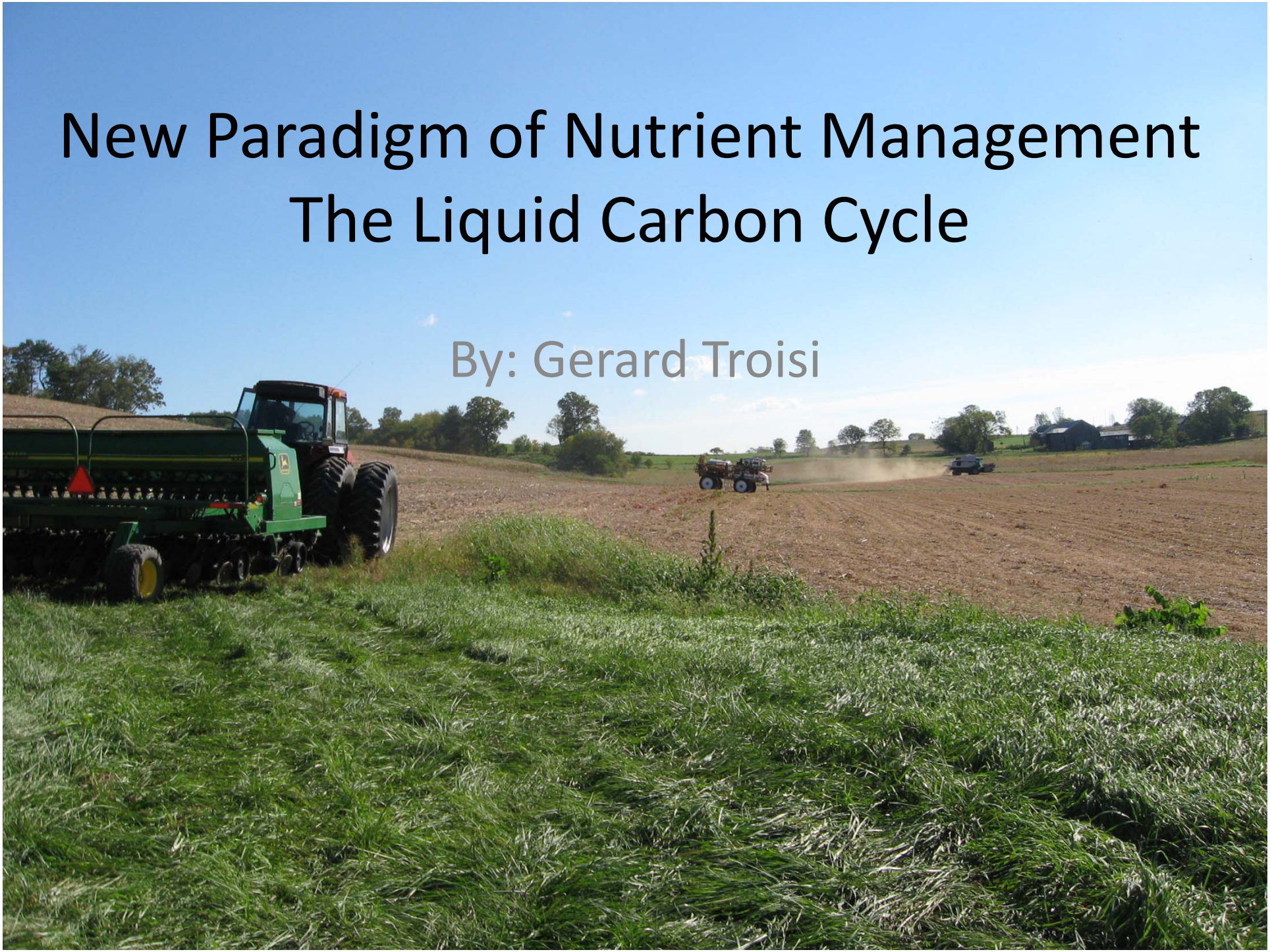
New Paradigm of Nutrient Management
The Liquid Carbon Cycle

By: Gerard Troisi



We Grow Big Radishes in PA

Unfortunately Big Slugs Grow on Big Radishes!

