Introduction to Soil Quality and Health

Key to gaining agricultural productivity, environmental quality, and sustainability

Presented by:

Steven Hefner, Team Leader
USDA-NRCS South Missouri Water Quality Office

Historical Perspective: Dust Bowl Era

A degraded land leads to poverty

- Homestead Act (1909) offered small parcels of land near the Oklahoma Panhandle. People plowed native grasslands to grow wheat in the 1920's.
- In 1931, the depression, drought and an all time low in the wheat market ($0.19/bu) created a man-made disaster.
- May 9, 1934 soil from the prairies of the western U.S. deposited in New York, Washington D.C., and on ships 200 miles offshore in the Atlantic.
- In 1935, most residents in the area on government assistance to keep from starving. 2.25 million acres were purchased by the government, who figured this was cheaper than providing relief to hold onto marginal land.

"Well, I know I've got to make a move but I don't know where to. I can stay off relief until the first of the year. After that I don't know. I've eat up two cows and a pair of horses this past year. Neither drink nor gamble, so I must have eat'n 'em up. I've got left two horses and two cows and some farm tools. Owe a grocery bill.

Native Texan farmer on relief, Hardeman County, Texas, 1937. Farm Security Administration –Office of War Information Photograph.

Societal Success Depends Upon Soil Stewardship

Ruins of one of the Hundred Dead Cities of Syria. From 3 to 6 feet of soil have been washed off most of the hillsides. This city will remain dead because the land around it can no longer support a city.

- "We must be in possession of a certain amount of abundance to be provident; a starving farmer will eat his seed grain; you will do it and I will do it, even though we know it will be fatal to next year's crop. Now is the time, while we still have much good land capable of restoration to full or greater productivity, to carry through a full program of soil and water conservation. Such is necessary for building here a civilization that will not fall as others…"

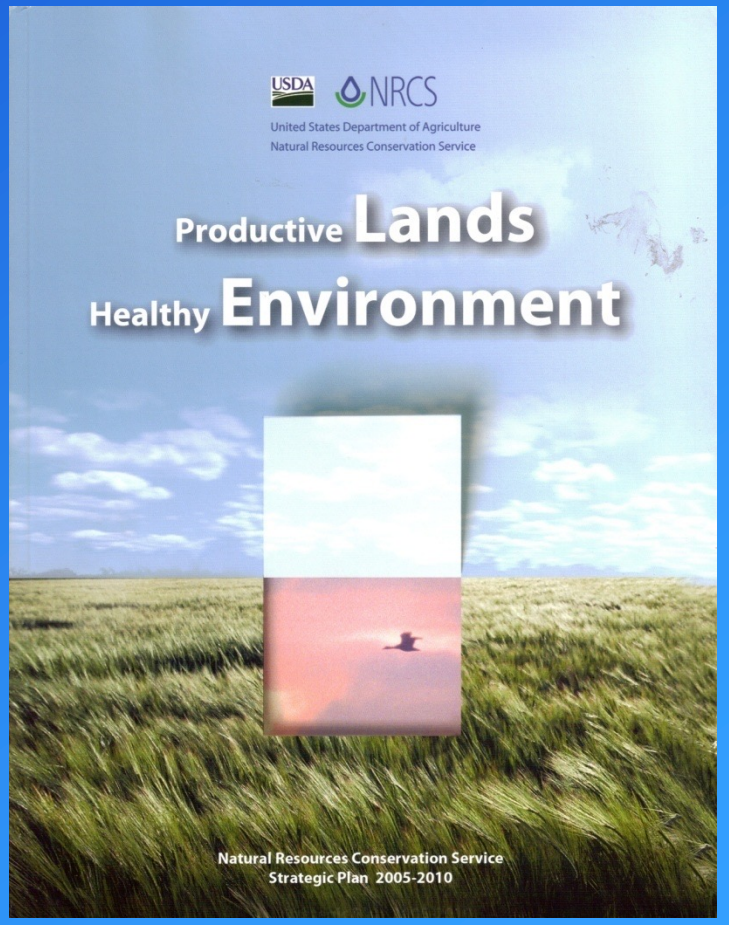
~ Conquest of Land Through 7,000 Years

W.C. Lowdermilk, Assistant Chief, SCS, 1939

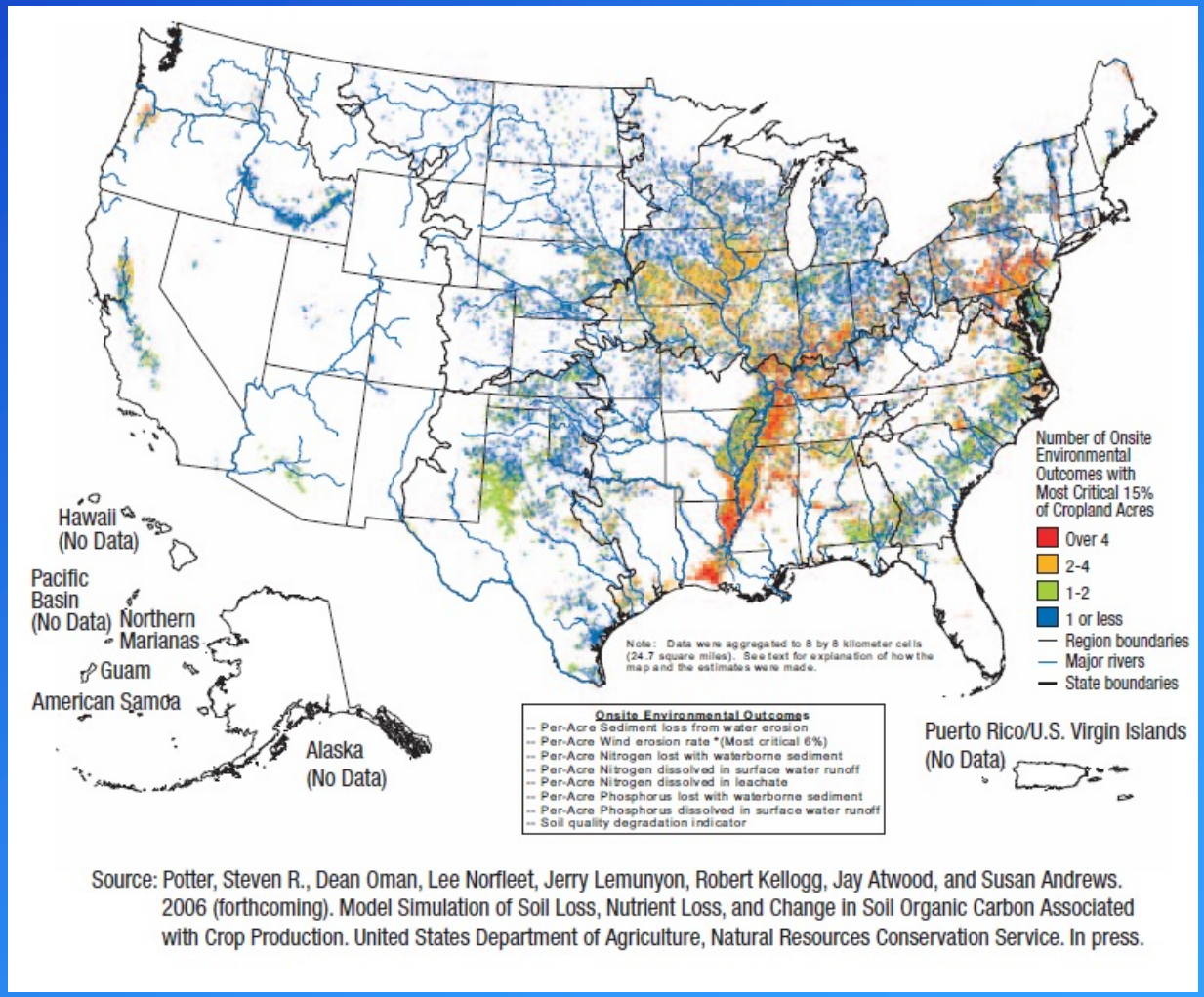
NRCS Foundation Goal: High Quality, Productive Soils

- Expand technical assistance to emphasize soil quality. Conservation plans, practices. Cover Crops.

- Use analytical tools to support soil quality monitoring. Soil Surveys, RUSLEII



Highest Potential for Erosion, Nutrient Loss, & Soil Quality Degradation



Source: Potter, Steven R., Dean Oman, Lee Norfleet, Jerry Lemunyon, Robert Kellogg, Jay Atwood, and Susan Andrews. 2006 (forthcoming). Model Simulation of Soil Loss, Nutrient Loss, and Change in Soil Organic Carbon Associated with Crop Production. United States Department of Agriculture, Natural Resources Conservation Service. In press.

MO Parks & Soils Program
Soil Erosion Benefits

- Estimated Suspended Pollutants Trapped per Year by Terraces and Ponds by the Parks & Soils Tax.

