 feet wide Tall fescue buffer midslope	0.297	0.78	0.54	2.73	$10.70

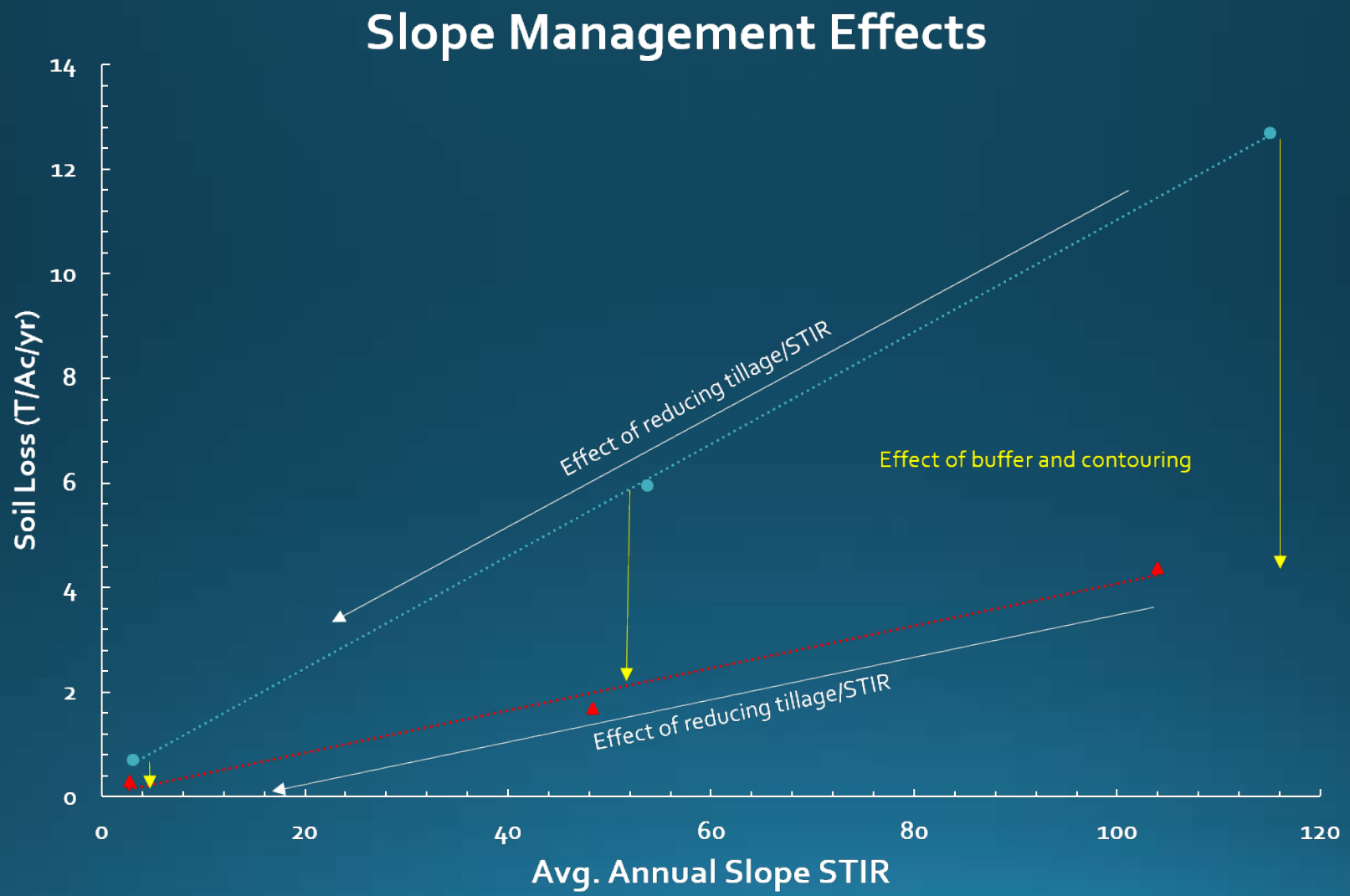
Tillage Systems – Erosion Impacts



Tillage Systems – Erosion Impacts



Tillage Systems – Erosion Impacts



Tillage Systems – Economics

We saw:

Description	Fuel cost, US$/ac
Plowed rotation	$26.70
Reduced tillage rotation	$17.90
No-till rotation	$11.90
Plowed rotation + cont + midslope buffer	$24.00
Reduced tillage rotation +cont + midslope buffer	$16.10
No-till rotation + cont + midslope buffer	$10.70

But, what else needs to be considered?

Tillage Systems – Economics

Additional Costs and Consideration:

Tillage Systems – Economics

Additional Costs and Consideration:

Capital

- Additional field equipment required including no-till drill and spray rig.
- Increase in pesticide use (substitute tillage with chemical pest control).
- Annual operation, maintenance and replacement costs of new field equipment.

Tillage Systems – Economics

Additional Costs and Consideration:

Capital

- Additional field equipment required including no-till drill and spray rig.
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Management

- Increase management costs in developing crop, nutrient, pest plans and learning to operate the new equipment (especially the first years).

Tillage Systems – Economics

Additional Costs and Consideration:

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- Additional field equipment required including no-till drill and spray rig.
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Management

- Increase management costs in developing crop, nutrient, pest plans and learning to operate the new equipment (especially the first years).

Risk

- Reduced flexibility when tillage is not available as a management option.
- High residue on cold and wet soils may delay crop emergence and early growth.

Let's Review

Impacts of Farming Implements on the Soil

- Identified the types of soil disturbance
- Saw examples of farm implements that demonstrate specific types of soil disturbance

Looked at different Corn-Bean tillage systems

- "Conventional" tillage system
- "Reduced" tillage system (CPS 345)
- "No-Till" system (CPS 329)

Explored Economics

- Fuel/Energy consumption
- Other consideration

QUESTIONS?

Thank you!

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