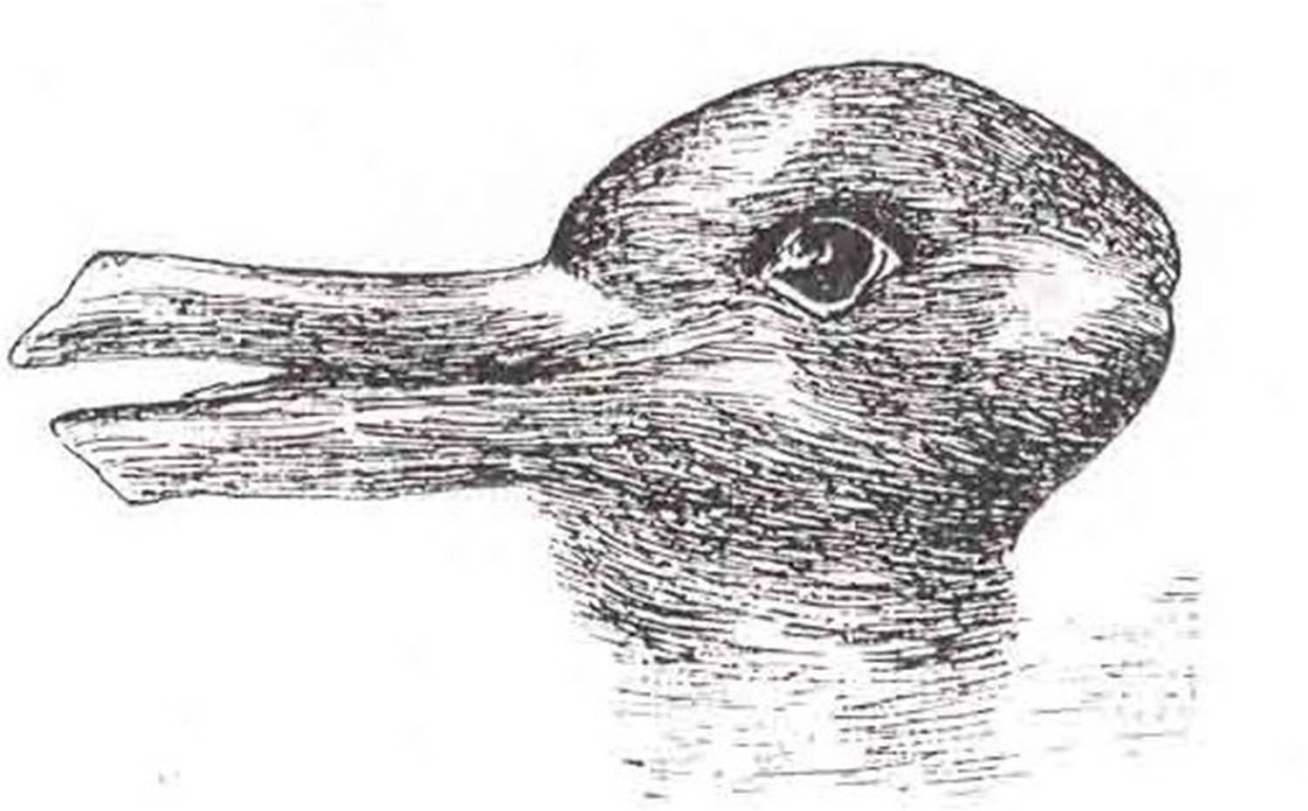
Required vocabulary before we begin.

Paradigm shift: A paradigm shift is a change in the basic assumptions, or paradigms, within the ruling theory of science.

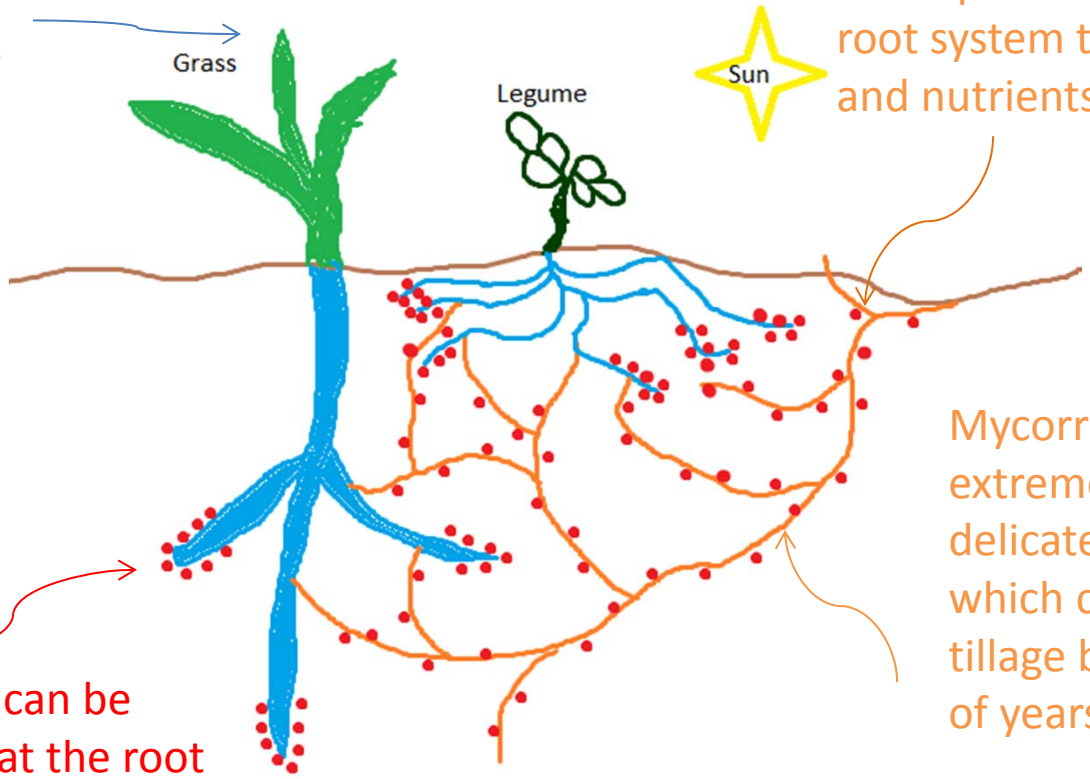
Dogma is a principle or set of principles laid down by an authority as incontrovertibly true.

Chris Columbus and Seiko

A paradigm shift is occurring in the science of agriculture and must occur in order for agriculture to meet the human need for food, fuel, and fiber on an ever shrinking land base without destroying the planet in the process.