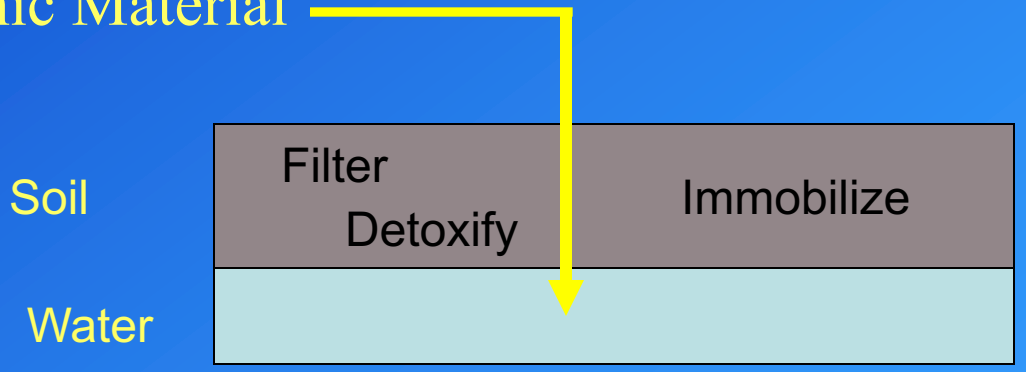
Sediment (1000 tons/yr)	Organic N (tons/yr)	Organic P (tons/yr)
9,302.8	9,645.7	5,449.8

*** FAPRI-MU Report #31-07, August 2008**

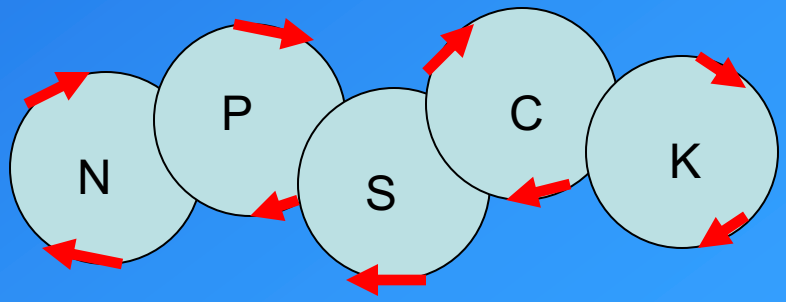
9.3 million tons of sediment can cover 4,759 miles of streambeds 30 feet wide with a depth of 6 inches in sediment.

Key Soil Functions

Filtering Organic & Inorganic Material

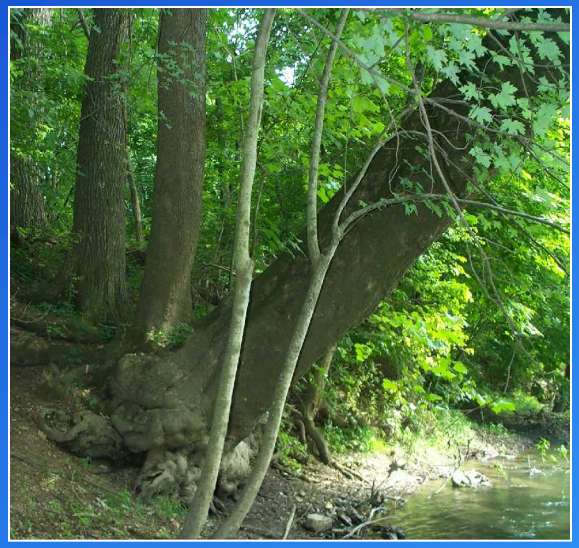


Supply, Store and Cycle Nutrients for growth.



Key Soil Functions

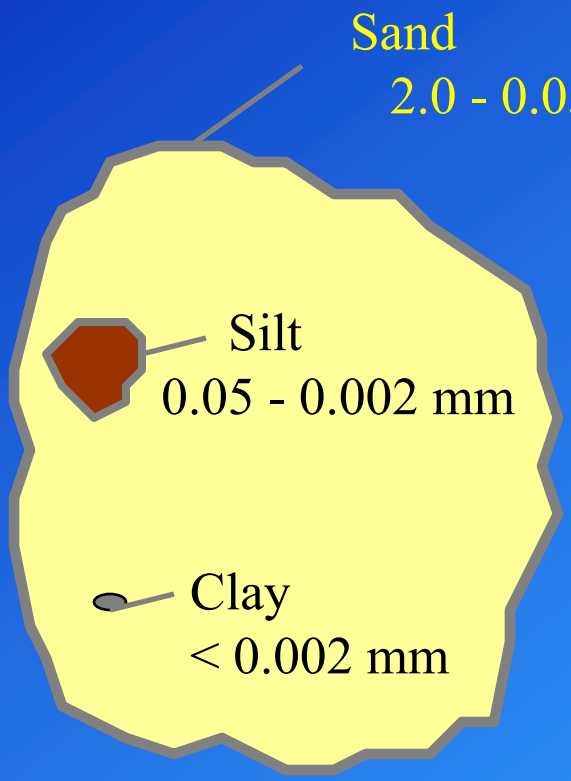
- Receive rainfall and store water for root utilization.
- Decompose organic matter and other foreign material.
- Support plants or buildings.



James River, Stone County - stream bank erosion causes tree to lean. Photo: Steve Hefner, USDA-NRCS

Tower of Pisa, Italy – inadequate foundation set in unstable soil. Wikipedia, 2010.

Soils: More than just sand, silt, clay



- The biological component of soils cannot be separated from the physical. Live and decaying plant residues, and the microbes and organisms that feed on them are just as important.

- Soil microbiology is by in large 'invisible' and thus a 'elusive' component to understand. However, it is *essential* to productive agriculture. (Kennedy and Papendick, 1992)

Soil Biology
From the Invisible to the Visible

BACTERIA – Break down the proteins and carbohydrates in residue which serves as the source of food. Fix and release nitrogen.

FUNGI – decomposition of proteins and carbohydrates in residue, glomalin secretion, assist with phosphate uptake.

ARTHROPODS –invertebrates with exoskeletons and jointed legs. This millipede is a plant shredder.

Photo credits: Serita Frey, Colorado St U; Randy Molina, Oregon St U; David B. Richman, New Mexico St U

Soil Biology: It's a War Out There

- Fungal hyphae or filament rings that constrict when a nematode swims through.
- Fungi then invade the prey and use its energy resources.
- Building organic matter and encouraging nematode predation (fungi) can help with control.

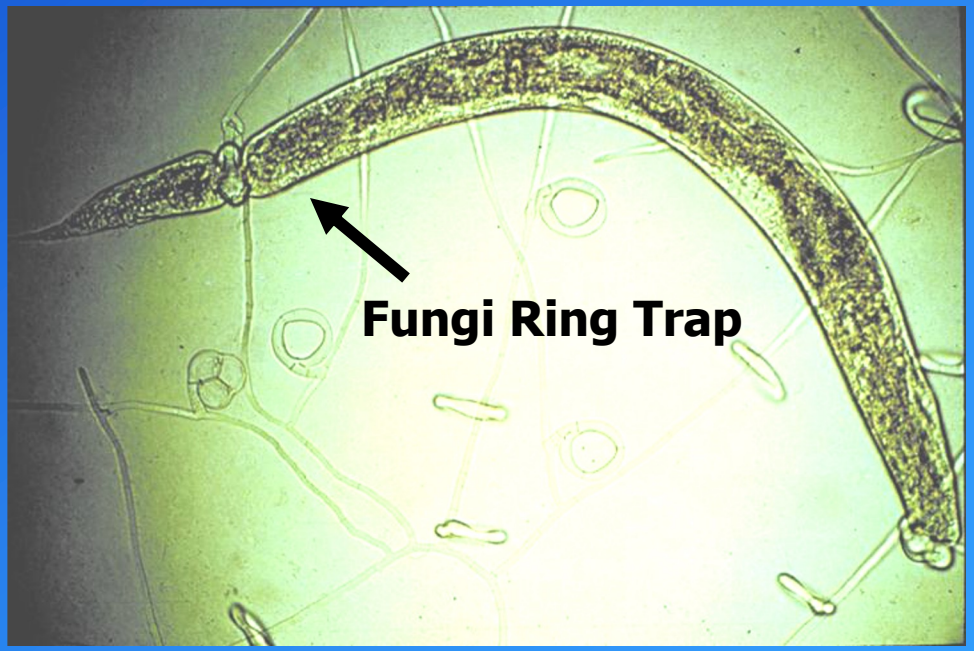


Photo credit: George L. Barron, University of Guelph, Ontario.

Soil Biology

- Plant roots exude sugars from photosynthesis
- Soil fungi use the sugars to live
- In return, fungi expand the root system and assist with phosphorus and water uptake.
- Fungi in the rhizosphere also help protect against disease agents and vectors.

Photo: Steve Hefner, USDA-NRCS

Carbon is Critical

- Plants pull CO_2 from air during photosynthesis and incorporates the carbon into plant matter (carbohydrates, fibers, proteins).

- Plants die and residues are the main energy and nutrient source of microbes. They give back water, heat, and CO_2.

Photo: Robert DeMoss, USDA-NRCS

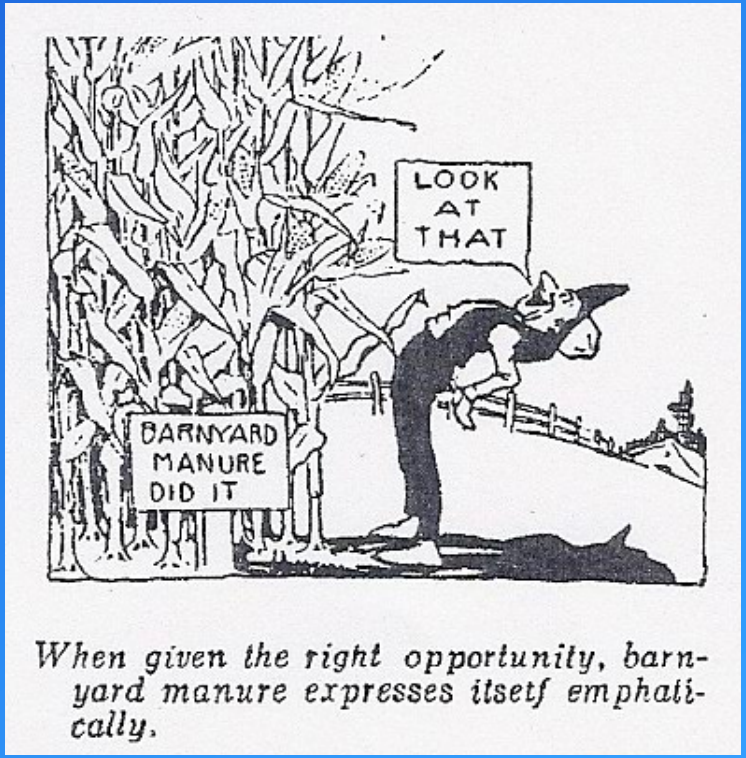
Carbon is Critical

- Add more residue than microbes can consume, carbon is sequestered in the soil. Add less residue than microbes can consume, carbon is depleted.
- Tillage or disturbance adds oxygen to the soil and accelerates microbial activity and consumption of carbon sources.
- To build OM reduce tillage, grow high residue crops, and leave undisturbed root systems in the soil for microbes.

