Using RUSLE2 to Evaluate Soil Health Planning Principles

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Soil Health
Planning Principles

1. Manage more by Disturbing Soil Less
2. Use Diversity of Plants to add diversity to Soil Micro-organisms
3. Grow Living Roots Throughout the year
4. Keep the Soil Covered as Much as Possible

- Manage erosion & compaction
- Goal: To create the most favorable habitat possible for the soil food web

Erosion Control = Soil Health (in many ways)

RUSLE 2 Outputs

- **Erosion rate/sediment delivery**
- **Soil Conditioning Index (SOM trends)**
- **STIR (disturbance rating)**
- Fuel/energy use
- Grazing tool (future)

Field Office User

Selects –

1. Location (climate)
2. Soil map unit component
3. Slope length and steepness
4. Crop Management (Use Rotation Builder to develop rotation)
5. Supporting Practices

RUSLE2 Version 1.26.6.4 (Nov 13 2006) - [Profile: otoemonona]

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Auto update

STEP 1: Choose location to set climate: Location USA\Nebraska\Otoe County

STEP 2: Choose soil type: Soil ...raska Soils\Otoe County, Nebraska\8075 Monona silt loam, 2 to 6 percent slopes\Monona silt loam 100%

STEP 3: Set slope topography: Slope length (along slope), ft 150 Avg. slope steepness, 6.0

STEP 4a: Select base management Base management CMZ 16\c.Other Local Mgt Records\Corn NT w/NH3 - Soybeans NT Dbl Disk Openers- Wheat NT

STEP 4b: Modify/build man. sequence if desired:

Management sequence

Man. +	Man. -	Management	Starting date, m/d/y	Ending date, m/d/y	Correct dates by:
1		...6\c.Other Local Mgt Records\Corn NT w/NH3 - Soybeans NT Dbl Disk Openers- Wheat NT	4/20/2	8/1/4	===>

STEP 4c: adjust management inputs if desired:

Adjust yields	open
General yield level	Base yield
Adjust res. burial level	Normal res. burial
Adjust ext. res. addition	Residue inputs
Rock cover, %	0

Fuel type for entire run	(none)
Energy use for entire simulation, BT	1000000
Equiv. diesel use for entire simulatio	7.4
Fuel cost for entire simulation, US$/	22

Apply rot. builder manage. sequence to erosion calc. Apply

Save temp. management as permanent Save

STEP 5: Set supporting practices:

Contouring a. rows up-and-down hill

Actual row grade, % 6.0

Crit. slope length, ft

Strips/barriers (none)

Diversion/terrace, sediment basin (none)

Subsurface drainage (none)

Yrs offset from start year

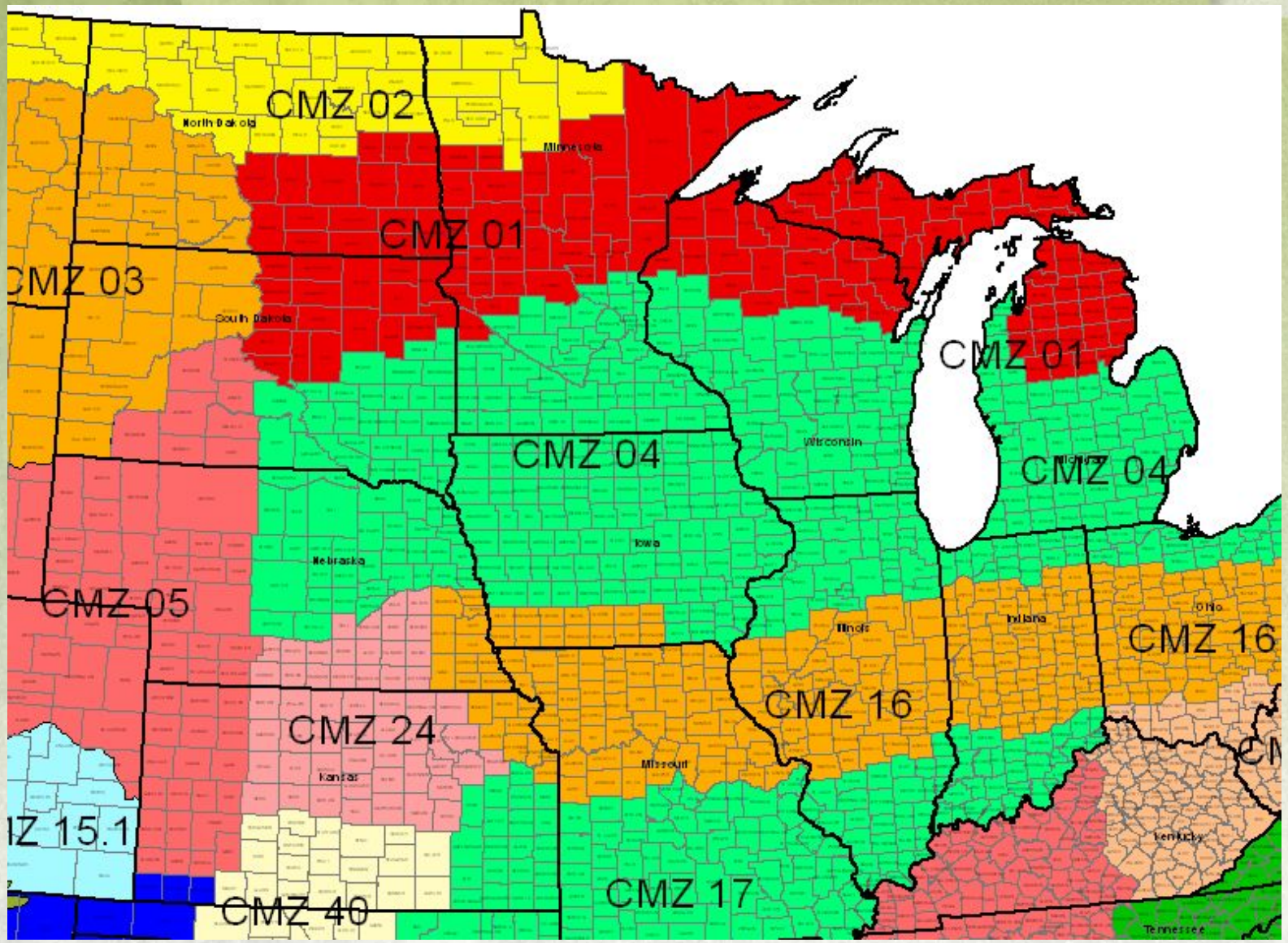
Segment +	Segment -	Yrs offset from start year, yr
1		0

Results | Additional Results | Track Residue and Canopy

Soil loss for cons. plan, t/ac/yr	1.2
T value, t/ac/yr	5.0
Surf. res. cov. values	open
Soil conditioning index	Soil conditioning index

Info

RUSLE2 CMZ Map



Crop Mgt Sequence (Operations & Vegetation)

RUSLE2 Version 1.26.6.4 (Nov 13 2006) - [Management: CMZ16\c.Other Local Mgt Records\Corn NT w/NH3 - Soybeans NT Dbl Disk Openers- Wheat NT]

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Auto update

Graphic

Rel. row grade, % 100

Long-term natural rough., in. 0.24

Normally used as a rotation? Yes

Duration, yr 3

Add to this management to make new one Open

View/edit rotation builder used to make this management open

Irrigation system no irrigation

Fuel for all operations default

Base equiv. diesel use, 7.4

Base energy use , BTU 1000000

Base fuel cost, US$/ac 22

erations | Info

Management Operations

Date, m/d/y	Operation	Vegetation	Yield (# harv. units)	Max. canopy, %	Type of cover material	Cover from addition, %	Cover matl add/remove, lb/ac	Standing res. added by op. desc., lb/ac	Fuel used this operation
4/20/2	Fert. applic. anhyd knife 30 in								...ault
4/27/2	Sprayer, kill crop					3.5	60.000		...ault
5/5/2	Planter, double disk opnr w/fluted coulter	Corn, grain	140						...ault
10/20/2	Harvest, killing crop 50pct standing stubble					77	3856.8		...ault
5/10/3	Drill or airseeder, double disk, w/ fluted coulters	Soybean, mw 7in rows	40.0						...ault
10/5/3	Harvest, killing crop 20pct standing stubble					48	1096.9		...ault
10/11/3	Drill or airseeder, double disk, w/ fluted coulters	Wheat, winter 7in rows	75.0						...ault
7/1/4	Harvest, killing crop 50pct standing stubble					88	3527.5		...ault
8/1/4	Drill or airseeder, double disk, w/ fluted coulters	Vetch, hairy, Midwest	1200						...ault

Comparing SHMSs in Worksheet View

RUSLE2 Version 1.26.6.4 (Nov 13 2006) - [Worksheet: webinar*]

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Owner name: **Owner name**
Tract #: **Tract number**
Field name: **Field number**
Info

Compare management alternatives for a single hillslope profile

Location: USA\Nebraska\Otoe County
Soil: ...raska Soils\Otoe County, Nebraska\8075 Monona silt loam, 2 to 6 percent slopes\Monona silt loam 100%
T value, t/ac/yr: 5.0
Slope length (along slo: 150
Avg. slope steepness,: 6.0

Management alternative table

Temp. sce + -	Show in summary?	Description	Management	Yield values	Residue values	Contouring	Diversion/terrace, sediment basin	Strips / barriers	Rock cover, %	Cons. plan. soil loss,	Cover values	Soil conditionin	Soil conditionin	STIR value	Wind & irrigation-in	Fuel type	Equiv. diesel use,	Fuel cost, US$/ac
Profile	Yes	Corn Soybean No-Till w/ Anhydrous and Rye Cover Crop	...ans NT Dbl Disk OpenerwCC	Yields	... inputs	default	(none)	(none)	0	0.96	... cover	... index	0.610	4.69	0	(none)	4.4	13
Profile	Yes	Corn Soybean No-Till	...oybeans NT Dbl Disk Opener	Yields	... inputs	default	(none)	(none)	0	1.5	... cover	... index	0.510	3.89	0	(none)	4.8	14
Profile	Yes	Corn Soybean Wheat/Hairy Vetch Cover Crop	...Dbl Disk Openers-Wheat NT	Yields	... inputs	default	(none)	(none)	0	1.2	... cover	... index	0.663	9.03	0	(none)	7.4	22

Soil Health Principle 1

Manage More by Disturbing Soil Less

- Three Types of Disturbance
  - Physical (tillage, planting, fertilizer injection, harvesting & other operations)
  - Chemical (Fertilizer)
  - Biological (overgrazing)

Intensive tillage “butchers the biology” in the soil. It cuts, slices, and dices the soil and blend’s, mixes, and inverts the soil creating havoc for the soil biology (fauna).