Sunlight + CO^2 produce sugar in the plant which is moved to the root which in turn picks up nutrients and water for top growth.



Under specific conditions mycorrhizal fungi infect plant root tips and serve as a second root system to supply moisture and nutrients to the plant

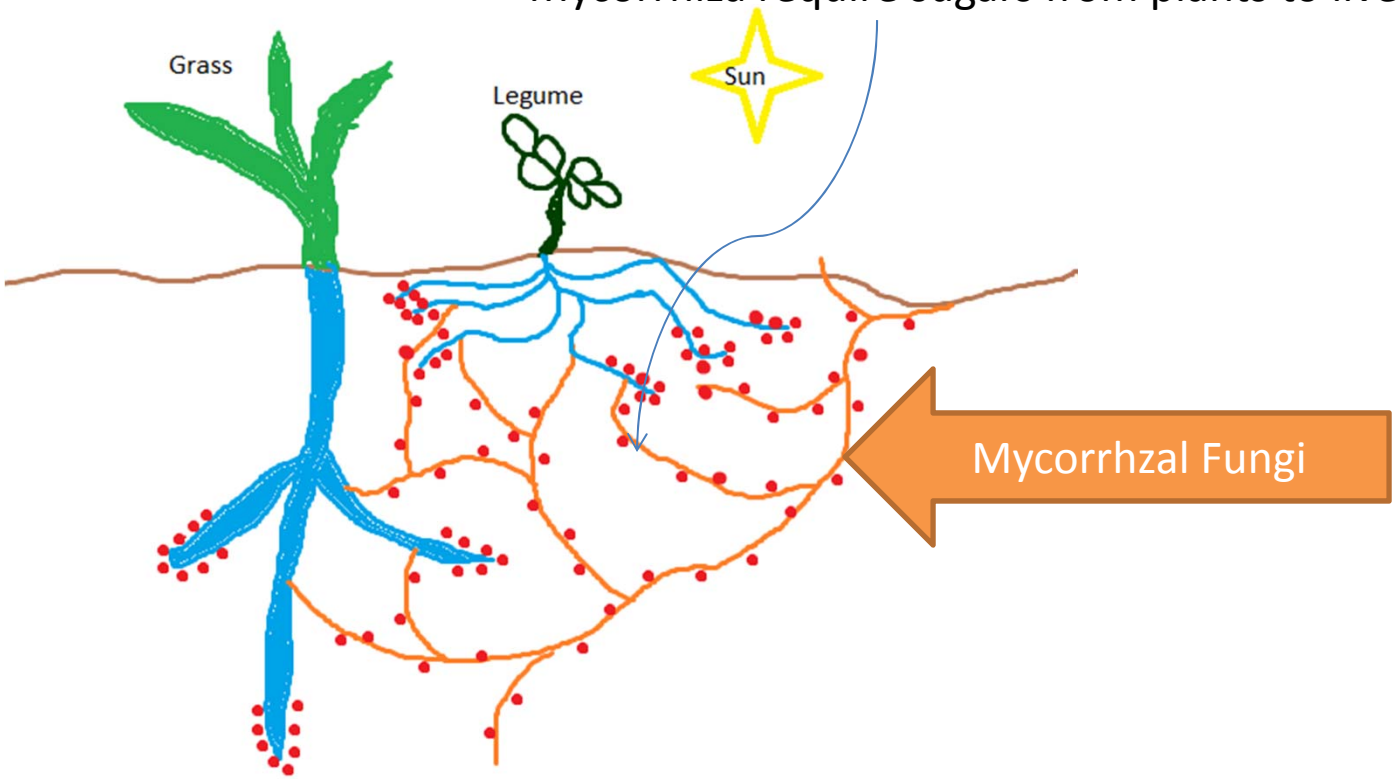
Mycorrhizal fungi are extremely small and delicate structures which cannot survive tillage but can last 100s of years if not disturbed

Bacteria in the soil can be nourished directly at the root tips where sugar leaks out of the plants, where they mineralize some nutrients for the plant, additional nutrients need applied for maximum production

Since mycorrhiza are so small they infect plant cells directly and can support bacteria along their entire length which can be as large as 100 yards connecting thousands of plants from different species Mesh Topology