USDA-NRCS Photo

Benefits of Organic Matter

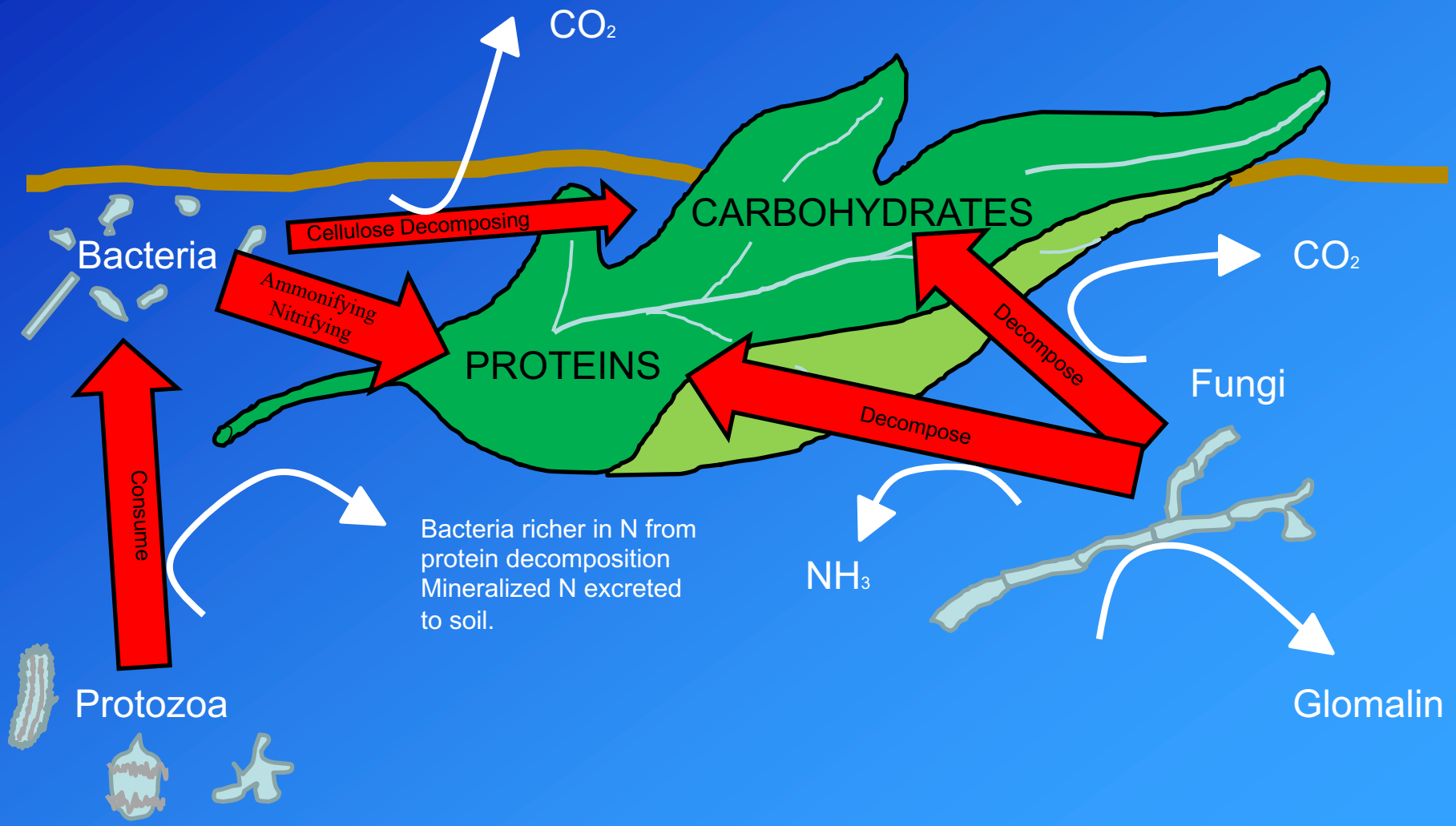
- Organic Matter has a lot of exchange sites that can buffer soils (e.g. when H+ is held by OM it removes acidity from soil solution).
- 1% of soil organic matter is estimated to deliver 20-30 lbs of nitrogen per year.
- Organic matter also can store water. It is estimated that it can hold 90% of its weight in water.
- The added water holding capacity & soil structure benefits can cut erosion rates significantly.



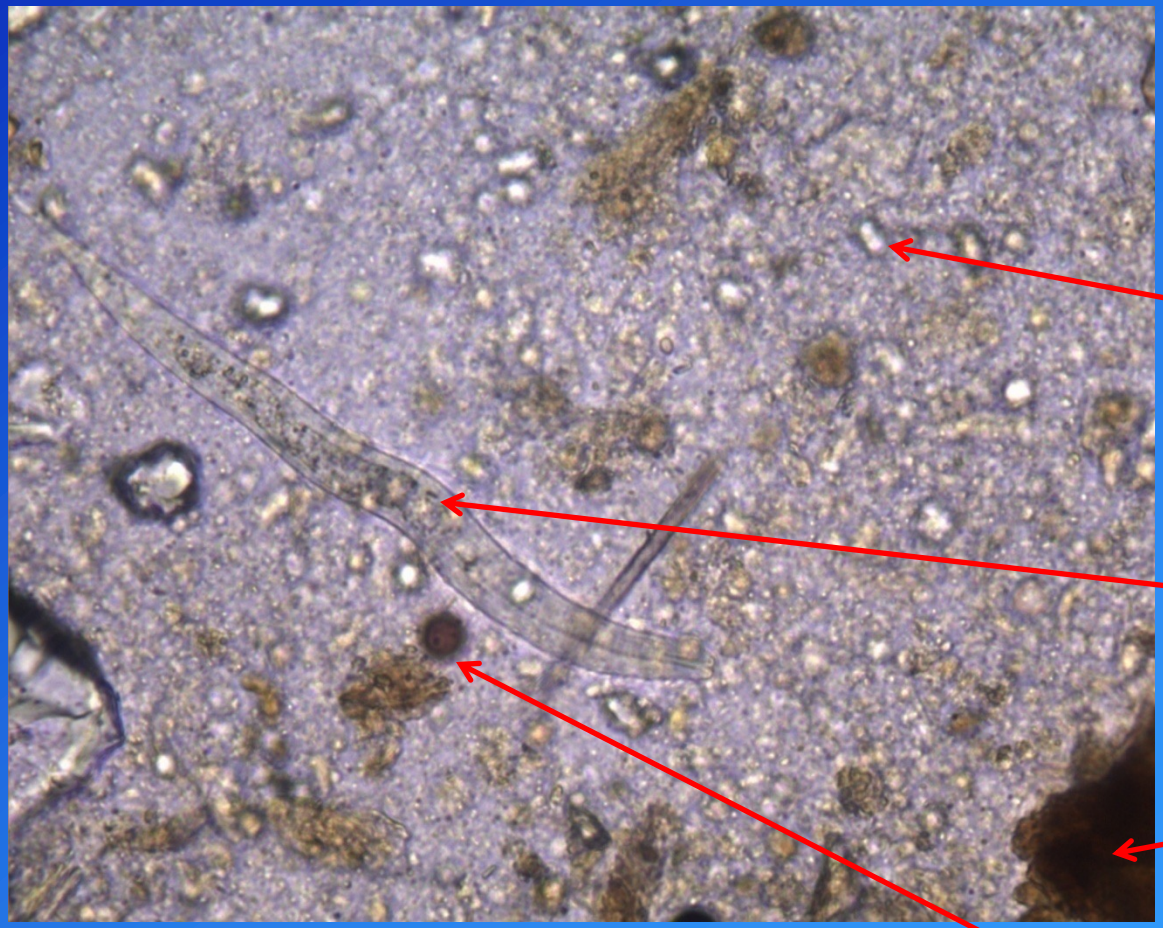
When given the right opportunity, barnyard manure expresses itself emphatically.

Archived Cartoon from The Furrow Magazine

Residue Decomposition



Microscopic Proof



Magnification = 40X

Mineral particle

Male Rhabditis nematode consuming bacteria.