CO_2 loss

CO_2 loss

Before Primary Tillage

After Primary Tillage

After Secondary Tillage

Manage More by Disturbing Soil Less

- Physical (Tillage)
  - Operations database (contains all types of equipment)
  - STIR
- Biological/Physical
  - Impact of flattened residue vs. standing (decomposition of flat residue vs. standing)
  - Impact of type of residue (C:N ratio affects decomposition)
  - Impact of climate on decomposition

Disturbance Continued

- Chemical Disturbance (pesticides. Fertilizer)
  - RUSLE 2 does not evaluate chemical disturbance (only field operation disturbance)
- Biological
  - Grazing removal of biomass
  - Impacts of grazing or termination on root systems and biomass

STIR - Soil Tillage Intensity Rating

- STIR models the amount of physical disturbance from tillage/planting/fertilizer

1. Operational speed of tillage equipment
2. Tillage type
3. Depth of tillage operation
4. Percent of the soil surface area disturbed (includes soil splash)

Table 2 Soil Tillage Intensity Ratings (STIR)

	B	C	D	F	G	H	
1	name	Recommended Operating Speed (MPH)	Tillage Type	Recommended tillage depth (inches)	Surface area disturbed (decimal)	Soil Tillage Intensity Rating	
48	Disk, tandem light finishing	5.0	0.8	3.0	1	19.50	
49	Disk, tandem secondary op.	5.0	0.8	5.0	1	32.50	
50	Do all	5.0	0.8	4.0	1	26.00	
51	Do all, on beds	5.0	0.8	3.0	0.8	15.60	
52	Drill or air seeder single disk openers 7-10 in spac.	5.0	0.8	2.5	**0.15**	2.44	CC
53	Drill or air seeder single disk openers, + fert. opnrs 7-1	5.0	0.8	2.5	0.35	5.69	
54	Drill or air seeder tee slot openers 7-10 in spac.	5.0	0.8	2.0	0.15	1.95	
55	Drill or air seeder, hoe opener in hvy residue	5.0	0.8	4.0	0.65	16.90	
56	Drill or air seeder, hoe/chisel openers 12-15 in spac.	5.0	0.8	4.0	0.8	20.80	
57	Drill or air seeder, hoe/chisel openers 6-12 in spac.	5.0	0.8	4.0	**0.9**	23.40	CC
58	Drill or airseeder, dble disk opnr w/ fluted coult 5x10 p	5.0	0.8	2.5	0.75	12.19	
59	Drill or airseeder, double disk	5.0	0.8	1.5	0.65	6.34	
60	Drill or airseeder, double disk opener, w/ fert openers	5.0	0.8	2.5	0.85	13.81	
61	Drill or airseeder, double disk, w/ fluted coulters	5.0	0.8	2.0	0.55	7.15	
62	Drill or airseeder, offset double disk openers	5.0	0.8	2.5	0.3	4.88	
63	Drill, air seeder, sweep or band opener	5.0	0.8	2.5	0.6	9.75	
64	Drill, deep furrow 12 to 18 in spacing	5.0	0.8	4.0	**0.9**	23.40	CC
65	Drill, double disk, 7-8" packer C	5.0	0.8	2.0	**0.85**	11.05	CC
66	Drill, heavy, direct seed, dbl disk opnr	5.0	0.8	3.0	**0.85**	16.58	CC
67	Drill, heavy, direct seed, dbl disk opnr w/row cleaners	5.0	0.8	3.0	0.9	17.55	
68	Drill, range	4.0	0.8	2.0	0.6	6.24	
69	Drill, semi-deep furrow 12 to 18 in spacing	5.0	0.8	4.0	0.85	22.10	

Example

Example: *2Year Rotation*

CROP	OPERATION	STIR
	Chisel, straight point	45.50
	Disk, tandem secondary operation	32.50
	Disk, tandem light finishing	19.50
Corn, grain	Planter, double disk opener w/fluted coulter	2.43
	Harvest, killing crop	0.15
Soybean	Drill	2.43
	Harvest, killing crop	0.15
	Your Soil Tillage Intensity Rating (STIR) is:	**51.33**

CASE INTERNATIONAL

Stalk Slicer Values

!!!YOU MUST CANCEL OR CLOSE THIS MODAL WINDOW BEFORE MOVING TO ANOTHER WINDOW!!!

Tillage type	Mixing + some inversion
Tillage intensity, fraction	0.40
Rec. till. depth, in.	1.5
Min till depth, in.	1.0
Max till depth, in.	2.5
Ridge height, in.	0.50
Initial roughness, in.	0.40
Final roughness, in.	0.24
Surf. area disturbed, %	40

Apply | Apply/Close | Cancel

Residue burial ratios (by mass)

Residue type	Burial ratio, fraction	Resurfacing, fraction
fragile-very small (soybeans)	0.053	0.0100
mod. tough-short (wheat)	0.038	0.0100
non-fragile-med. (corn)	0.030	0.0100
woody-large	0.015	0.0200
gravel-rock	0.030	0.0100

Operation:

Rec. spe

Min spe

Max spe

Operati

Diesel use per

Sequenc

Sequence of Processes

Process: Flatten standing res.

Process: Disturb surface

View/edit Operation Builder used to make this op

Add to this operation to make new one

Disturbance "Operations" in RUSLE2

- Burial rate +/- 30% for operation (profile view)
- Speed
  - RUSLE2 computes how speed of an implement affects residue burial
  - Recommended speed of each implement (manufacturers recommendation)
  - Speed between the range of a minimum and maximum can be entered (management view)
- Additional processes accounted for operations (disturbance)
  - Kill vegetation
  - Flatten standing residues
  - Begin growth
  - Harvest

Drill Single Disk openers
Effect on Standing Residue (No-Till)

RUSLE2 Version 1.26.6.4 (Nov 13 2006) - [Resi

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Residue type	Flattening, fraction
fragile-very small (soybeans)	0.30
mod. tough-short (wheat)	0.25
non-fragile-med. (corn)	0.15
woody-large	0.10

Biological Disturbance (overgrazing vs. proper grazing)

Grazing Disturbance

RUSLE2 Version 1.26.6.4 (Nov 13 2006) - [Management: CMZ 16\c.Other Local Mgt Records\Corn No Till w NH3 - Soybeans NT Dbl Disk OpenerwCC*

File Database Edit View Options Tools Window Help

Auto update

Graphic
Rel. row grade, % 100

Long-term natural rough., in. 0.24
Normally used as a rotation? Yes
Duration, yr 2

Base equiv. diesel use, 4.4
Base energy use , BTU 610000
Base fuel cost, US$/ac 13
Fuel for all operations default

Add to this management to make new one Open

Irrigation system no irrigation

View/edit rotation builder used to make this management open

Operations | Info

Management Operations

Date, m/d/y	Operation	Vegetation	Yield (# harv. units)	Type of cover material	Cover matl add/remove, lb/ac	Cover from addition, %	Fuel used this operation
5/5/2	Planter, double disk opnr w/fluted coulter	Corn, grain	140				...ault
10/20/2	Harvest, killing crop 50pct standing stubble				3900	77	...ault
5/10/3	...ir seeder single disk openers 7-10 in spac.	Soybean, mw 7in rows	20.0				...ault
10/5/3	Harvest, killing crop 20pct standing stubble				580	29	...ault
10/6/3	Graze, stubble or residue 50 pct						...ault
10/6/3		Rye, winter cover	2240				...ault
4/21/4					46	2.7	...ault

Graze, continuous overgrazing
Graze, continuous, heavy hoof traffic
Graze, continuous, light hoof traffic
Graze, continuous, moderate hoof traffic
Graze, intensive rotational
Graze, rotational
Graze, stubble or residue
Graze, stubble or residue 25 pct
Graze, stubble or residue 50 pct
Graze, stubble or residue 75 pct

Grazing disturbance in RUSLE2

- Aftermath grazing
- Grazing of annual forages (biomass removal)
- Grazing of perennial forages(biomass removal)
- Reduces canopy/height
- Impact on root systems/regrowth of vegetation
- Used to terminate annual cover
- Forage balance (grazing tool)

Increase Diversity in a Crop Rotation

- Lengthen the rotation by adding more crops
  - Increases soil organic matter
  - Breaks pest cycles
  - Improves nutrient utilization and availability
  - Utilize available water deeper in the soil profile
  - Provide windows for management
    - Spread manure
    - Plant & harvest crops
- Add more plants in the current crop rotation
  - Utilize cover crops during non-cropping part of the year

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Change Database

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  - climates
  - contour-systems
  - deep-soil-drain-systems
  - erosivities
  - fuels
  - hydraulic-element-flow-paths
  - hydraulic-element-systems
  - hydraulic-elements
  - irrigation-systems
  - managements
  - operations
  - plans
  - profiles
  - residues
  - soils
  - strip-barrier-systems
  - structures-barriers
  - vegetations
  - worksheets

Name	Modified
Alfalfa brome /oat silage, harv to yr2 1st cut	12/19/2006 02
Alfalfa brome /oat silage, spring seed	06/16/2005 08
Alfalfa brome /oat, seed	03/19/2002 08
Alfalfa brome /oat, harv to yr2 1st cut	12/19/2006 02
Alfalfa brome, fall seed senes to yr2 regrowth	12/19/2006 02
Alfalfa brome, spring seed	12/19/2006 02
Alfalfa brome, spring seed regrowth after cut	12/19/2006 02
Alfalfa brome, spring seed senes to y2 regrowth	12/19/2006 02
Alfalfa brome, spring seed senes winter graze to y2 regrowth	12/19/2006 02
Alfalfa brome, yr2 regrowth after cut	12/19/2006 02
Alfalfa brome, yr2 senes to yr3 regrowth	12/19/2006 02
Alfalfa brome, yr2 senes winter graze to yr3 regrowth	12/19/2006 02
Alfalfa brome, yr3 regrowth after cut	12/19/2006 02
Alfalfa brome, yr3 senes to yr4 regrowth	12/19/2006 02
Alfalfa brome, yr3 senes winter graze to yr4 regrowth	12/19/2006 02
Alfalfa seed nw, fall plant senes to yr2 clipback	02/12/2008 11
Alfalfa seed nw, spring plant	12/19/2006 02
Alfalfa seed nw, yr2 regrowth after clipback	02/12/2008 11
Alfalfa seed nw, yr2 senes to yr3 regrowth	12/19/2006 02
Alfalfa seed sw, fall plant senes to yr2 clipback	02/12/2008 11
Alfalfa seed sw, yr2 regrowth after clipback	02/19/2008 04
Alfalfa seed sw, yr2 senes to yr3 regrowth	12/19/2006 02
Alfalfa, fall seed senes to yr2 regrowth	12/19/2006 02
Alfalfa, NW fall seeding, senes to yr2 regrowth	12/19/2006 02
Alfalfa, NW spring seeding, senes to yr2 regrowth	12/19/2006 02
Alfalfa, NW yr2 regrowth after cutting	12/19/2006 02
Alfalfa, NW yr2 senes to yr3 regrowth	12/19/2006 02
Alfalfa, NW yr3 regrowth after cutting	12/19/2006 02
Alfalfa, NW yr3 senes to yr4 regrowth	12/19/2006 02

Planning Principle 2 Crop Diversity

(RUSLE2)

- Crops (perennial, annual, cover crops, double cropping)
- Planting, tillage, maturity/harvest dates
- Termination/Kill Crop (chemical, frost, tillage, grazing, etc.)
- Climate (growth & decomp.)
- Growth curves
- Major part of SCI rating

Various termination measures & Cover Crops

Cover Crop Role in Diversity

1. Allow you to look at cropping periods rather than years
2. Can be used to accelerate rejuvenating soil health
3. Getting 6 to 8 weeks of growth is adequate to get some of the “rotation” effect benefits!
4. Will increase soil biological diversity “Diversity above = diversity below”

RUSLE2 (growth curves, production, canopy)

- Plant morphology
  - Broadleaf
  - Grasses
- Plant growth habits
  - Cool season
  - Warm season

Soil Health Principle 3

Grow Living Roots Throughout the Year

Benefits:

- Increase microbial activity influences the N mineralization and immobilization
- Increase plant nutrient/vitamin uptake/ concentrations with mychorrhizal and bacteria associations
- Increase biodiversity and biomass of soil organisms
- Improve physical, chemical and biological properties
- Sequester and redeposit nutrients
- Increase Soil Org. Matter

Living Roots (RUSLE2)

- Climate (growing season, temp, precip)
- Root production (accounts for living & dead roots)
- Growth curves (includes root production at different depths)
- Termination dates (chem, tillage, frost)
- Grazing impacts