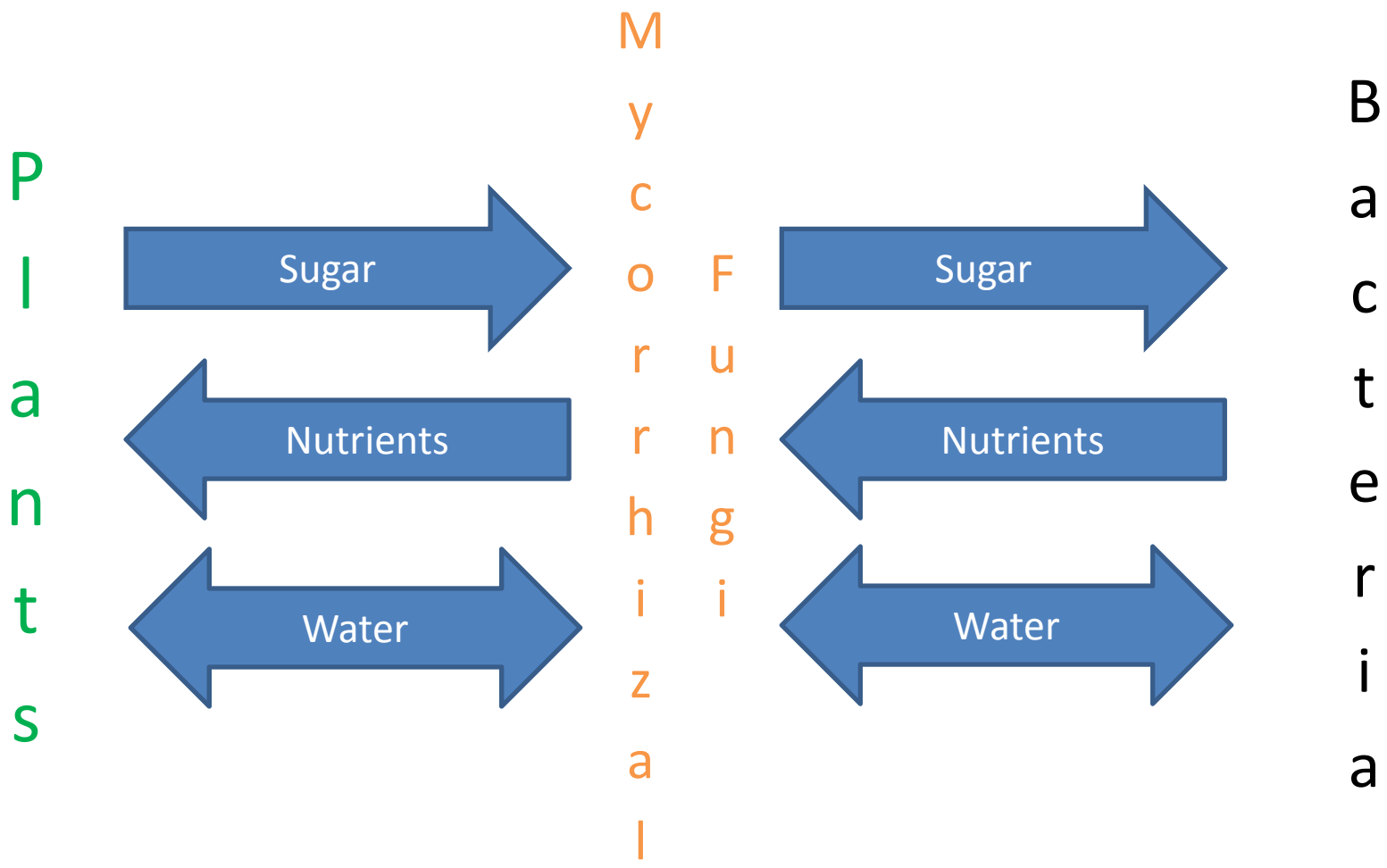
Plant sugar also feeds bacteria on mycorrhiza…some of these bacteria fix nitrogen from the atmosphere, dead bacteria release nutrients which are picked up and transported to plants by mycorrhizal fungi.

Mycorrhiza require sugars from plants to live



Living bacteria also produce nitrogen as amino acid by-produces (Nitrogen) which is not in nitrate or ammonium form so it can't be lost to water but can be utilized by the plant and take less energy than picking up fertilizer nitrogen!

The central player of this system is Carbon NOT Nitrogen, Phosphorous, Potassium or other Macro or Micro Nutrients.



Translocation in mycorrhizal fungi is bi-directional and simultaneous

Mycorrhizal Fungi are living microscopic transportation systems

- Require nutrients from plants to function and grow
- Tolerate very little disturbance of their network
- They are disturbed by traditional crop practices
- Directly responsible for soil stability and water and air infiltration
- 4 times as large by weight in a healthy soil as bacterial life
- 10 times as large by weight in a healthy soil as plant root system
- Directly responsible for organic matter accumulation and soil building
- Capable of supplying all your crop phosphorous requirements
- A major component of soil organic matter in healthy soil, capable of holding an additional 50,000 gallons of water per acre for each 1% of organic matter in addition to the soils physical water holding capacity
- Absolutely Free!

No-till and Cover Crops on Pennsylvania Dairy

James Harbach
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SCHRACK FARMS
Loganton, Pa.
SF 3
SAFETY INSTRUCTIONS