Clump of Organic matter

Fungal Spore

Photo: Emily Bonilla, USDA-NRCS, North Dakota

Nitrogen Mineralization

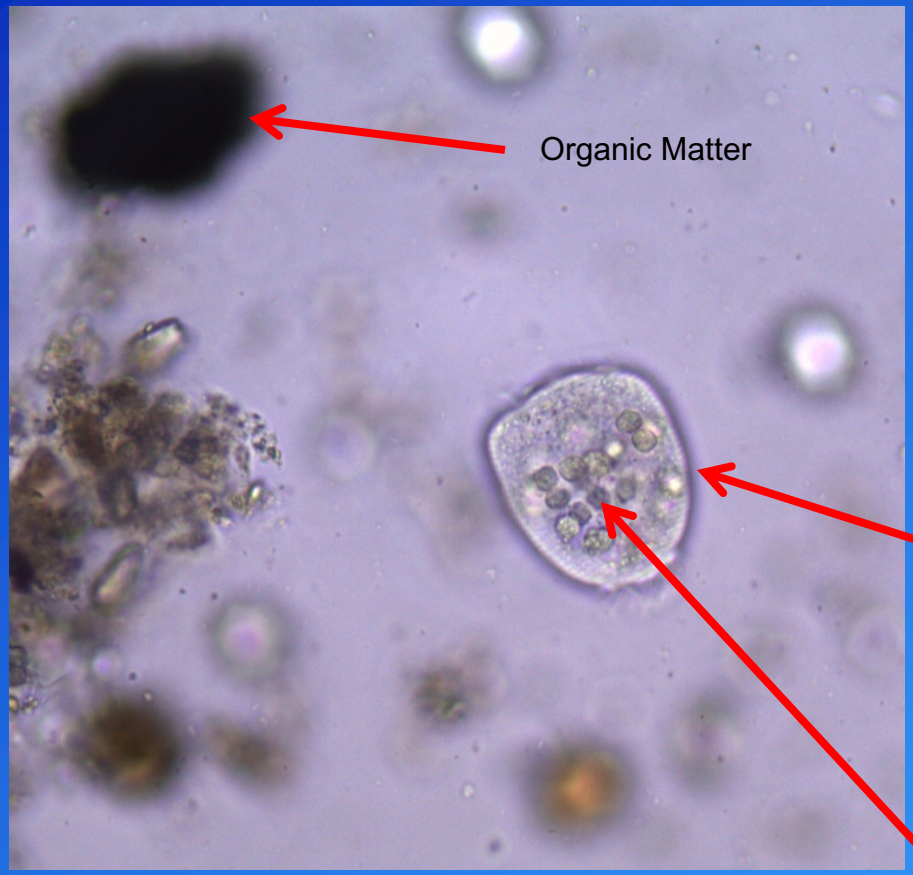


Photo: Emily Bonilla, USDA-NRCS, North Dakota

- Occurs when protozoa consume bacteria.
- Bacteria are richer in proteins (N) and the excess N is excreted and released into the soil when protozoa consume bacteria.

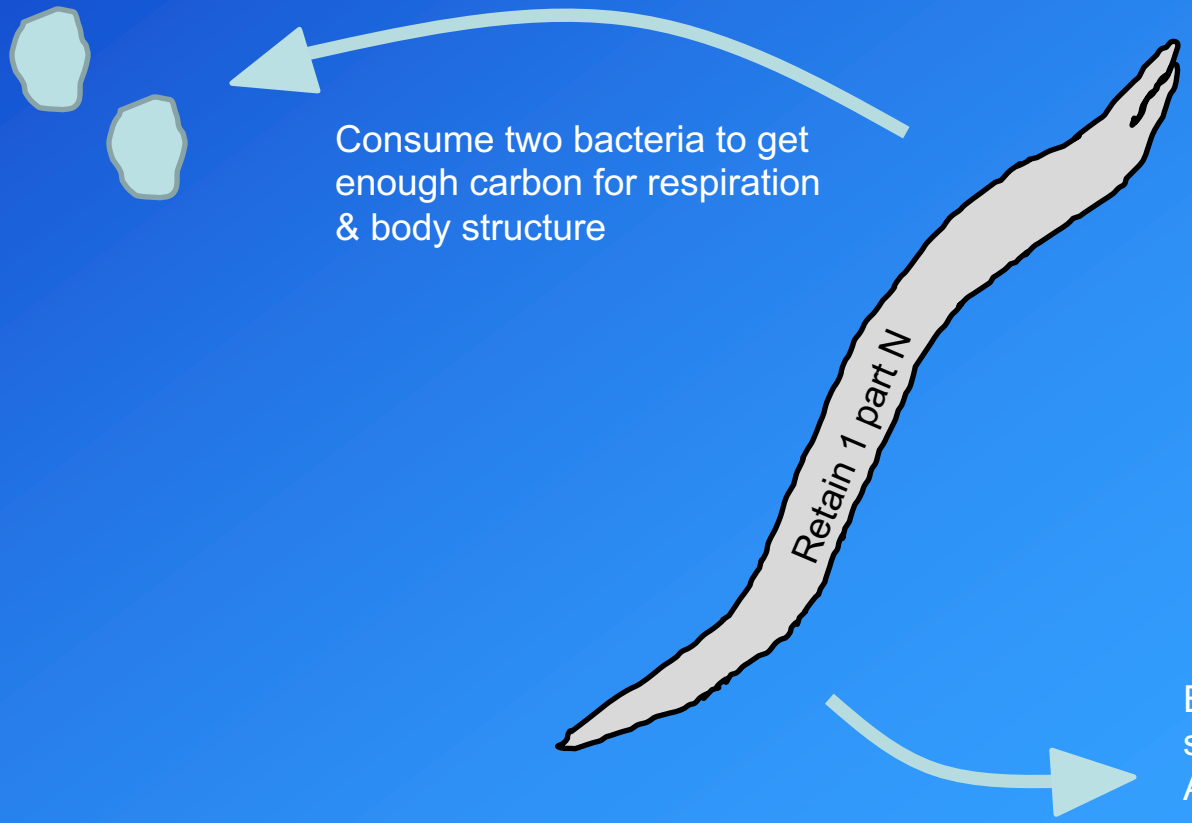
Nitrogen Mineralization

Bacteria

C:N ratio about 5:1

Bacteria Feeding Nematode

C:N ratio about 10:1

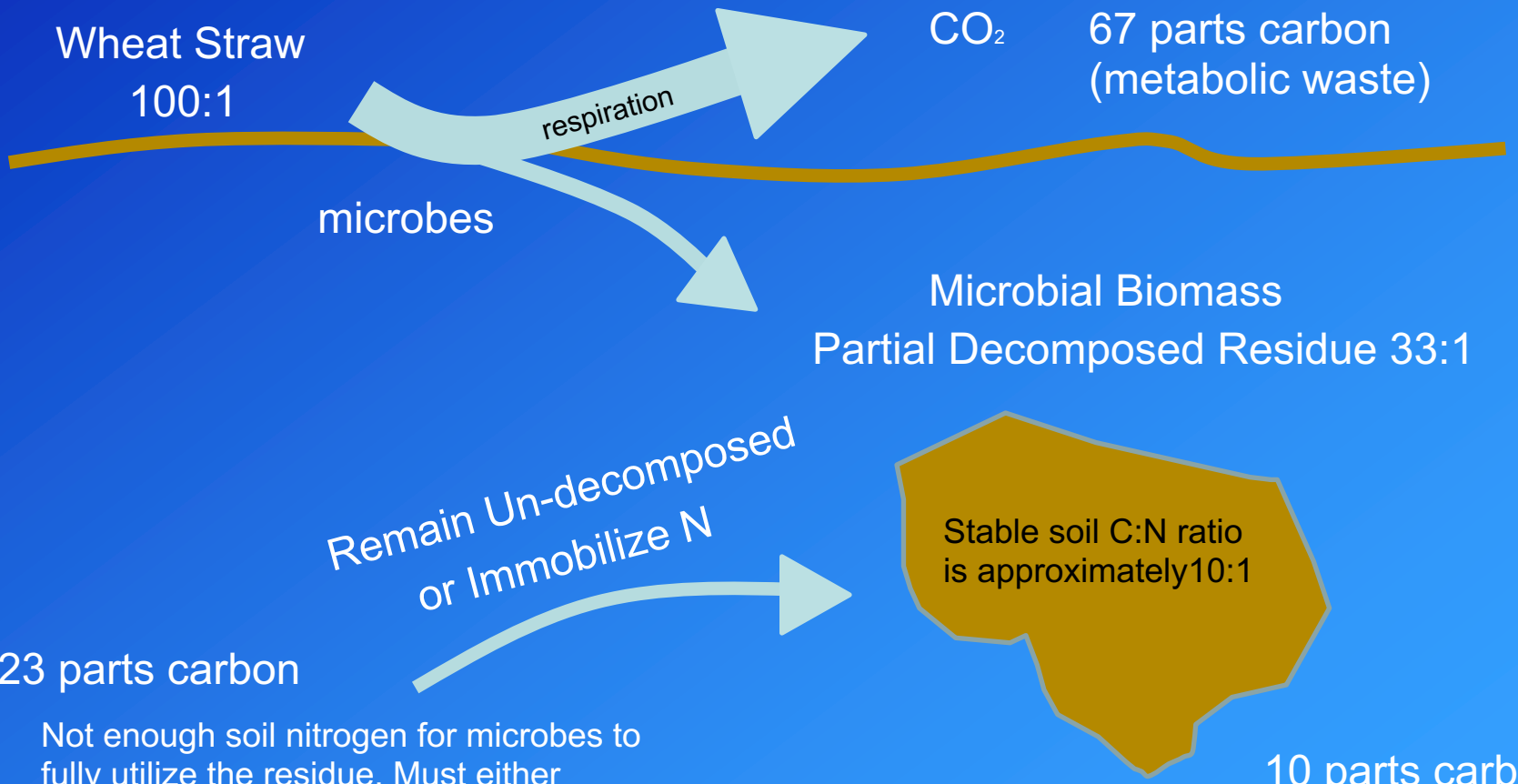


Carbon : Nitrogen Ratio

- Carbon makes up large component of organic matter. Nitrogen comparatively less.
- Soil microbes need nitrogen (for proteins) for life cycle and compete for the limited amounts.
- A high C:N (lots of carbon) does not permit much microbial activity and release of nitrogen.