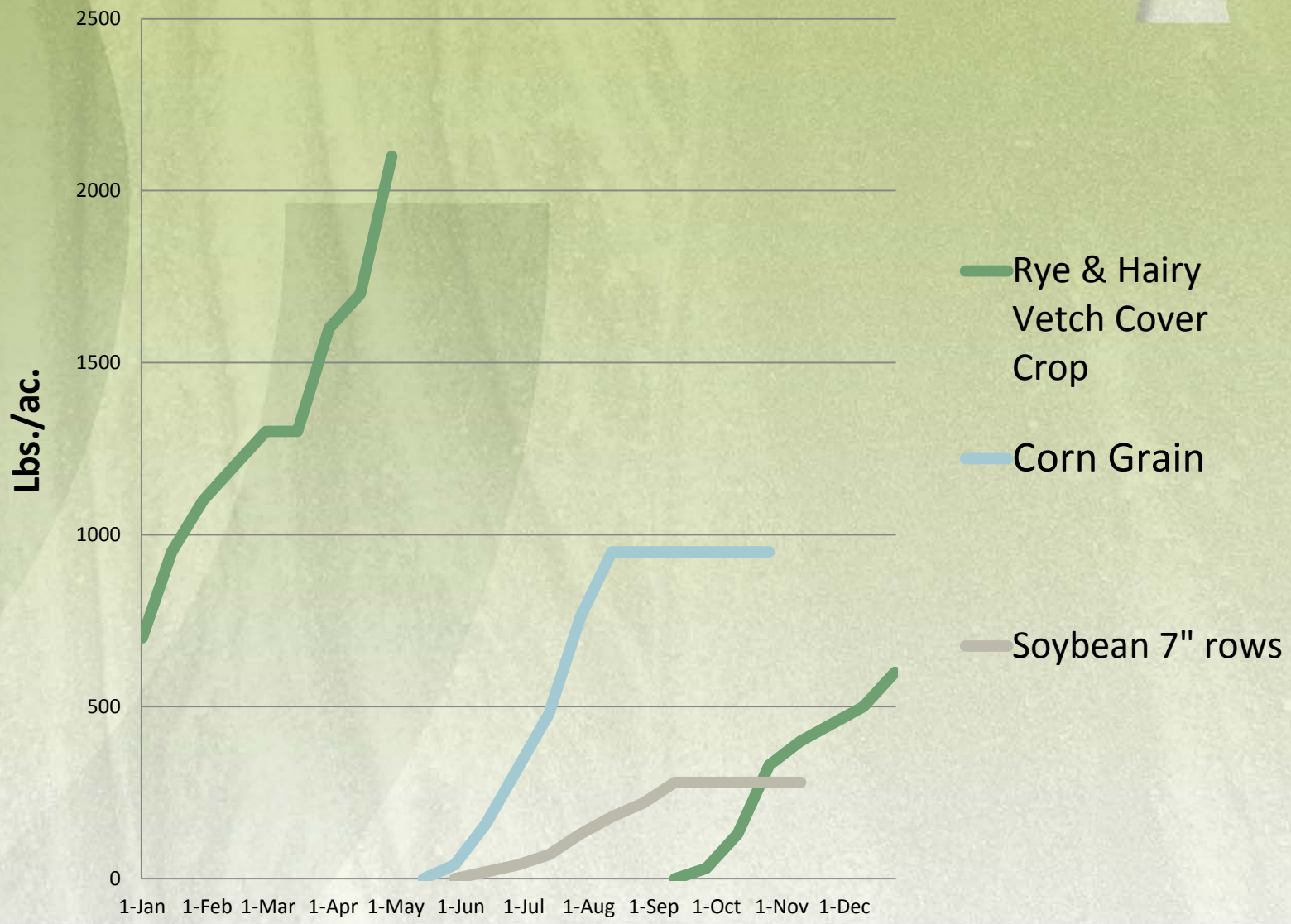
How to Keep a Living Root All Year Long with RUSLE2

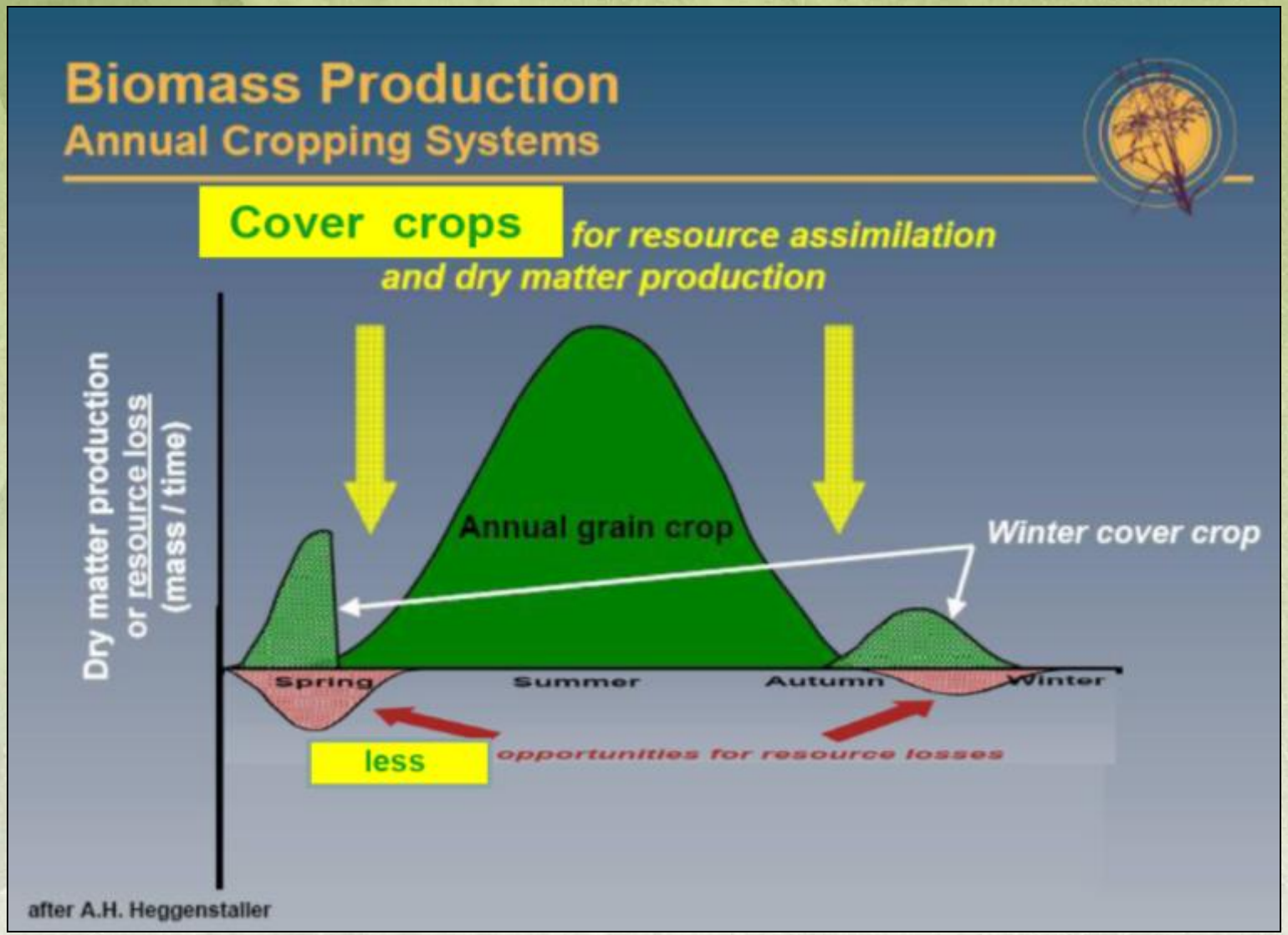
- Lengthen or intensify Rotation
  - Add Wheat
  - Double crop
- Select Shorter Season Varieties
  - Choose 100 -104 day
  - Only need 6 - 8 weeks to provide benefit
- Interseed into Growing Crops
  - Planting cover crop before harvesting of cash crop

Diversity in Root Systems

- Diversity in root systems= diversity in soil biota

Root Mass in Top 4” of Soil





A. H. Heggenstaller, University of Alberta

Hairy vetch

good fall growth

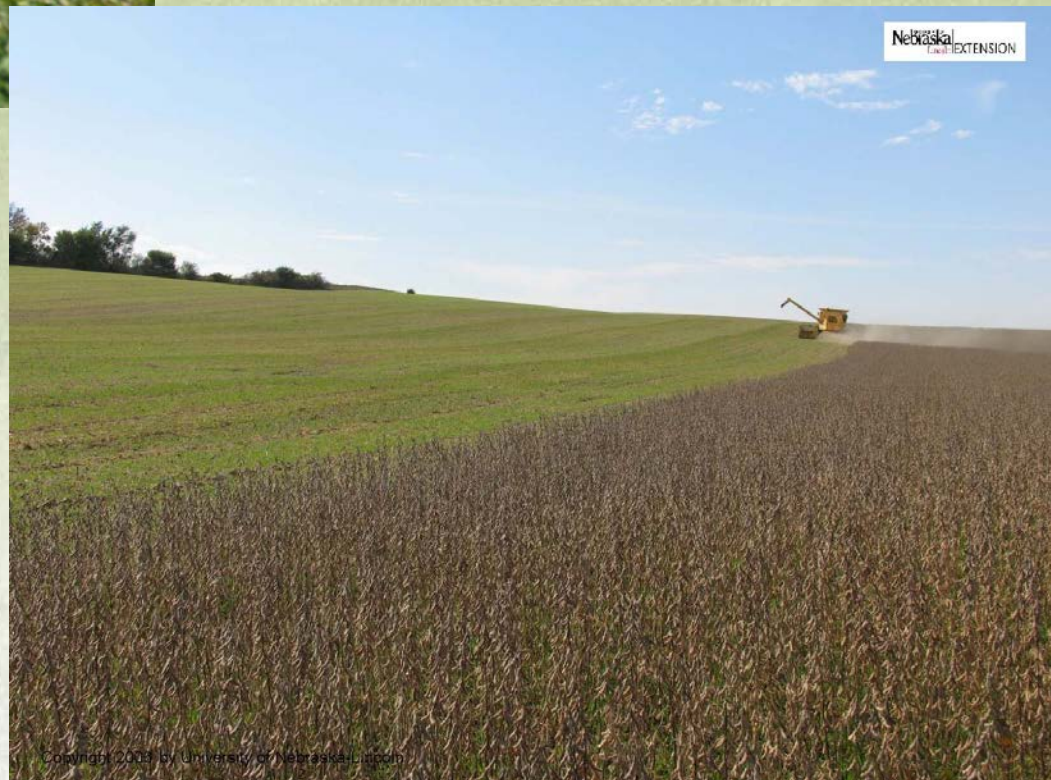
Photos 29 Oct 2003

Hairy vetch planted into corn July 17

Hairy vetch planted into bean June 29

Earlier Planting Date & Growth

Aerial Seeding



Broadcast while defoliating cotton

Seeded a multi-species cover crop mix

- Cereal rye
- Crimson clover
- Hairy Vetch

Soil Health Principle 4

Keep it Covered as Much as Possible

Benefits:

- Control Erosion
- Protect Soil Aggregates
- Suppresses Weeds
- Conserves Moisture
- Cools the Soil
- Provides Habitat for Soil Organisms

Keep it Covered

Live crop biomass =

"active protective blanket"

Both are food sources for the soil biology!