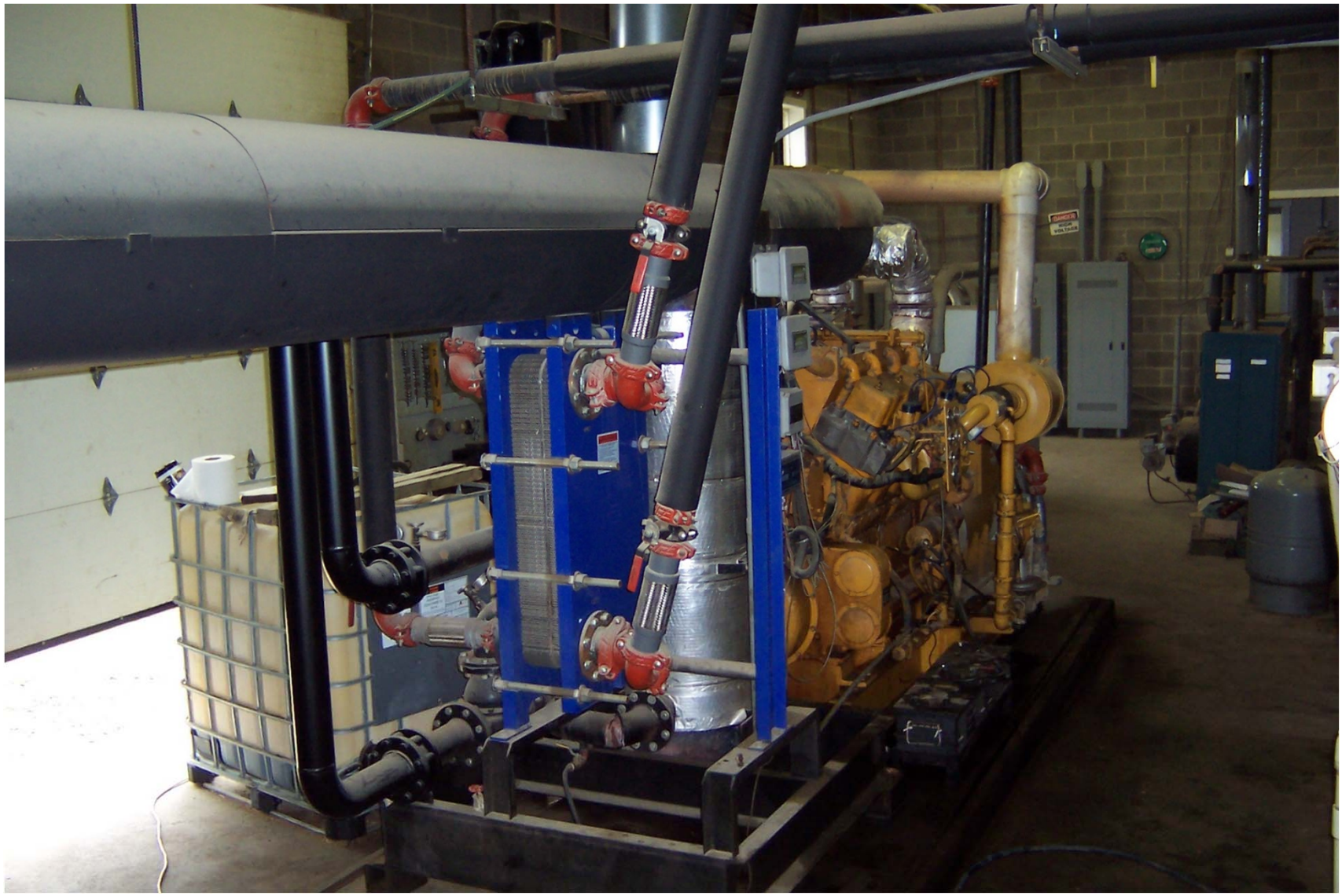
Direct load facilities

Special needs barn

Main free stall barn

All liquid manure on the operation is anaerobically digested to produce electricity

Methane generator



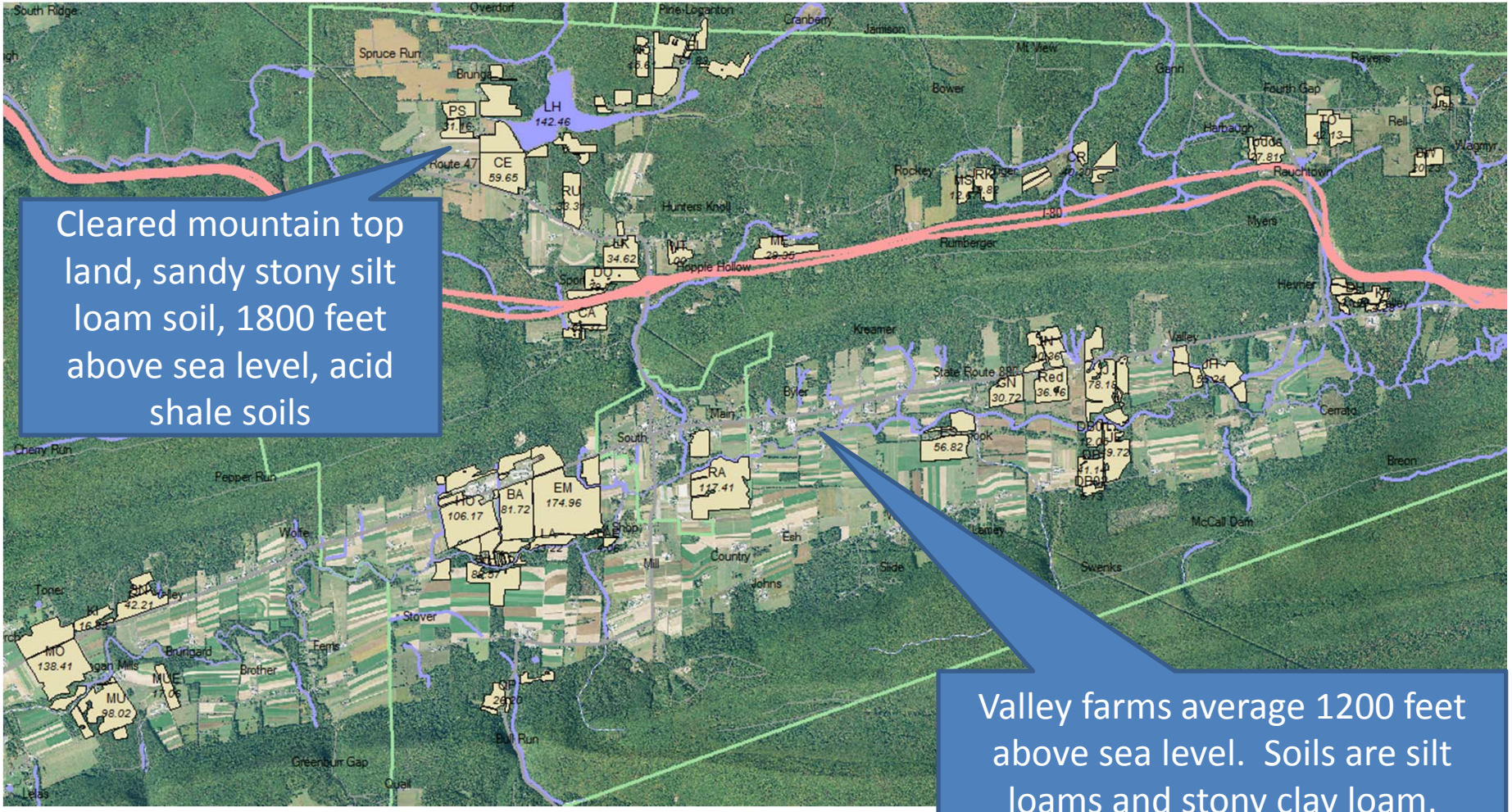
Digested manure passes through this separator to produce solids for use as bedding