The C:N ratio of straw can approximate 100:1.
Photo: Steve Hefner, USDA-NRCS

C:N Ratio Example



Use C:N Ratio in your favor

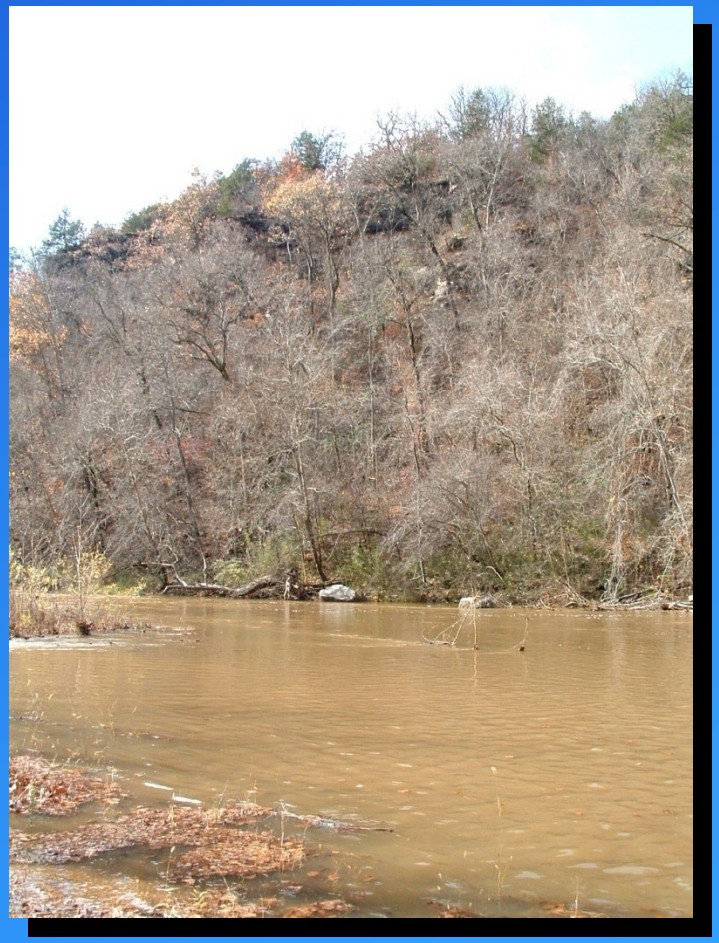
- Need more residue for erosion protection or moisture conservation, then use a cover crop with a high C:N ratio.
- Need less residue for nutrient cycling, then use a low C:N ratio.

Newspaper	400-850:1
Sawdust	~250:1
Wheat straw	100:1
Corn Stalks	60-80:1
Rye	14-20:1
Crimson Clover	15:1
Hairy Vetch	15:1
Cow Manure	10-30:1
Fungi	10:1-25:1
Nematodes	~10:1
Soil	10:1
Sewage Sludge	5-16:1
Cottonseed Meal	7:1
Bacteria	5:1-7:1
Blood Meal	3:1

Sullivan, 2003. ATTRA Publication # IP024

Soil Health &Water Quality Are Linked

- Sediment transport affects water quality and is greatest during storm events. A few large storm events transport the majority of the pollutants.
- Preparation (through conservation implementation) must occur before storm events in order to prevent sediment transport.
- Soil is in every watershed. A healthy, functioning soil is the best defense against sediment transport. Soils that function have less runoff, less erosion, and filter water.



Beaver Creek, Taney County, MO

Impact of Disturbed Aggregates on Tennessee Cotton Fields

Sediment Migration via Urban Storm Water

Douglas County, MO

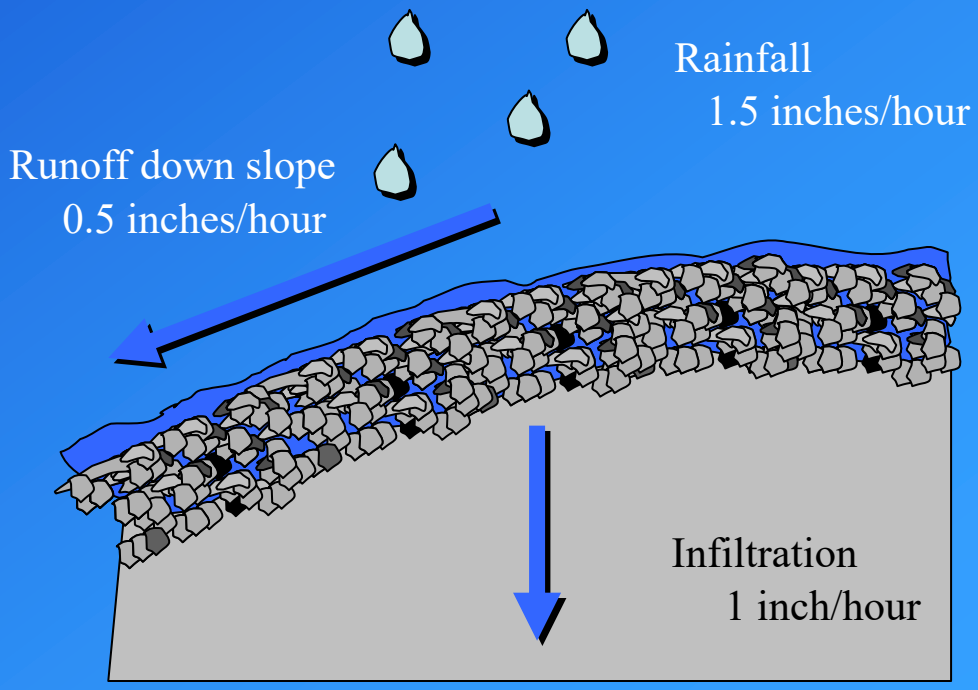
Photo: Steven Hefner, USDA-NRCS

What determines how much run-off is produced?

Some factors include…

- How much rain
- How intense
- How long
- Where rain falls
- Moisture & Storage Level of Soils
- Conveyance of land

Hortonian Flow (infiltration excess)



Adapted from Figure 2.6 Stream Corridor Restoration

Soil Health Principles

"The principles to soil health are universal. How you get there and how fast is up to you."

Jay Fuhrer

1. Keep Soil Covered
2. Less Disturbance
3. More Diversity
4. Living Roots

Jay Fuhrer, USDA-NRCS District Conservationist, Burleigh County, North Dakota

Soil Quality Principle: Always Cover the Soil

- Cover crops during the dormant season leads to greater residue on surface, more biological activity, erosion protection, and ultimately greater organic matter.
- Surface residue reduces surface sealing
- Increase in surface soil organic C increases water-stable aggregation.

Photo: USDA-NRCS

Types of Erosion

- Sheet – soil removed in a uniform manner from all of the slope
- Rill – soil removed in numerous small channels only centimeters deep
- Gully – water concentrates in channels and removes soil to form a deep void.

Soil Temperature

Bare soils promote drought even though we irrigate.

Covered Soil

Bare Soil

Soil Quality Solutions: More Plant Diversity

- Crop rotations should include as many crop types as possible – cool season grass, cool season broadleaf, warm season grass, warm season broadleaf.
- 8, 12, and 15 cover crop "cocktail" mixes were being evaluated with positive results.

Photo: Steve Hefner, USDA-NRCS

Cover Crops

- Cover crops in the rotation help heal soils by adding organic matter, providing cover for erosion protection, and stimulating microbial activity for nitrogen release.

Plow layer easily visible in this soil profile and impedes root growth

Photo: Steven Hefner, USDA-NRCS

Cover Crops

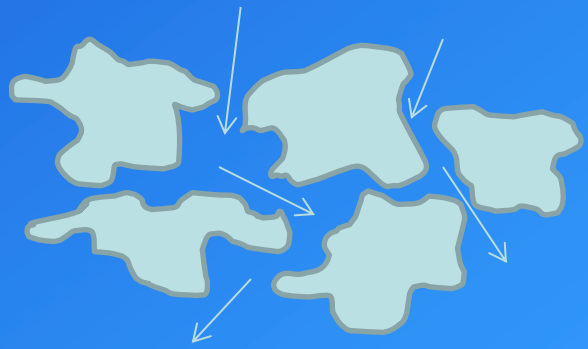
- Feeds soil microbes and helps with nutrient cycling.
- Inhibits weed growth
- Protects from erosion
- Less energy required
- Build OM and soil structure

Photos: Rodale Institute

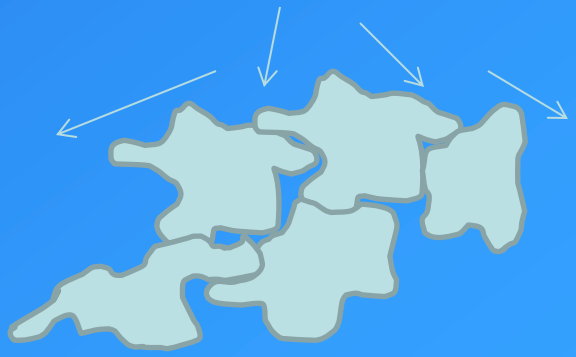
Soil Quality Principle: Less Soil Disturbance

- Disturbance disrupts the water cycle by rupturing pore space between soil particles.
- Ratio of fungi to bacteria is less when soils are disturbed. Fungi are highly desirable.
- Disturbance disrupts the nutrient cycle by introducing air to soil bacteria that consume the carbon in the soil as a food source and release CO_2.