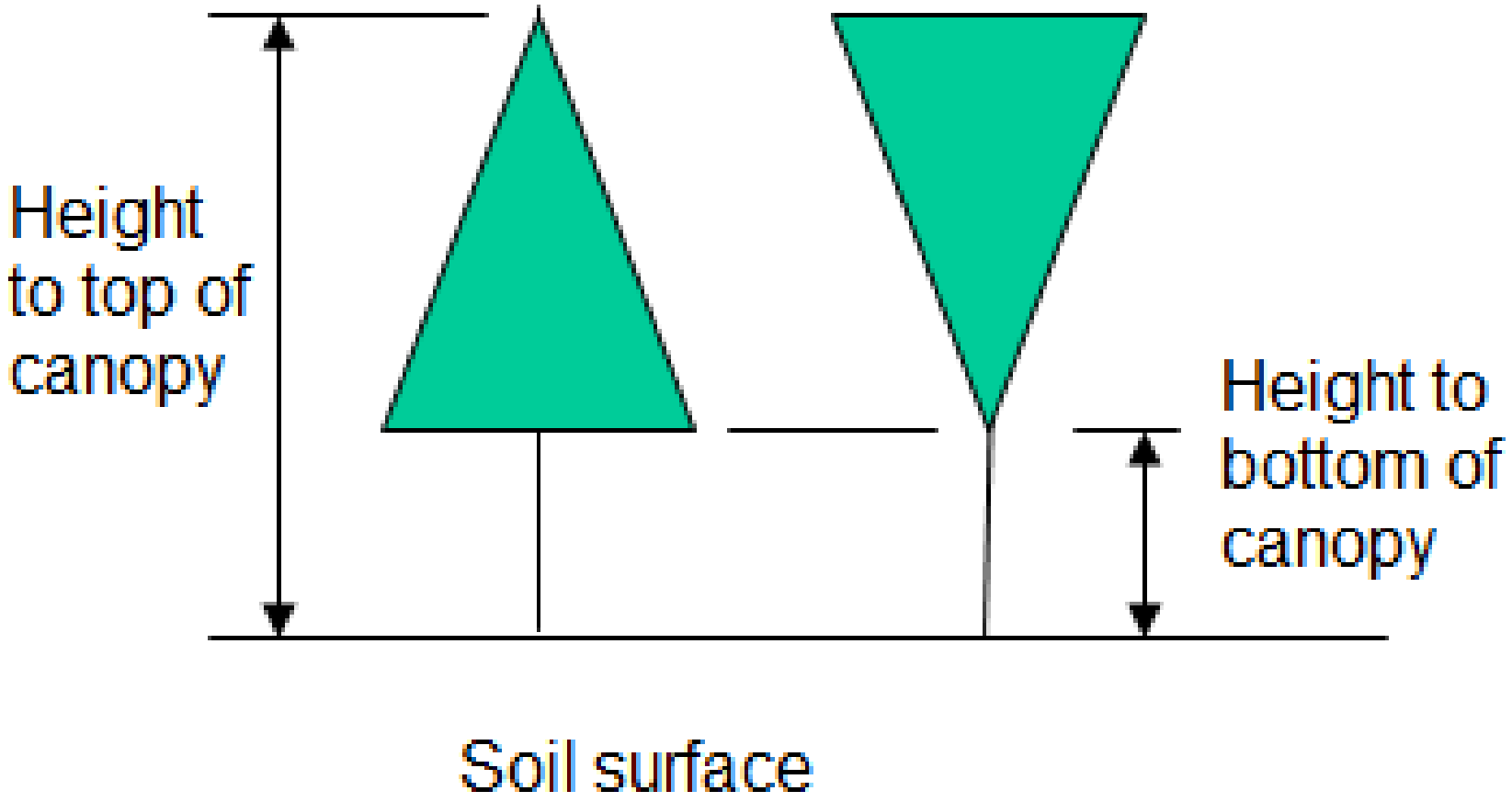
Dead crop residue =

"passive protective blanket"

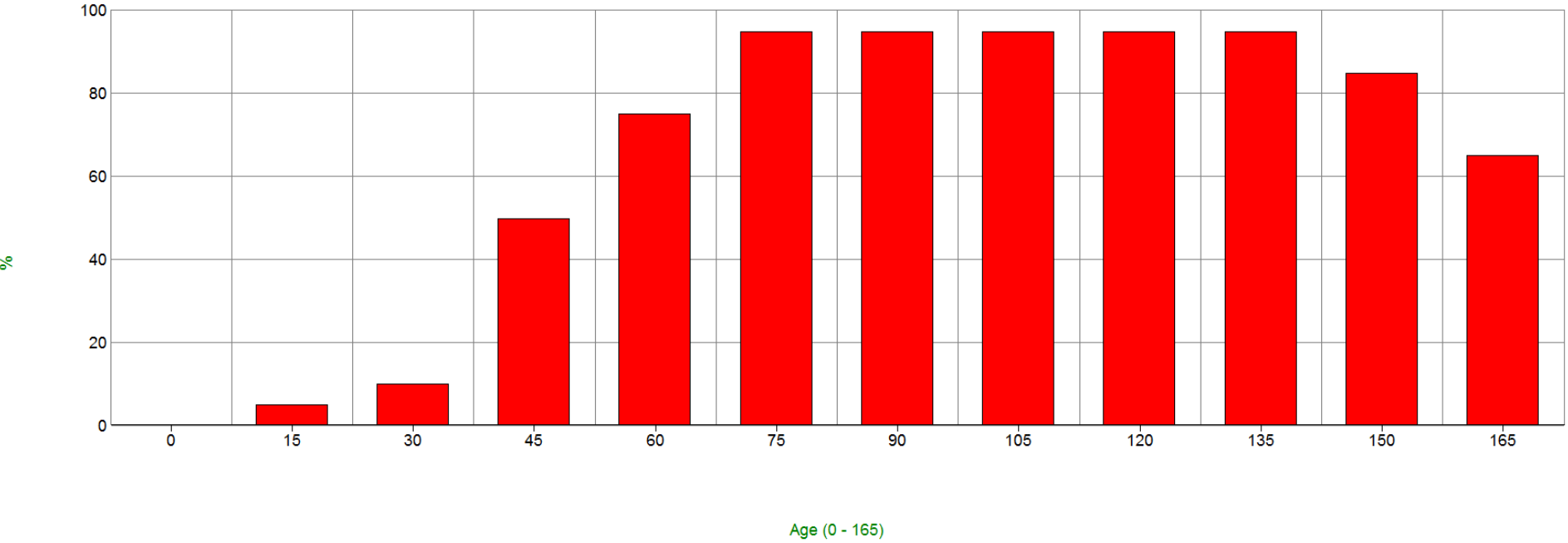
Keep it Covered (RUSLE2)

- Climate (erosion index, growing season, temp, precip)
- Biomass production (amount & timing)
- Irrigation water inputs (decomp., growth, erosion)
- Canopy & residue cover (amount, type, flat vs. standing)
- Drilled vs. Wide Rows (quicker canopy)
- Canopy shape
- Growth curves
- Mulch & manure (amount, type, application method)
- Surface Residue/Manure Decomposition rate
- Operations (type of & amount and timing of disturbance, description)
- STIR (disturbance rating)

Canopy Shape Considered



Canopy Cover (Corn)



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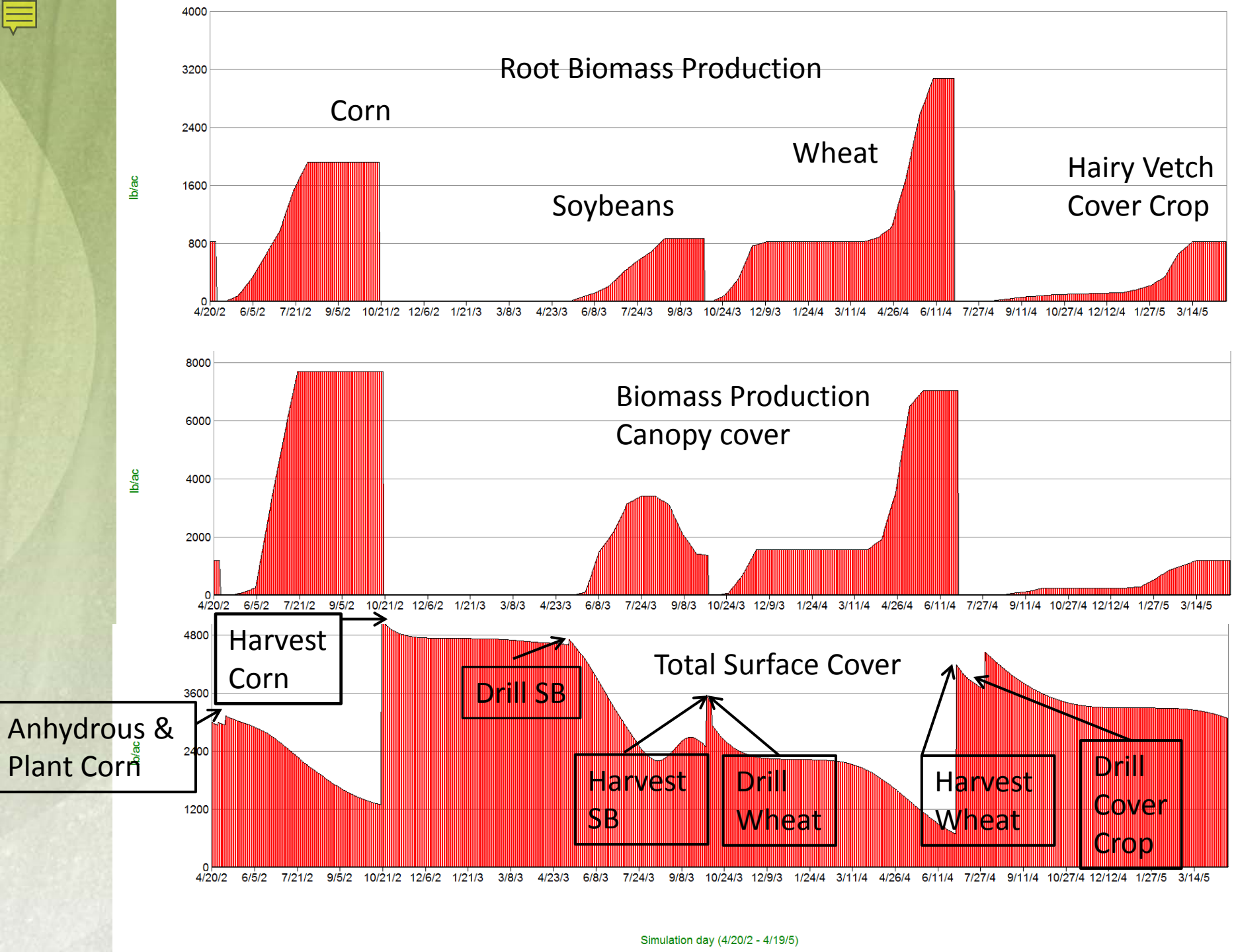
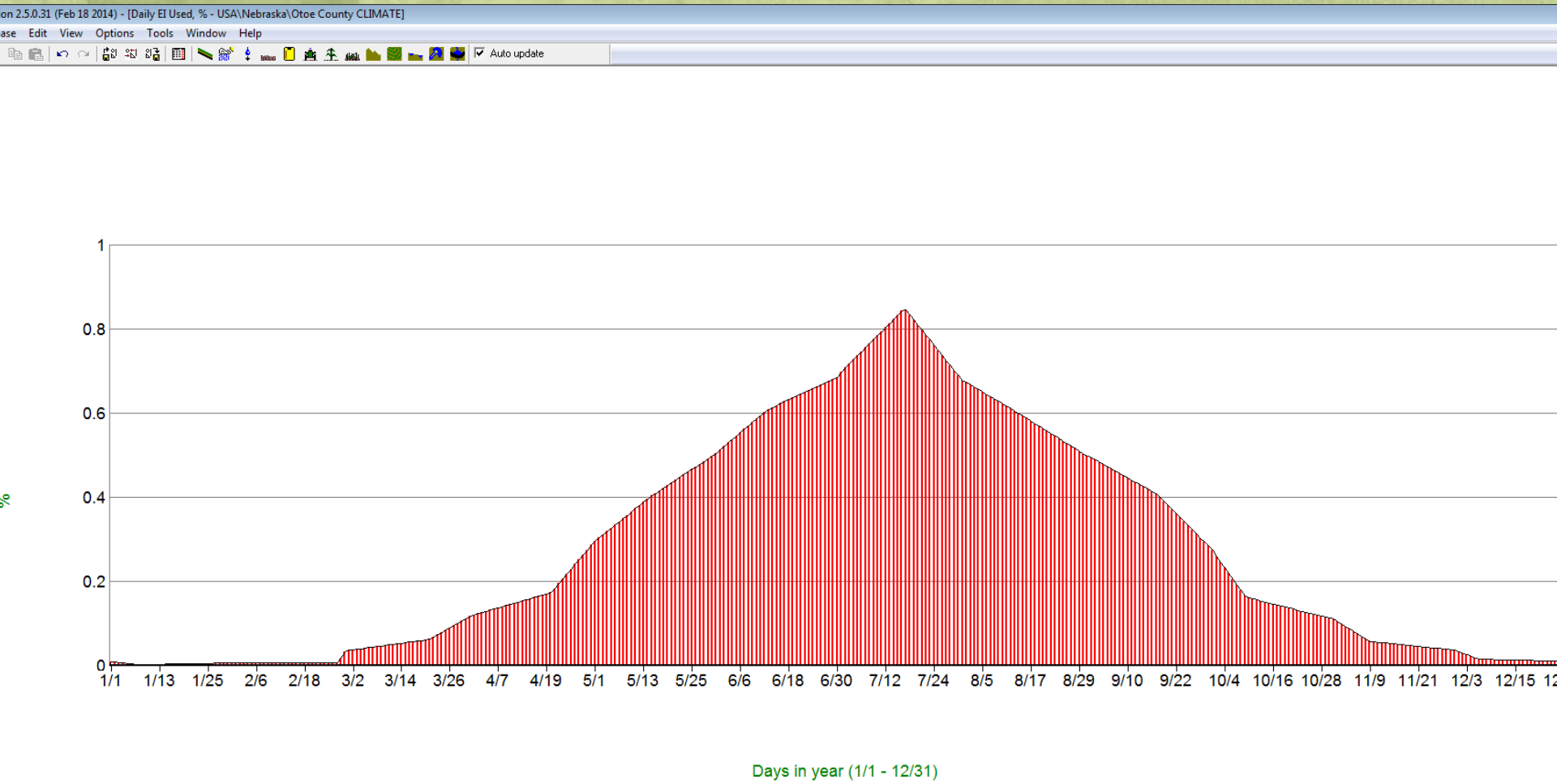
  - soils
  - strip-barrier-systems
  - structures-barriers
  - vegetations
  - worksheets