Optional conveyer to solids dryer

Separated solid dryer

Separated solids bin…used for bedding

Overview of Sugar Valley, PA



Soil slopes up to 15% , note the large field size compared to local farms and the lack of terraces, waterways and rill erosion control measures required under continuous tillage practices of neighboring farms.

Water infiltration capacity of healthy no-till soil during rain event on frozen ground

Dec 7, 2013

Cereal Rye/ Triticale and Crimson Clover Mixture for cover and forage production

Planted:
Sept 21,2013

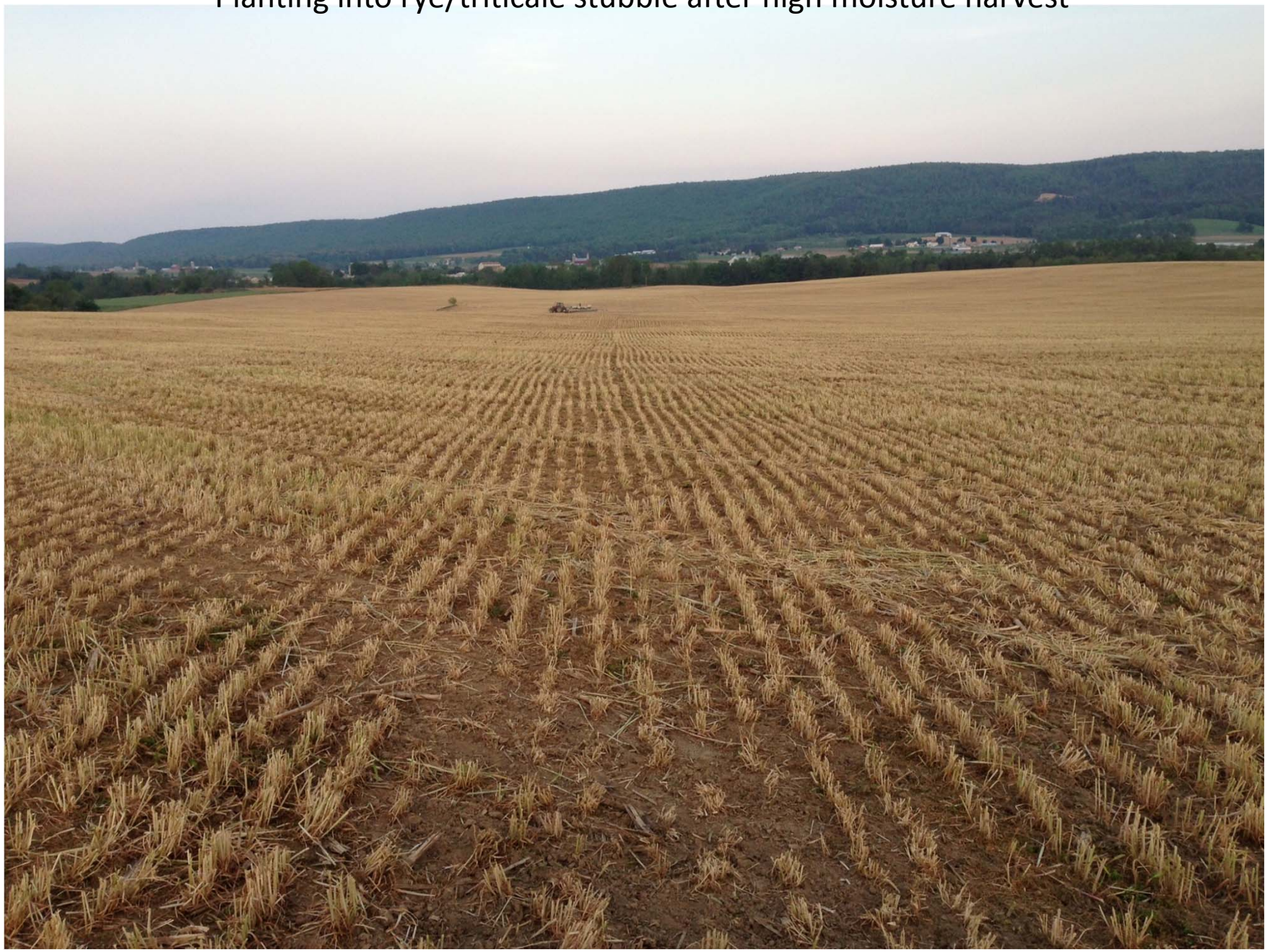
Photo:
Dec 7,2013

Rye/Triticale ready for harvest 3rd week in May

Cover crop of Rye/Triticale layed out to dry for 1 day haylege…perfect seed bed!

Corn planter we used for 30+ years, still in operation

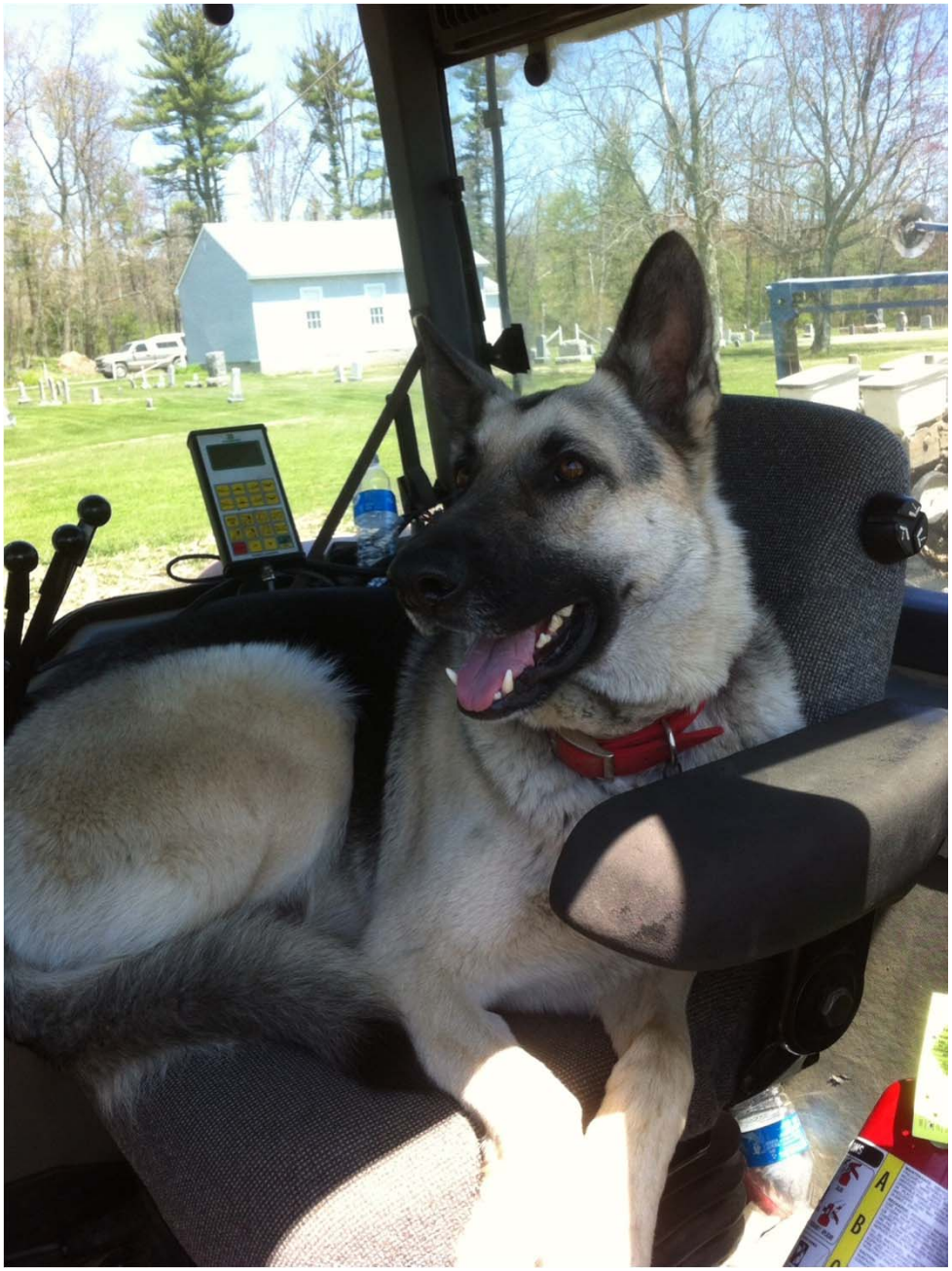
Planting into rye/triticale stubble after high moisture harvest



40 foot planter with interseeding units capable of planting 15” or 30” corn, soybeans or covers


8950
CASE IH
KINZE 3660

Ag Leader planter controller shows corn monitor information and planting coverage map…documents all facets of the planting operation from corn variety used to fertilizer banded



Corn planter operator
uses GPS and Autosteer

Beginning to spread manure on corn planting

Drag hose separated manure on top of corn planting

Note 15” rows of corn across rows of rye/triticale cover stubble less than 3 hours after 9000 gal manure applied

One pass corn after corn for grain the previous year…cover crop rye is no till established after corn harvest, in spring corn is planted into green cover crop and sprayed once with burndown plus corn pre-emergnece herbicide. Fields are scouted at corn emergence to check for insect activity…about 1 year in 5 there are some armyworms that warrant insecticide control. Broadcast applications of insurance insecticide and fungicide must be avoided if soil health is to be achieved.