Before Disturbance



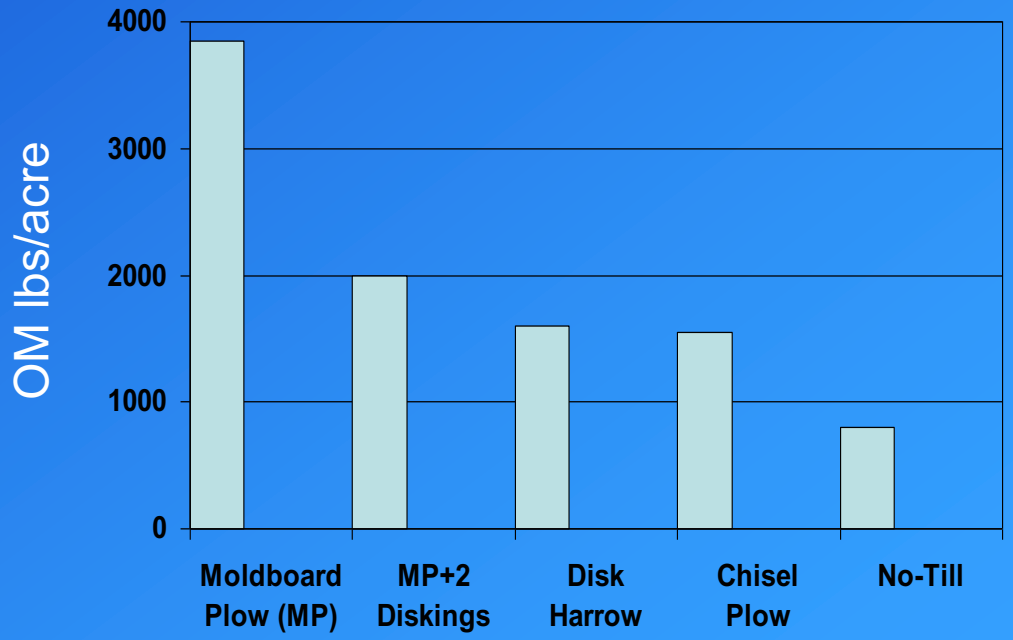
After Disturbance



Soil Quality Solutions: Minimize Disturbance

How much of this soil is covered all year?
How much disturbance has occurred?

Pounds organic matter lost 19 days after tillage.



Auburn University (Reicosky et al., 1995. Agronomy J 85(6) 1237-1243.

Soil Quality Solutions: Minimize Disturbance

More Living Roots year round growth feeds micro-organisms.

Overgrazing is another type of soil disturbance

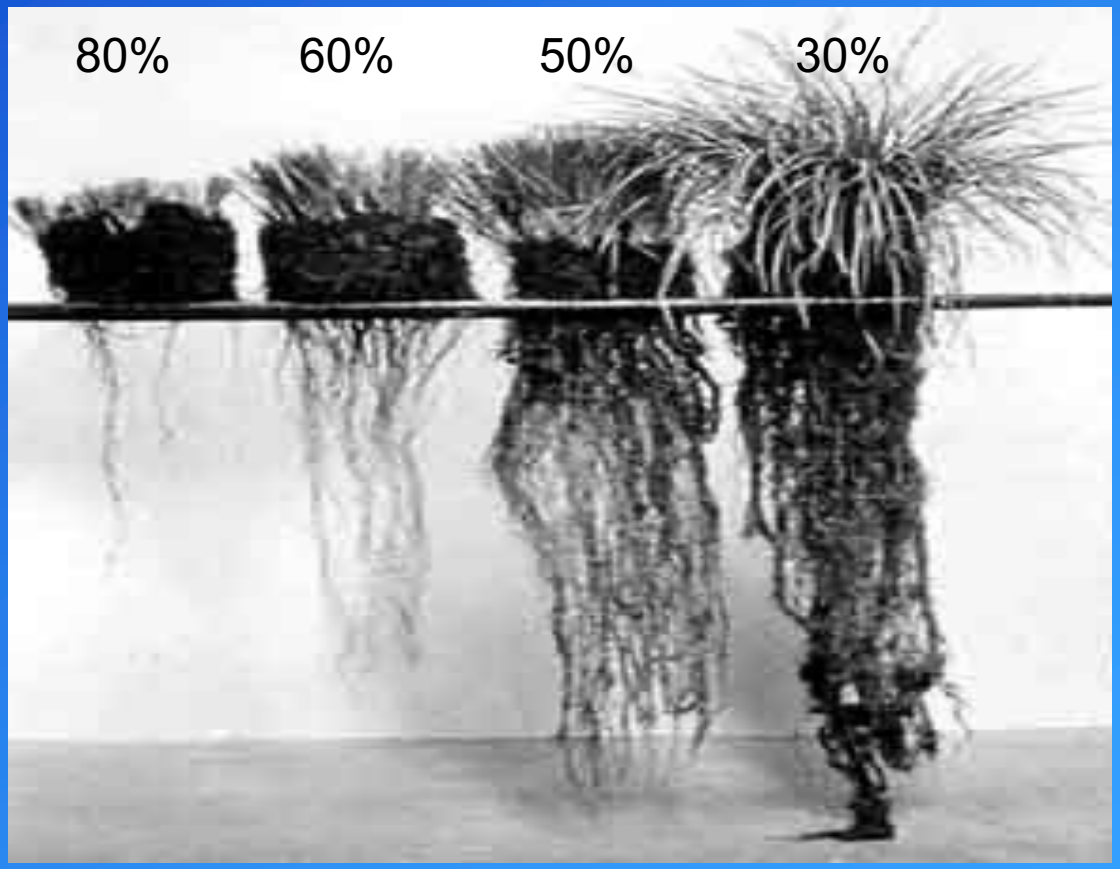
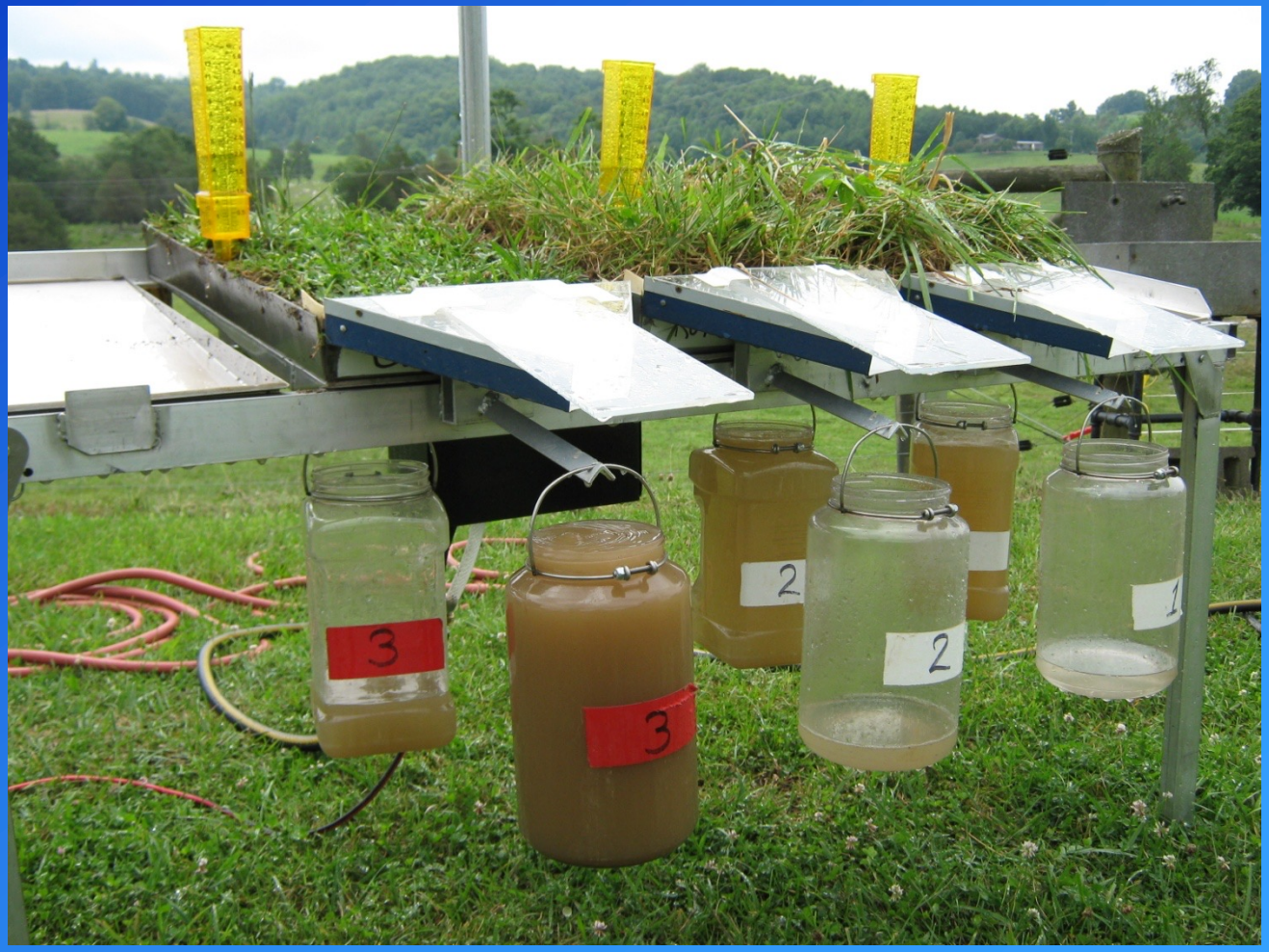


Photo courtesy of NRCS East National Technology Support Center

Grazing Condition & Runoff



Soil Structure

- Grouping of soil particles into aggregates, which can form into plates, columns, blocks, or spheres.
- Good soil structure includes poor space and is less dense than compacted. Structure permits air and water movement, and root penetration in the soil.
- “The soil should be half something and half nothing.”