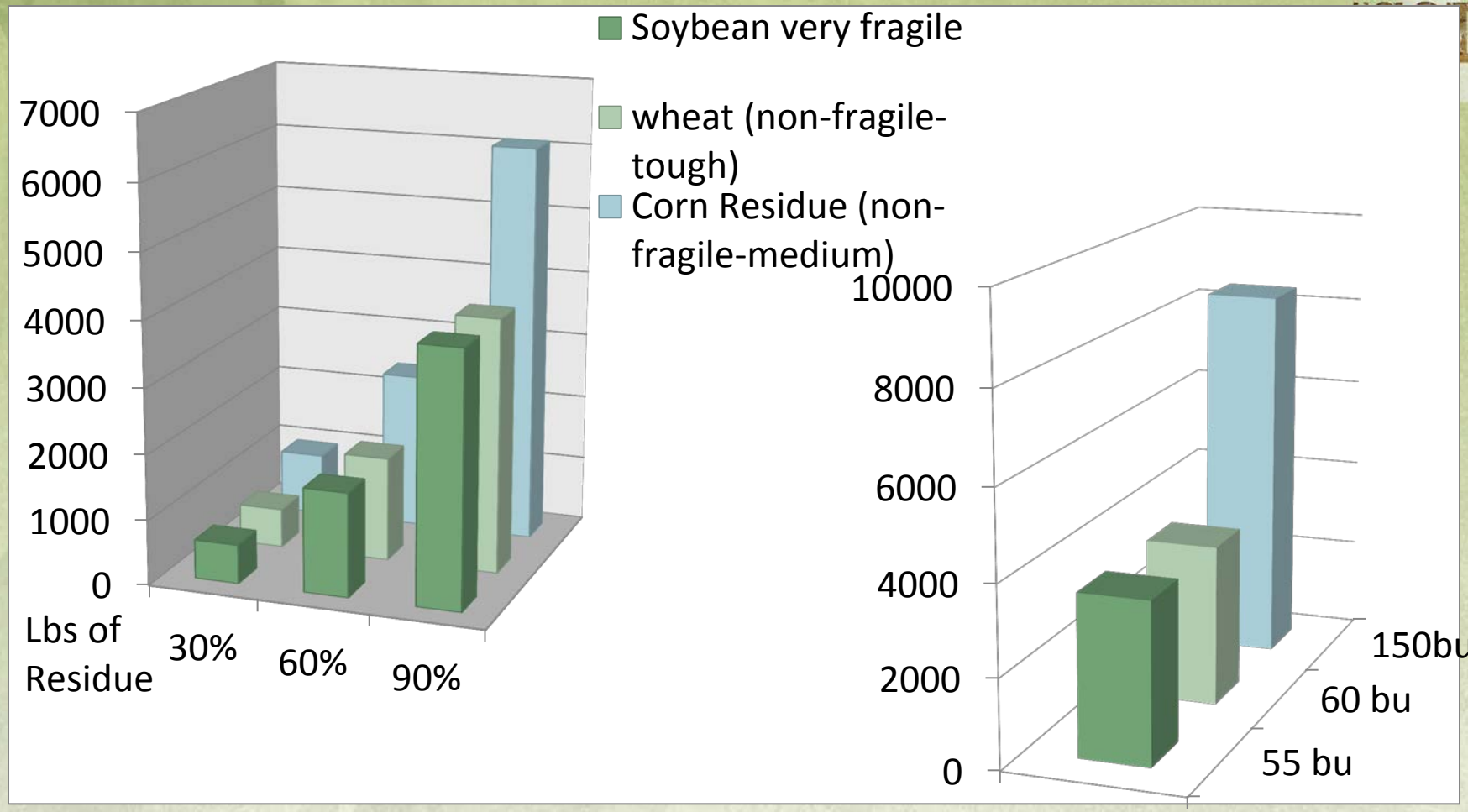
Name	Modified	Owner	Group	Permissions
agroforestry	11/19/200...	dave.lightle	R2_NRCS	RWCD
alfalfa	02/07/200...	dave.lightle	R2_NRCS	RWCD
artichoke	04/17/200...	dave.lightle	R2_NRCS	RWCD
asparagus	09/24/200...	dave.lightle	R2_NRCS	RWCD
banana	01/19/200...	dave.lightle	R2_NRCS	RWCD
bean, green snap	01/05/200...	dave.lightle	R2_NRCS	RWCD
beet, garden	01/05/200...	dave.lightle	R2_NRCS	RWCD
broccoli	03/21/200...	dave.lightle	R2_NRCS	RWCD
buckwheat	11/19/200...	dave.lightle	R2_NRCS	RWCD
cabbage	09/20/200...	dave.lightle	R2_NRCS	RWCD
canola	07/10/200...	dave.lightle	R2_NRCS	RWCD
carrot	01/05/200...	dave.lightle	R2_NRCS	RWCD
cassava	01/19/200...	dave.lightle	R2_NRCS	RWCD
cauliflower	07/09/200...	dave.lightle	R2_NRCS	RWCD
cellulose/paper mulch	09/01/200...	dave.lightle	R2_NRCS	RWCD
cellulose/paper mulch w/tackifier	08/14/200...	dave.lightle	R2_NRCS	RWCD
clover	12/29/200...	dave.lightle	R2_NRCS	RWCD
clover, annual	12/20/200...	dave.lightle	R2_NRCS	RWCD
coir fiber mulch	10/03/200...	Dave.Lightle	R2_NRCS	RWCD
collard	07/09/200...	dave.lightle	R2_NRCS	RWCD
compost	07/16/200...	Dave.Lightle	R2_NRCS	RWCD
corn	12/14/200...	dave.lightle	R2_NRCS	RWCD
corn, seed	11/19/200...	dave.lightle	R2_NRCS	RWCD
cotton	01/05/200...	dave.lightle	R2_NRCS	RWCD
cucumber	01/12/200...	dave.lightle	R2_NRCS	RWCD
default	05/01/200...	dave.lightle	R2_NRCS	RWCD
eggplant	01/19/200...	dave.lightle	R2_NRCS	RWCD


Root Biomass Production
Corn
Soybeans
Wheat
Hairy Vetch
Cover Crop
lb/ac
Biomass Production
Canopy cover
Total Surface Cover
Harvest
Corn
Anhydrous &
Plant Corn
Drill SB
Harvest
SB
Drill
Wheat
Harvest
Wheat
Drill
Cover
Crop
Simulation day (4/20/2 - 4/19/5)

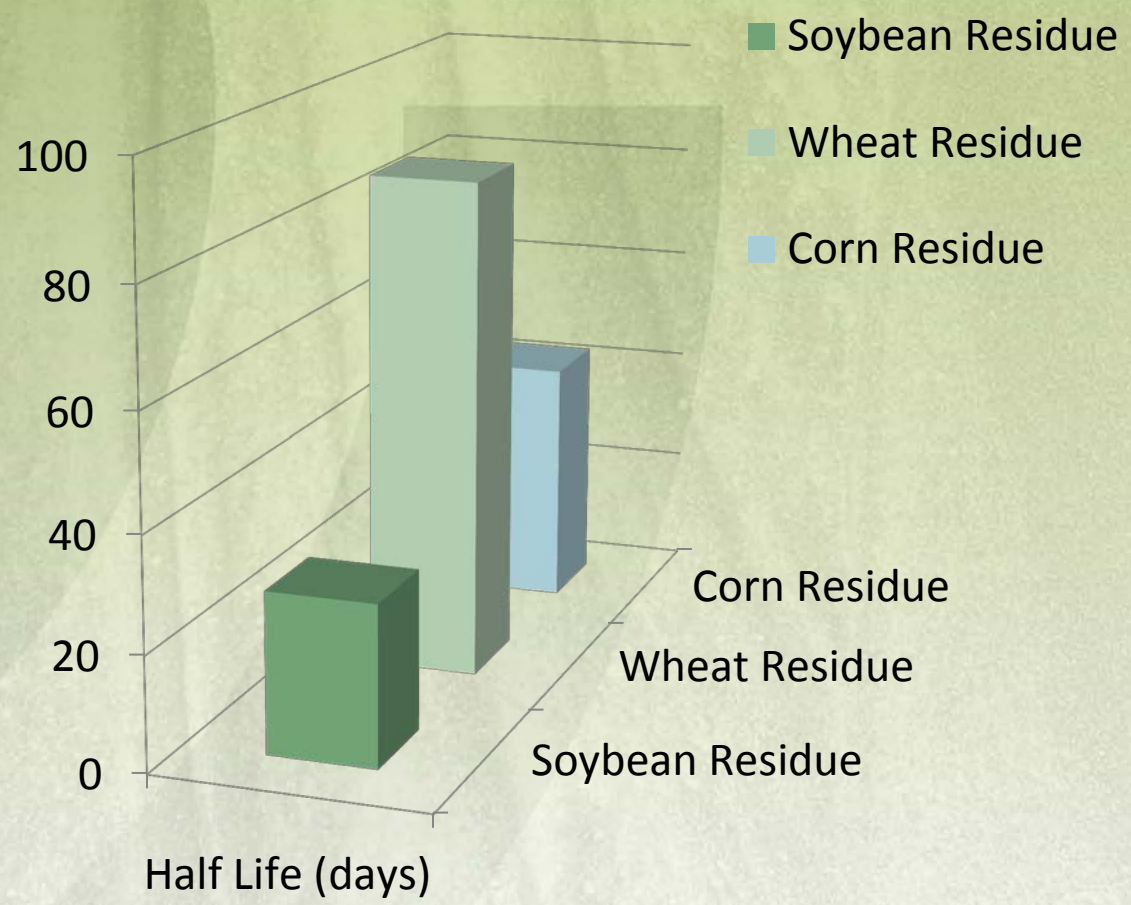
Water Erosion Index (keep it covered)



Residue Cover



How long will it last once it is on the surface?



What happens to residue?