Photo Courtesy of USDA-NRCS East National Technology Support Center

Glomalin: “Soil Glue”

- Glomalin: a protein and carbohydrate made by fungi that serves as “super glue” to bind soil particles and organic matter (Comis, 2009).
- Strong: it takes a bath of citrate combined with heating at 250 degrees F for an hour to dislodge glomalin in a lab study.
- It resists microbial breakdown longer than other soil components that contain nitrogen and carbon.

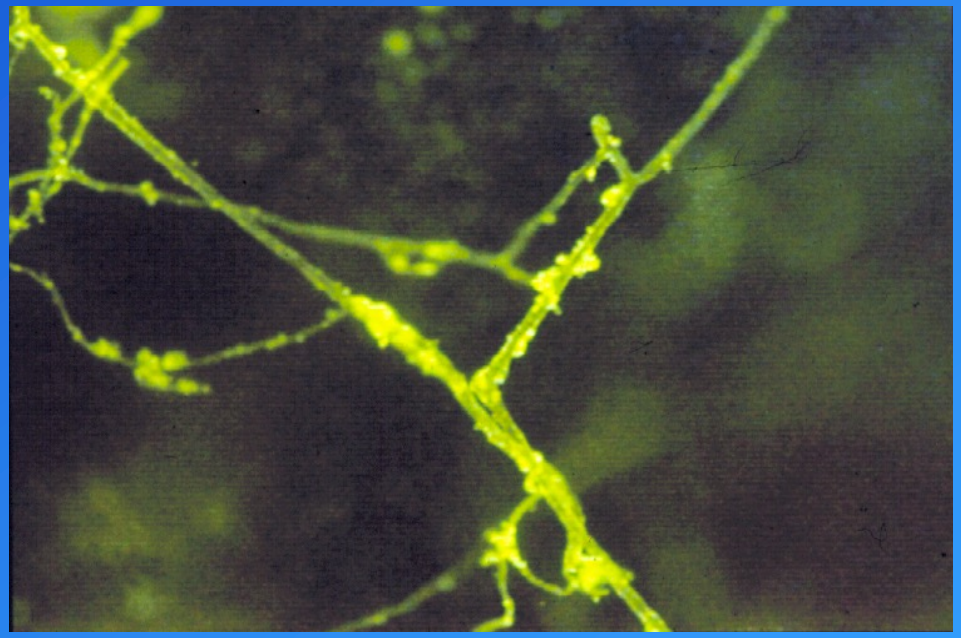


Photo courtesy of East National Technical Center, origin unknown to author.

Living Roots: Stimulate Soil Life

- Plant roots exude sugars.
- Soil biology feeds on sugars.
- Microbial activity cycles nutrients.

Cover crops used in Indiana to improve soils with platy soil structure. Photo: Steve Hefner, USDA-NRCS

Living “Bio-drillers”

- Earthworms – drill macropores, consume residue, excrete waste, exude “slime” that bind soils together.
- Plant Roots – penetrate soil, cycle nutrients, add organic matter when die.

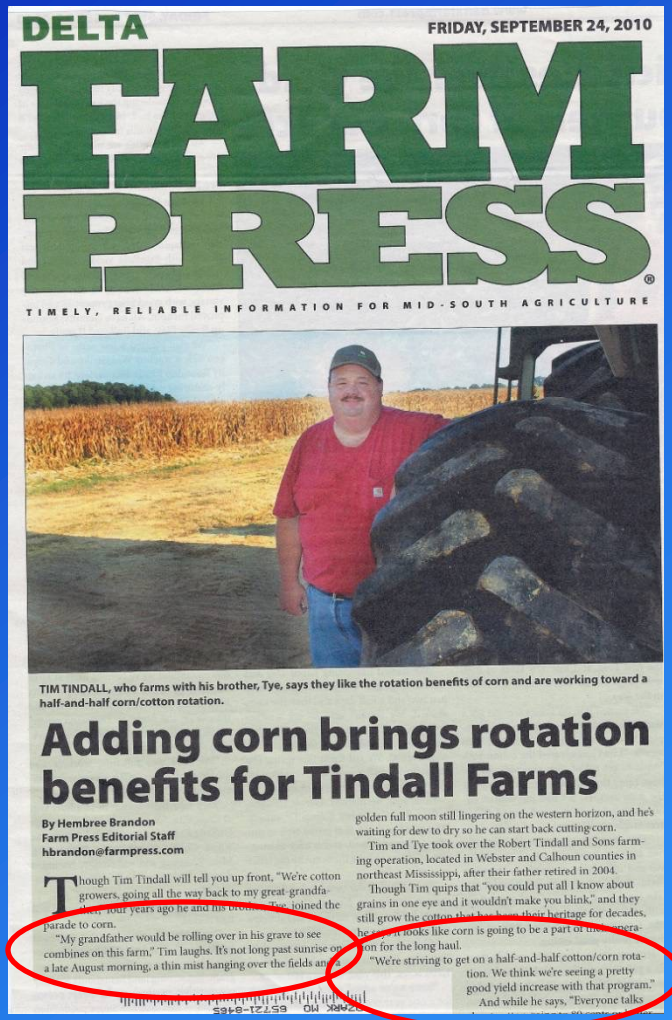
Photo: Steve Hefner, USDA-NRCS

Soil Quality in Southern Agriculture

- "The virgin fertility of our soils and the vast amount of unskilled labor have been more of a curse than a blessing to agriculture. This exhaustive system for cultivation, the destruction of forest, the rapid and almost constant decomposition of organic matter, have made our agricultural problem one requiring more brains than of the North, East, or West."

George Washington Carver

Farmer Testimonials



DELTA FRIDAY, SEPTEMBER 24, 2010

FARM PRESS

TIMELY, RELIABLE INFORMATION FOR MID-SOUTH AGRICULTURE

TIM TINDALL, who farms with his brother, Tye, says they like the rotation benefits of corn and are working toward a half-and-half corn/cotton rotation.

Adding corn brings rotation benefits for Tindall Farms

By Hembree Brandon
Farm Press Editorial Staff
hbrandon@farmpress.com

Though Tim Tindall will tell you up front, "We're cotton growers, going all the way back to my great-grandfa- ther, four years ago he and his brother, Tye, joined the parade to corn.

"My grandfather would be rolling over in his grave to see combines on this farm," Tim laughs. It's not long past sunrise on a late August morning, a thin mist hanging over the fields and a golden full moon still lingering on the western horizon, and he's waiting for dew to dry so he can start back cutting corn.

Tim and Tye took over the Robert Tindall and Sons farming operation, located in Webster and Calhoun counties in northeast Mississippi, after their father retired in 2004.

Though Tim quips that "you could put all I know about grains in one eye and it wouldn't make you blink," and they still grow the cotton that has been their heritage for decades, he says it looks like corn is going to be a part of their operation for the long haul.

"We're striving to get on a half-and-half cotton/corn rotation. We think we're seeing a pretty good yield increase with that program."

And while he says, "Everyone talks

"My grandfather would be rolling over in his grave to see combines on this farm."

"We're striving to get on a half-and-half cotton/corn rotation. We think we're seeing a pretty good yield increase with that program."

Farmer Testimonials

DELTA FARM PRESS

FRIDAY, JULY 23, 2010

TIMELY, RELIABLE INFORMATION FOR MID-SOUTH AGRICULTURE

"IT'S THE BEST-LOOKING crop I've had in years, at this point in the season," says Mark Rogers of the cotton he plants behind calves wintered on ryegrass. He says cotton after calves consistently out-yields his conventional cotton.

Cotton after calves proves good plan for Mark Rogers

By Hembree Brandon
Farm Press Editorial Staff
hbrandon@farmpress.com

They told Mark Rogers it wouldn't work — that cotton grown behind calves wouldn't perform well because the animals would pack the ground so much that the cotton would suffer.

But, Rogers tried it anyhow and has proved the naysayers wrong. Not only is he growing strip-till cotton on fields where calves have wintered on ryegrass, yields on those fields are consistently better than for his conventional cotton.

Cotton and calves are not the route Rogers, who also grows peanuts with his father, Mitchell, near Collins in south central Mississippi, had in mind when he went to Mississippi State University to study poultry science, with the idea of going into the chicken business.

"There's a lot of poultry in this part of the state," he says, "and a lot of people have done well in that business. But, when I got my poultry science degree in 1996, I re-examined the situation.

"The investment cost is heavy — it can easily run a million dollars — and you're stuck with those chicken houses for the

(See COTTON, Page 2)

A PENTON MEDIA PUBLICATION VOLUME 67, NUMBER 29

"They told Mark Rogers it wouldn't work – that cotton grown behind calves wouldn't perform well because the animals would pack the ground so much that the cotton would suffer."

"Not only is he growing strip-till cotton on fields where calves have wintered on ryegrass, yields on those fields are consistently better than for his conventional cotton."

Farmer Testimonials

2 www.deltafarmpress.com FRIDAY, JULY 23, 2010

Cotton behind calves finding success in south central Mississippi

Continued from Page 1

long term in order to recoup that investment. I just wasn't sure I wanted to be tied down to that kind of commitment, either financially or in terms of years.

"So, I came back here and farmed with my father, also growing some cotton on my own, until I figured out what I wanted to do.

"I had grown up in farming. My father has farmed here since the 1960s, and my grandfather and great-grandfather before him.

"My father grew cotton and raised cattle for many years, but when the gin closed in 1976 and everybody around here got out of cotton, he sold his equipment and got out, too, and put a lot of the land in pastures and timber. In 1982, when cattle prices dropped, he got out of cattle, too."

In 1989, a gin opened in Rankin County, about 75 miles away, and he started gradually getting back into cotton. In 1993, he bought a module builder and two 2-row pickers, and since then has steadily increased cotton acres. "We bought a 4-row picker in 1997 and would like to get a 6-row machine, but our terraces and everything are set up for 4-row.

"We're the only cotton farmers in this county and our operation is spread out over a 16-mile radius. Our largest field is 76 acres, but most average 20 acres to 30 acres. The nearest gin now is exactly 103 miles from our shop, Gaddis & McLaurin Gin at Indian, Miss.

It was the challenge of coming up with something to keep farm labor busy during the [illegible] to his present operation.

"I fenced in some of the land, planted it in ryegrass, bought some calves, let them graze through the winter, and sold them in the spring. That turned out pretty well.

"Then, I thought, why not follow the calves with cotton? My belief was that the organic matter from the ryegrass stubble and from the cow manure should be beneficial for the cotton. But, when I mentioned that theory to some old-time cotton growers, they told me it wouldn't work, that the ground would be too packed behind the calves, and that the cotton just wouldn't do well.

Some neighbors who were growing cotton were using a strip-till plow that was giving them good results, which provided him an idea for further refining his calves/cotton idea.

"Basically, they were burning down vegetation with Roundup, making one pass through the field with the strip-till plow and to mark rows, then planting. The plow cuts a 14-inch-deep subsoil slot, which gives the seed soft ground for easy germination and lets the plant's taproot quickly go straight down."

The first year he tried it, Mark says, "almost made me believe what I'd been told about it not working." He had bought one of the strip-till plows, but came planting time and things went somewhat awry.

"I got the calves off late and by the time I was ready to work up the field to plant cotton, we hadn't had rain in six weeks, and the ground was packed hard as a brick —the plow wouldn't penetrate it. The tractor wheels would just spin.

"Thankfully, we got a 1-inch rain to soften the ground and then the plow worked like a charm. That taught me my first lesson — I was going to strip-till, needed rain first.

"The 100 acres of cotton I planted strip-till into the ryegrass stubble behind the calves outperformed everything else by several hundred pounds. The following year, I did it on other land where I'd had calves, and I've gradually increased it every year since.

"I've never had a year in which cotton behind calves didn't outperform conventional cotton, even in side-by-side fields."

"Basically, what I do after selling the calves is to burn down the ryegrass, run the strip-till plow, and then plant cotton right into the stubble — cow patties and all. I figure the manure is equivalent to 3 tons to 4 tons of chicken litter. I've found the cotton fruits quicker, grows off better, and out-yields my conventional cotton. In most cases, it will begin fruiting on the fourth node, compared to the fifth node for conventional."

Mark says this year's crop "is probably the best-looking I've ever had. We got planted on time, had a [illegible] rains, and it has grown off well. I'm just hoping we'll have a good fall so we'll have a chance to make up some of what we lost last year."

Like most Mid-South farmers, 2009 is a year he'd as soon forget as far as cotton is concerned.

"Going into late summer, I had a fantastic crop. I started defoliating late August-early September, and then the rains set in. There was so much regrowth, I ended up defoliating three times. The rain also caused a lot of boll rot. I probably had a 900-pound or better yield going into harvest, but ended up getting only 500 pounds. It was disheartening, to say the least.

"The bright spot, though, was that it was one of the best years I've had for the calves. They gained well — averaging 2.1 pounds a day through the winter — and prices were good, so that proved a lifesaver financially."

Long term, Mark says, his average for cotton behind cattle is 950 pounds per acre and for conventional, about 760 pounds to 780 pounds.

This year, he planted Stoneville 5288B2F, a Roundup Ready Flex/Bollgard II variety, on land behind cattle. "It's a medium maturity, tough, versatile variety that sets a high level of fruiting nodes and has outstanding yield potential," he says. For conventional fields, he planted Stoneville 5458B2RF, a new Roundup Ready Flex/Bollgard II variety that also offers rootknot nematode tolerance.

The cotton was planted May 6 and by early July was blooming well and setting bolls.

PEANUTS have been grown on the Rogers farm for decades. But, when the government quota program was abolished, they opted not to grow for the commercial market; instead, they sell all their peanuts green at the farm.

"Since we're the only cotton farmers around, we don't have many pest problems — unless you count deer, which mowed down 40 acres of cotton last year," Mark says. "The Bollgard technology takes care of any worms, and we may spray a couple of times during the season for plant bugs."

He applies potash and phosphate in the fall when planting ryegrass, and 120 units of nitrogen during the winter. "In most years, we'll apply 1,000 pounds of lime in the spring behind the cattle, based on soil tests. Then, we'll put down 55 units of nitrogen ahead of the planter. I figure the manure from the calves is equivalent to about 40 units of nitrogen."

They've been operating with one four-row John Deere 9965 picker, but recently bought a used John Deere 9960 four-row machine to increase harvesting capability. "We hope to be done by the end of September or early October. I like to have the ryegrass planted by the middle of October."

Mark says he learned a valuable lesson early on — that baling the ryegrass for hay is a no-no for the cotton that follows.

"I baled the hay, planted cotton, and everything was fine until early August, when the cotton started showing a potash deficiency and a lot of it defoliated. When you take that much hay off the field, I found, it also takes off a lot of potash. I haven't made that mistake again."

Mark says they have another 500 acres to 600 acres that could be fenced for the cotton-behind-calves program. "Our soil is basically a sandy clay, and we've found the hill land that drains well does better for ryegrass-cotton than bottom land."

In addition to the improved cotton yields following ryegrass/calves, he says ryegrass also grows better behind cotton. "The only thing I have to be careful of is that some cotton materials have a residual effect on ryegrass."

While a lot of their land in the rolling hills isn't suited to cotton, it does make good pasture land, Mark says. About 500 acres is devoted to ryegrass for winter grazing for 1,000 calves, figuring two calves per acre.

"I'll start buying 325-pound calves in late September/early October and sell them in May, when they're 600 pounds to 675 pounds. They did really well this past winter, averaging 722 pounds at sale.

"They're mostly Angus, Brangus, and Charolais crosses — a little bit of everything. When they go to the feedlots, the breed doesn't matter that much. I mostly look for animals that are uniform in height and weight, and am not that concerned about color."

Unlike the long-term commitment for poultry, Mark says fattening calves overwinter "can be whatever you want it to be — once you sell them in the spring, you're not obligated to do it again if you don't want to.

"I like working with calves, and the ryegrass/calves/cotton program has worked well for me. I've been doing it 12 years now, adding fencing for another 40 acres to 60 acres each year."

In addition to the cotton and calves enterprises, the Rogers have 155 acres of peanuts.

"Rather than taking them to a buying point for processing and commercial uses, we sell them green, out of our shop here on the farm. There is really a good market for green peanuts — a lot of people come out of New Orleans and buy them by the truckload to resell for boiling.

"We grow three varieties, with staggered plantings starting in late March and going into early July. We have 35 acres of Valencias, a smaller size peanut, which we started digging in early July. They'll yield 1 ton to 1.5 tons per acre. We grow about 60 acres of Virginias, a medium-size peanut, which yield 2 tons to 2.5 tons per acre, and 60 acres of Super Jumbos, with about the same yield. By staggering planting and harvesting, we'll have peanuts to sell from early July all the way to Thanksgiving."

Back in the 1970s, Mark says, "My father and his uncle, Dennis Mitchell, were growing peanuts under the government quota system and shared equipment. They grew runner-type peanuts for the oil market. After the quota system was abolished, they were so far away from the mills that there wasn't much profit growing peanuts for the market, so they switched to producing strictly for green sales.

"Our operation and his uncle's are now separate — we're friendly competitors — and we've expanded a little each year. We do only minimal shaking and cleaning after digging the peanuts, then bag them and put them in the cooler until they're picked up."

Mark says he expects to continue with his cotton-behind-calves program for the immediate future.

"My father is getting to the point he may want to retire one of these days, and I don't see myself growing 1,200 acres of cotton long term. There's only so much I can do without stretching things."

"My belief was that the organic matter from the ryegrass stubble and from the cow manure should be beneficial for the cotton. But, when I mentioned that theory to some old time cotton growers, they told me it wouldn't work."

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" I've never had a year when in which cotton behind calves didn't outperform conventional cotton, even in side by side fields."

Farmer Testimonials

Photo: Steve Hefner, USDA-NRCS

"Knowing what I've learned about soil health the last several years , I am convinced that with 5 years and free reign, I can farm anywhere profitability."

Gabe Brown
North Dakota Farmer

Personal Observations: Poultry Litter Amended Soils

- Precision graded crop fields that expose sub-soils.
- Application to Ozark hill ground facilitates legumes growth.

USDA-NRCS photo

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