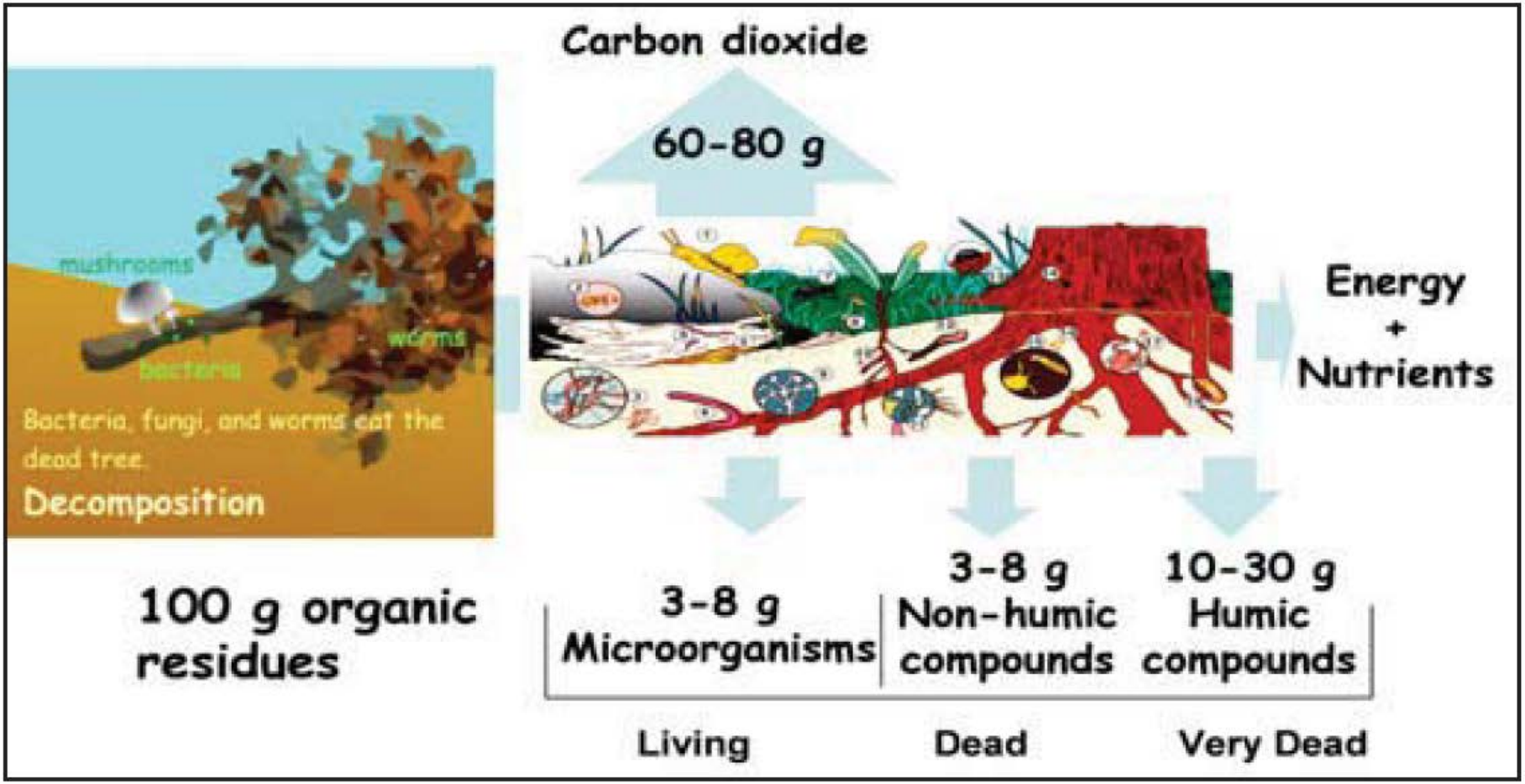
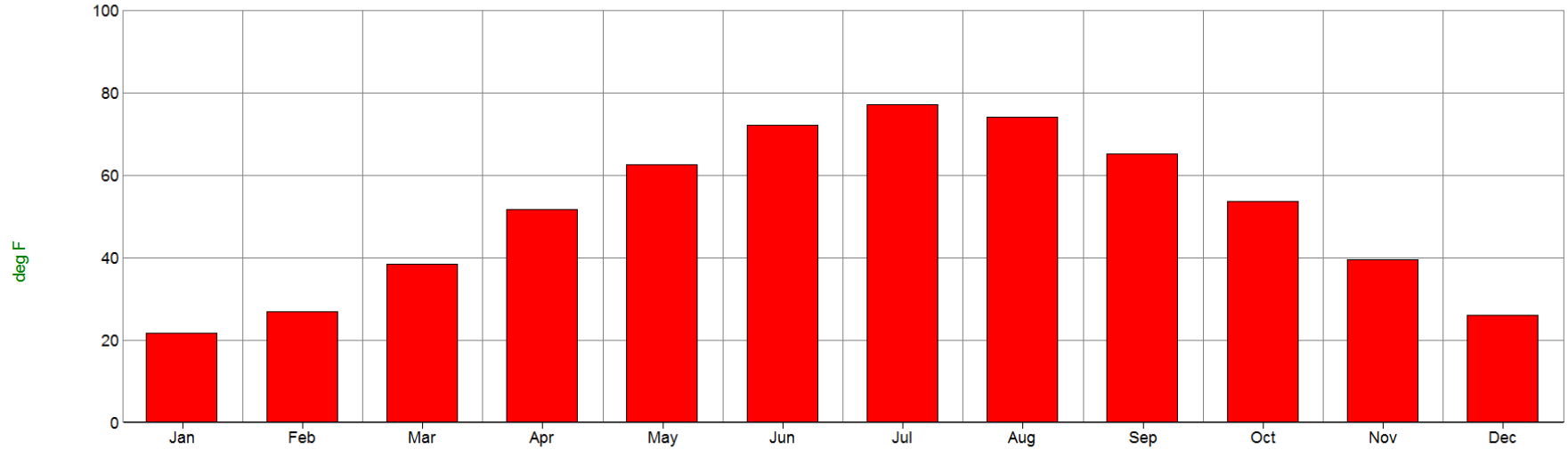
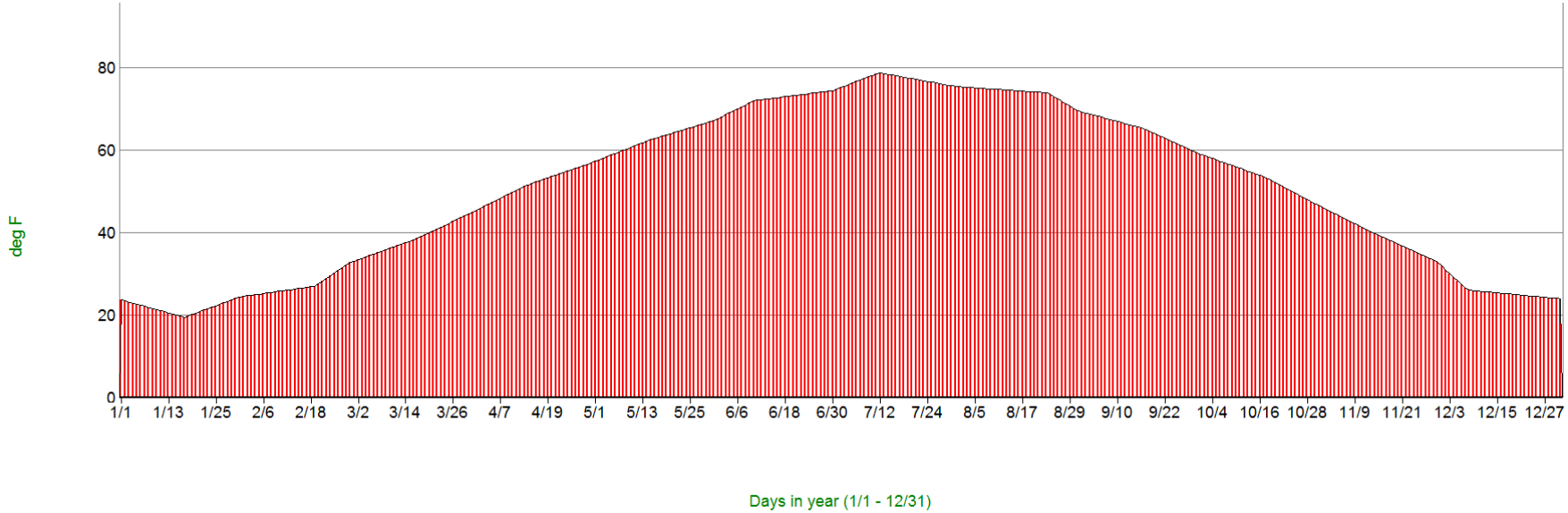


Diagram by Dr. Rafiq Islam

Average temperatures

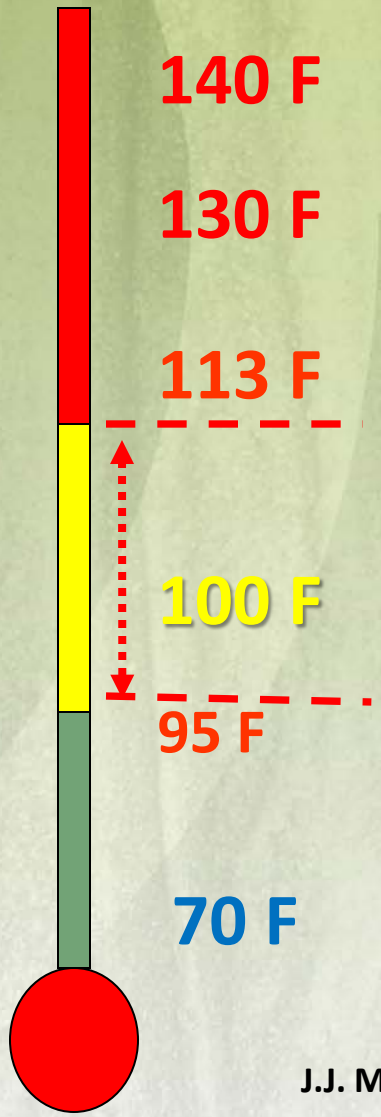




Soil Temperatures

- Conserve moisture and reduce temperature.
- Crop yields are limited more often by hot and dry, not cool and wet.

When soil temperature reaches



140 F — Soil bacteria die

130 F — 100% moisture is lost through evaporation and transpiration

113 F — Some bacteria species start dying

100 F — 15% moisture is used for growth

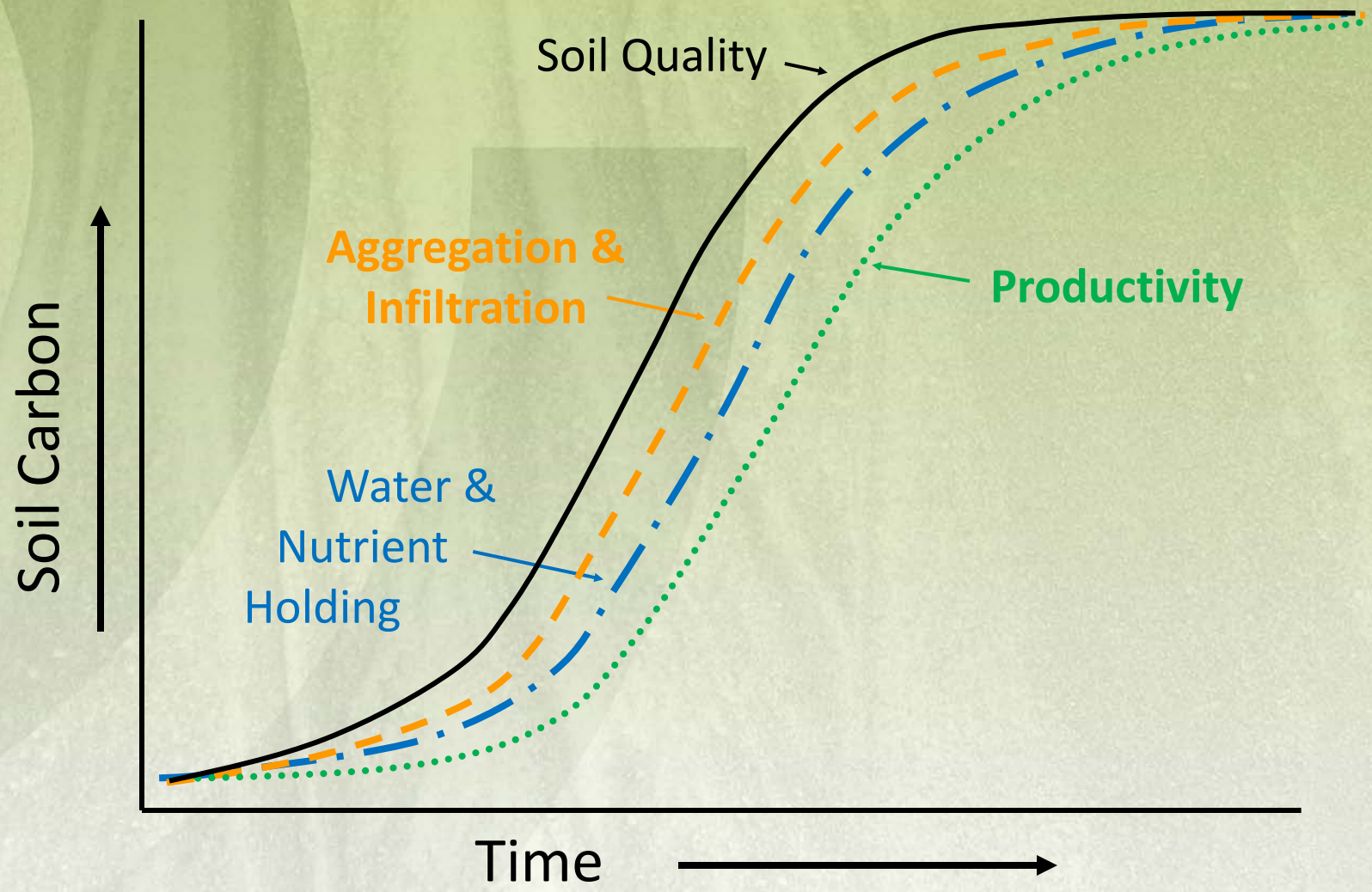
95 F — 85% moisture lost through evaporation and transpiration

70 F — 100% moisture is used for growth

J.J. McEntire, WUC, USDA SCS, Kernville TX, 3-58 4-R-12198. 1956

Soil Conditioning Index (Indicator of Soil Health)

Benefits of Soil Carbon



Silt loam soil

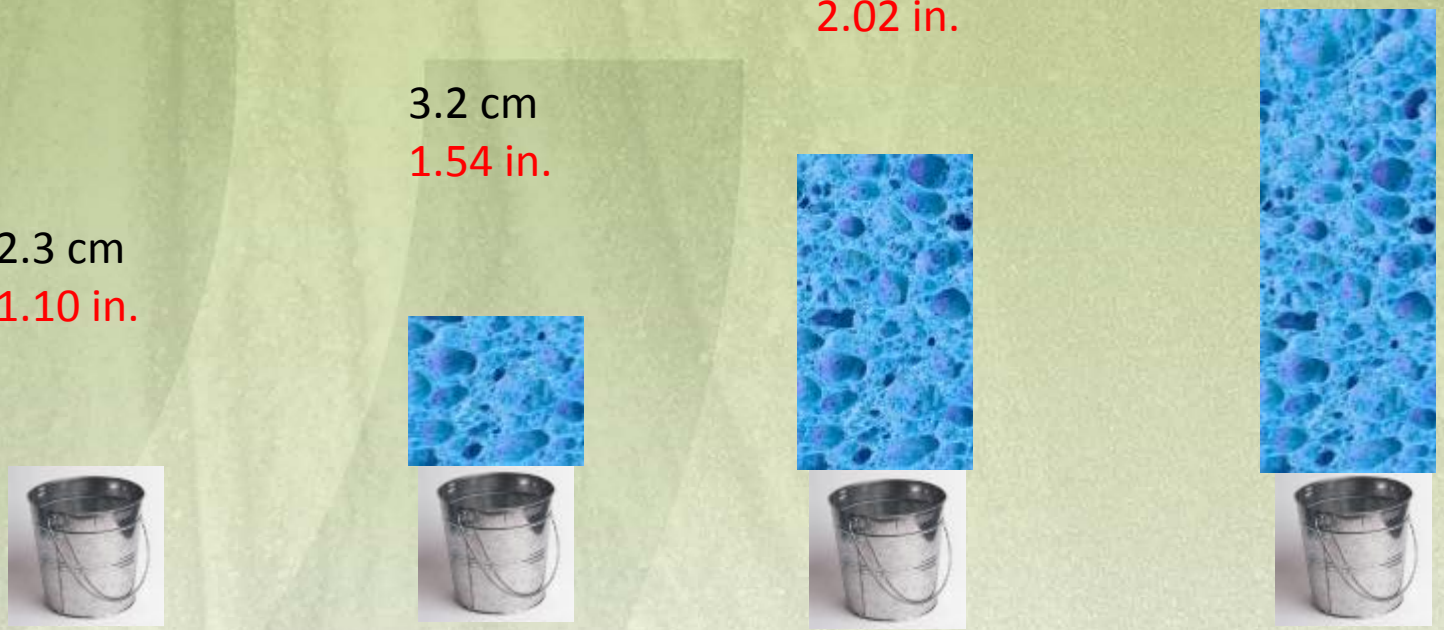
Available Water holding Capacity (AWC)
(cm H2O/ 25 cm soil)
(in. H2O/ ft. soil)

2.3 cm
1.10 in.

3.2 cm
1.54 in.

4.2 cm
2.02 in.

5.1 cm
2.45 in.



SOM = 0% **1%** **2%** **3%**

soil matrix water **+** **Soil organic matter "sponge" water**

Source: Berman Hudson, 1994. JSWC 49:189-194.

The Soil Conditioning Index:

- Evaluate and design conservation systems that maintain or improve soil condition.
- Effects of the system on organic matter trends as a primary indicator of soil condition.
- Estimate the combined effect of three major variables on trends in organic matter.

Soil Conditioning Index Model:

(OM x 0.4) + (FO x 0.4) + (ER x 0.2) =SCI

Where:

- **OM** = Organic Material returned to soil
- **FO** = Effect of Field Operations which stimulate organic matter breakdown
- **ER** = Erosion by sheet, rill, wind and/or irrigation induced

Calculate the OM subfactor value:

- OM =(RP - MA) / MA
- RP = average annual above and below ground biomass returned to the soil expressed as Residue Equivalent Value (REV/corn equivalent)
- MA = maintenance amount of residue (REV)

Residue Equivalent Values (REV)			Maintenance Amt. Including Roots
CITY CODE	CITY	STATE	Reference Condition
43999	*RENNER	TX	5719
27497	LINCOLN	NE	5455
28002	LAS VEGAS	NV	1997
33003	RALEIGH	NC	5858
34001	BISMARK	ND	4339
34002	WILLISTON	ND	4084
34248	FARGO	ND	4749
35001	CLEVELAND	OH	5420

- The FO component accounts for the effect of field operations which stimulate organic matter breakdown.

Accounts For Wind, Water and Irrigation Induced Soil Erosion (EO)

RUSLE2 Version 2.5.1.0 (Apr 7 2014)

File Database Edit View Options Tools Window Help

Auto update

Profile: Upper Midwest Madison

STEP 1: Choose location to set climate: Location USA\Wisconsin\Dane County

STEP 2: Choose soil type: Soil Generic Soils\silt loam (l-m OM)

STEP 3: Set slope topography: Slope length (along slope), ft 150 Avg. slope steepness, % 25

STEP 4a: Select base management Base management ...EW FORAGES\Upper Midwest FPZ\Alfalfa\Alfalfa Late Summer Direct 1x, FC, st pt, disk, fcult, grazed z4

STEP 4b: Modify/build man. sequence if desired: Rotation builder open

STEP 4c: adjust management inputs if desired: Adjust yields open Adjust ext. res. addition open Rock cover, % 0

Fuel type for entire run (none)
Energy use for entire simulation, BTU/ac 490000
Equiv. diesel use for entire simulation, gal/ac 3.5
Fuel cost for entire simulation, US$/ac 0

Adjust res. burial level Normal res. burial

STEP 5: Set supporting practices:

Contouring a. rows up-and-down hill Relative row grade, % Crit. slope length, ft 150

Strips/barriers (none)

Diversion/terrace, sediment basin (none)

Subsurface drainage (none)

Yrs offset from start year (MA

Segment +	Segment -	Yrs offset from start year, yr
1		0

Results | Additional Results | TRACK_BIOMASS

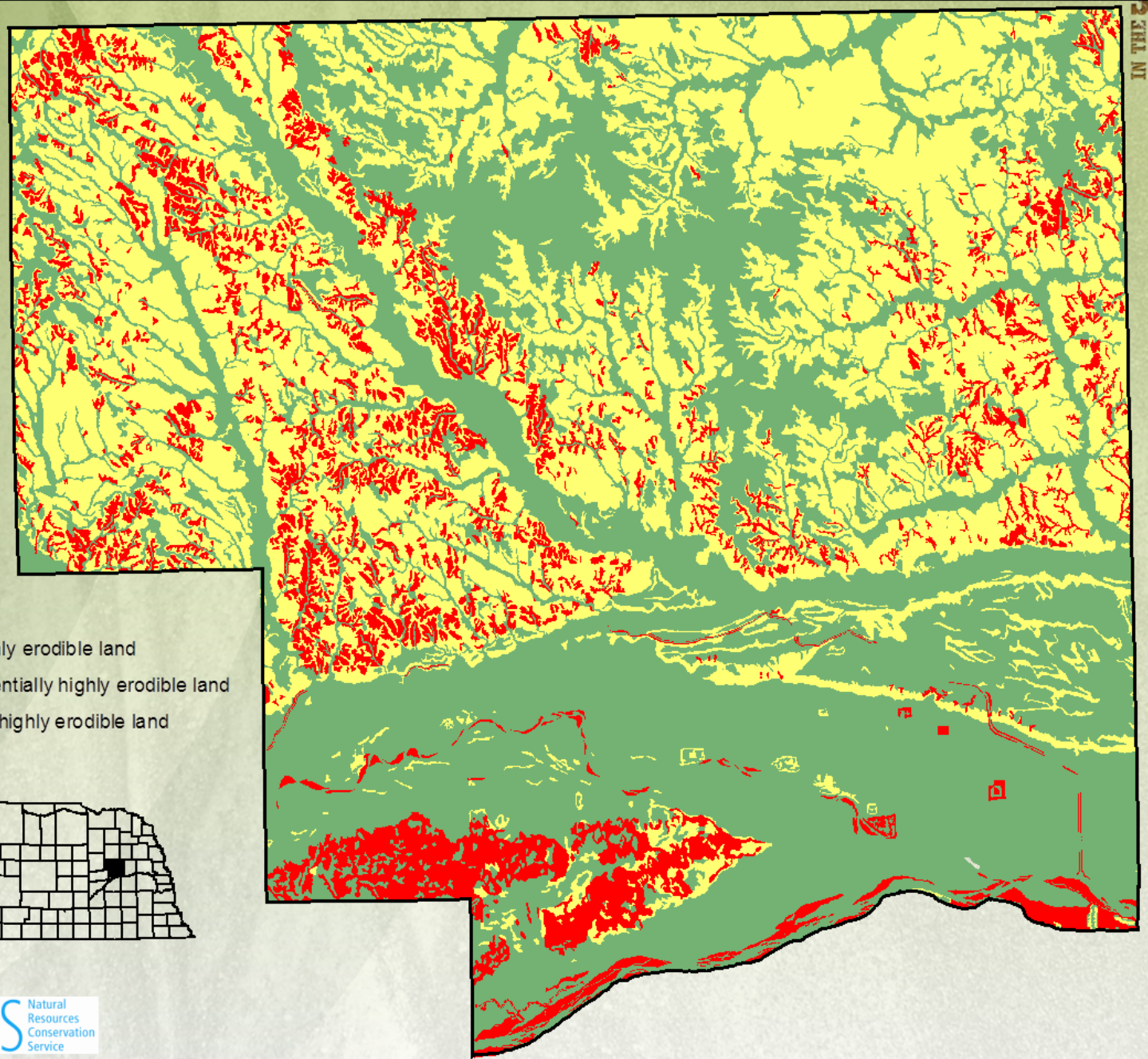
Detachment on slope, t/ac/yr 16
Soil loss erod. portion, t/ac/yr 16
Sediment delivery, t/ac/yr 16

Crop year results open Soil conditioning index open Surf. res. cov. values open
SCI value OK?

Avg. ann. forage harvest, lb/ac 2400

Net event runoff, in/yr 3.0

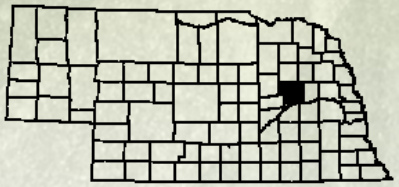
Platte County - HEL Classification



Highly erodible land

Potentially highly erodible land

Not highly erodible land

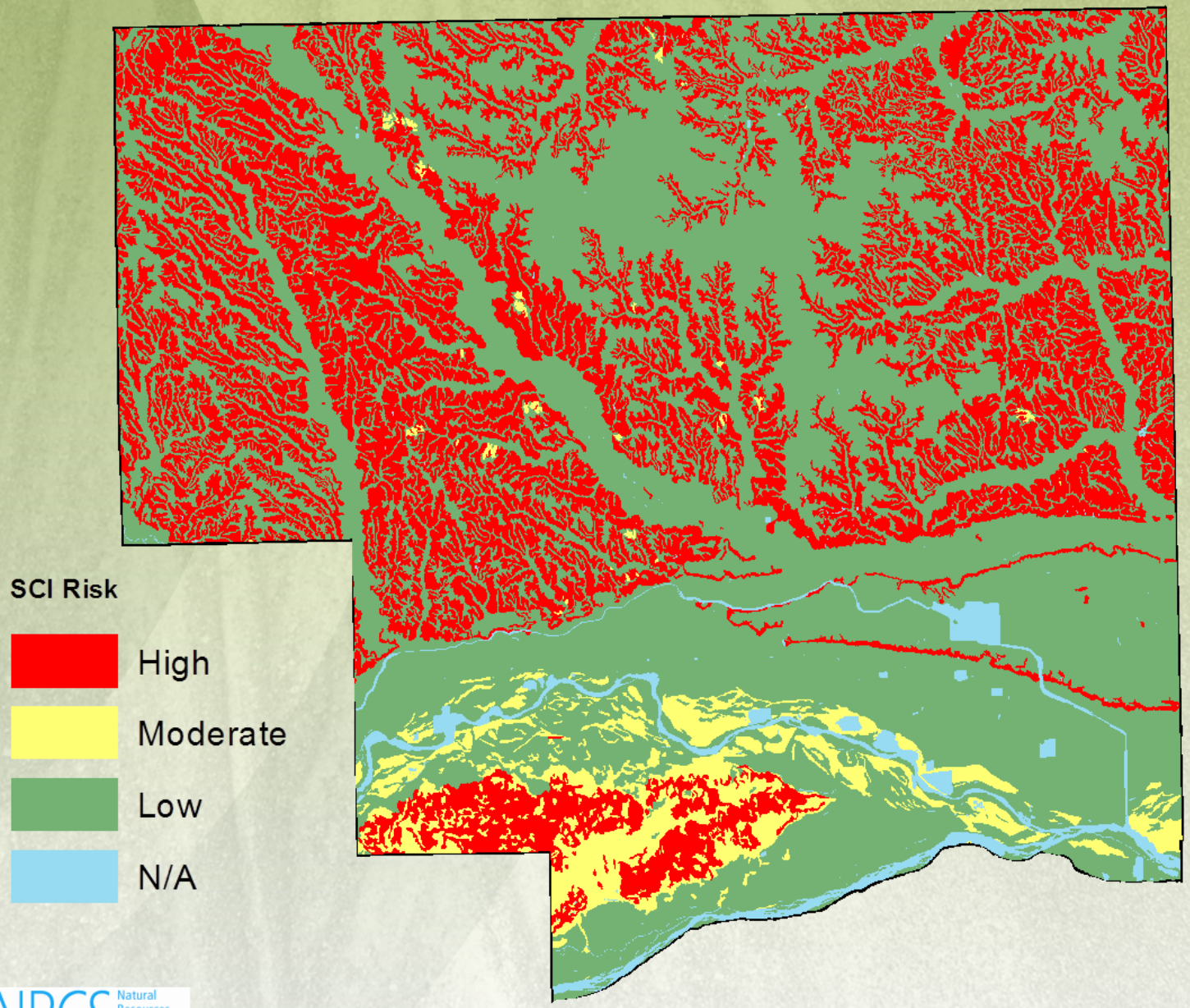


NRCS Natural Resources Conservation Service

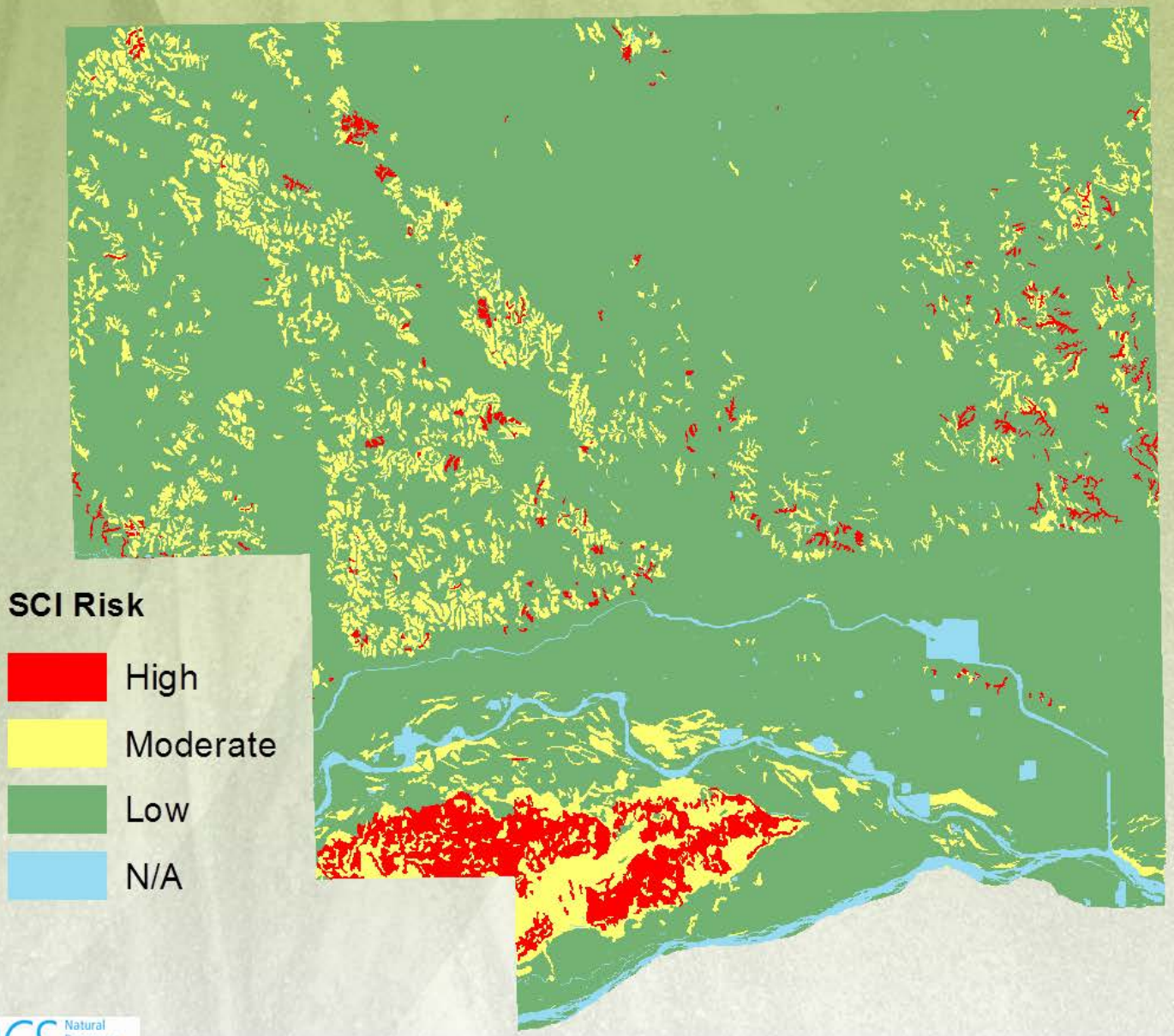
July 2006

Impact of Residue Removal on SCI
Nora-Crofton SiCL, 6-11% slopes

Corn/Soybeans with Mulch Tillage
Soil Conditioning Index (SCI) Risk



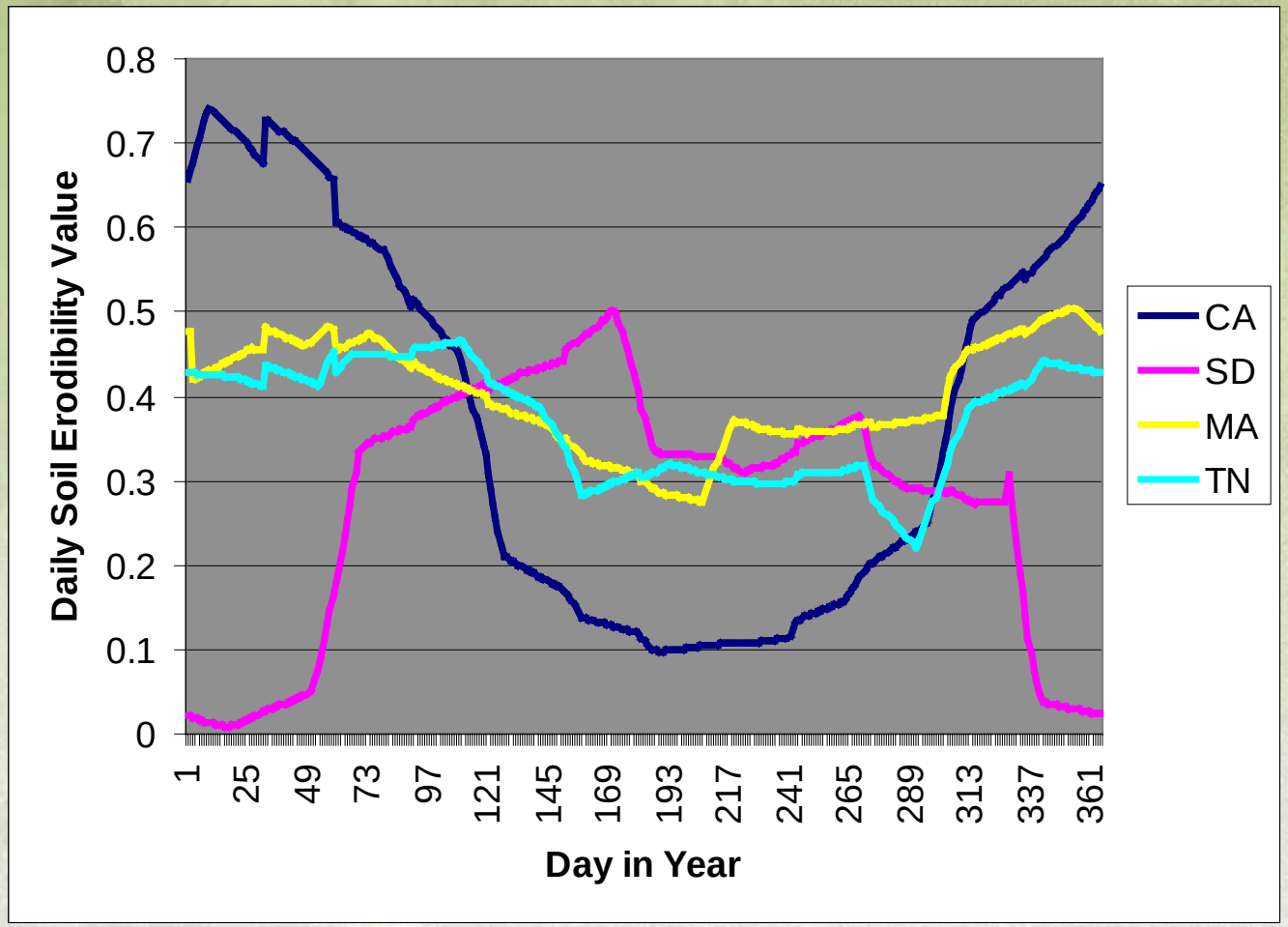
Corn/Soybeans with No-Till
Soil Conditioning Index (SCI) Risk



August 2006

Time Variable K

Base K value = 0.37



Future Work on K-Factor

- Working with ARS to improve the K erodibility prediction for high clay, organic and other soils
- Improving prediction of management effects on dynamic soil properties and erodibility factors
- RUSLE2 and WEPS runs also to be used for evaluation

Questions??