Check seeding depth frequently to ensure uniform depth of all planter rows…uniform corn emergence is critical to good corn yield, so insure seed is well covered and deep enough for uniform germination…shallow seed placement is the most common problem in uniform stand emergence for beginning no tillers.

Corn in 2013 ripening.

Trench Silos ready for corn harvest

Transitioning from upright storage to trench storage system.


STILES CONSTRUCTION
CAT
CAT

Good soil structure can support heavy equipment without making tracks

Corn harvest continues at a rapid rate once corn maturity is reached. Note Magnum with drill attached and filled with seed. It is critical that cover crop planting keeps up with harvest…in this way…rain does not delay cover seeding, seeding is done in optimum conditions and seeding does not delay manure applications after the field is finished.

No-till grass seeded following corn silage…2nd year

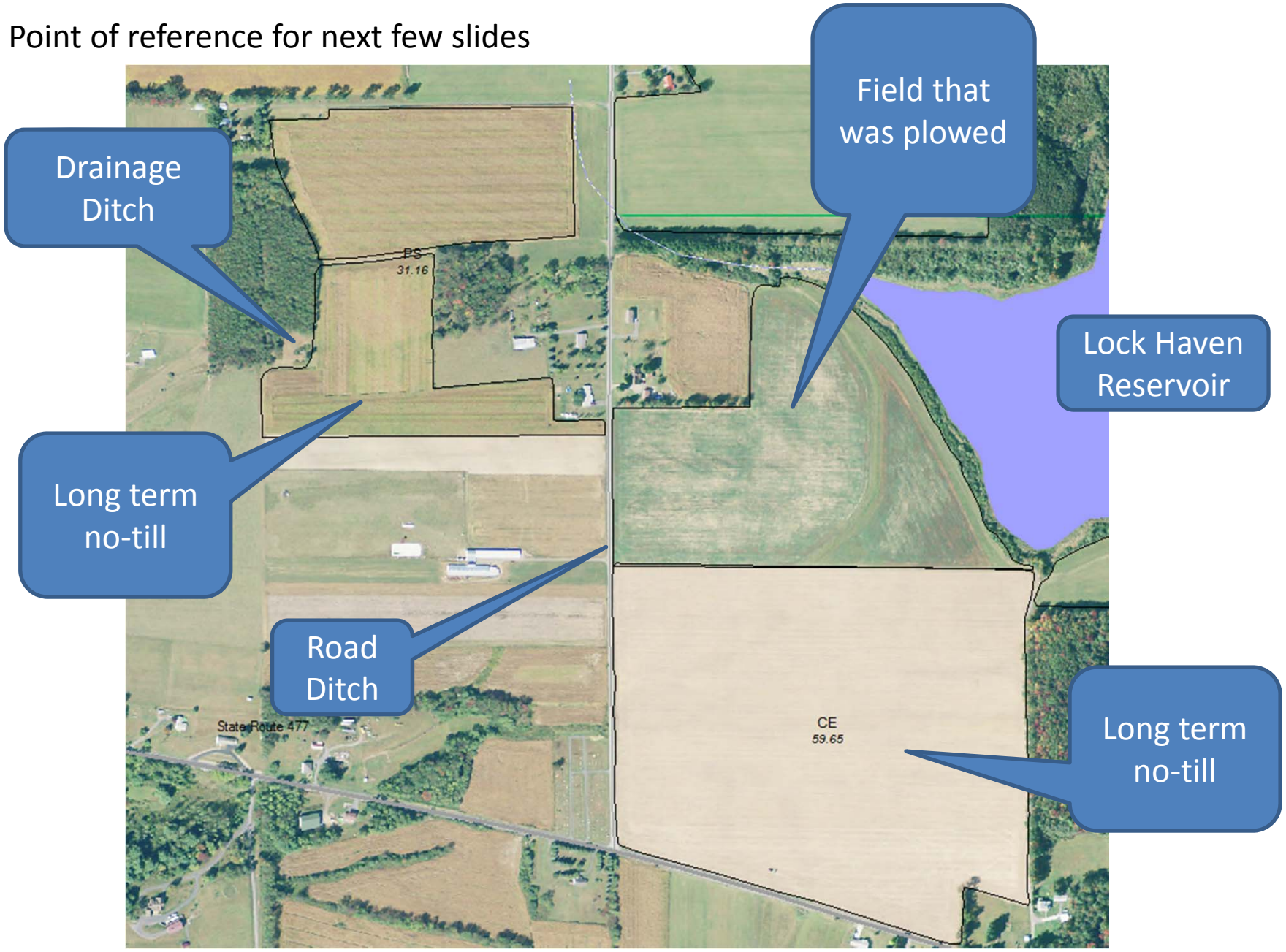
Cover crop of rye following soybean harvest will be corn or alfalfa seeding.

Multi-species cover crop following rye for grain

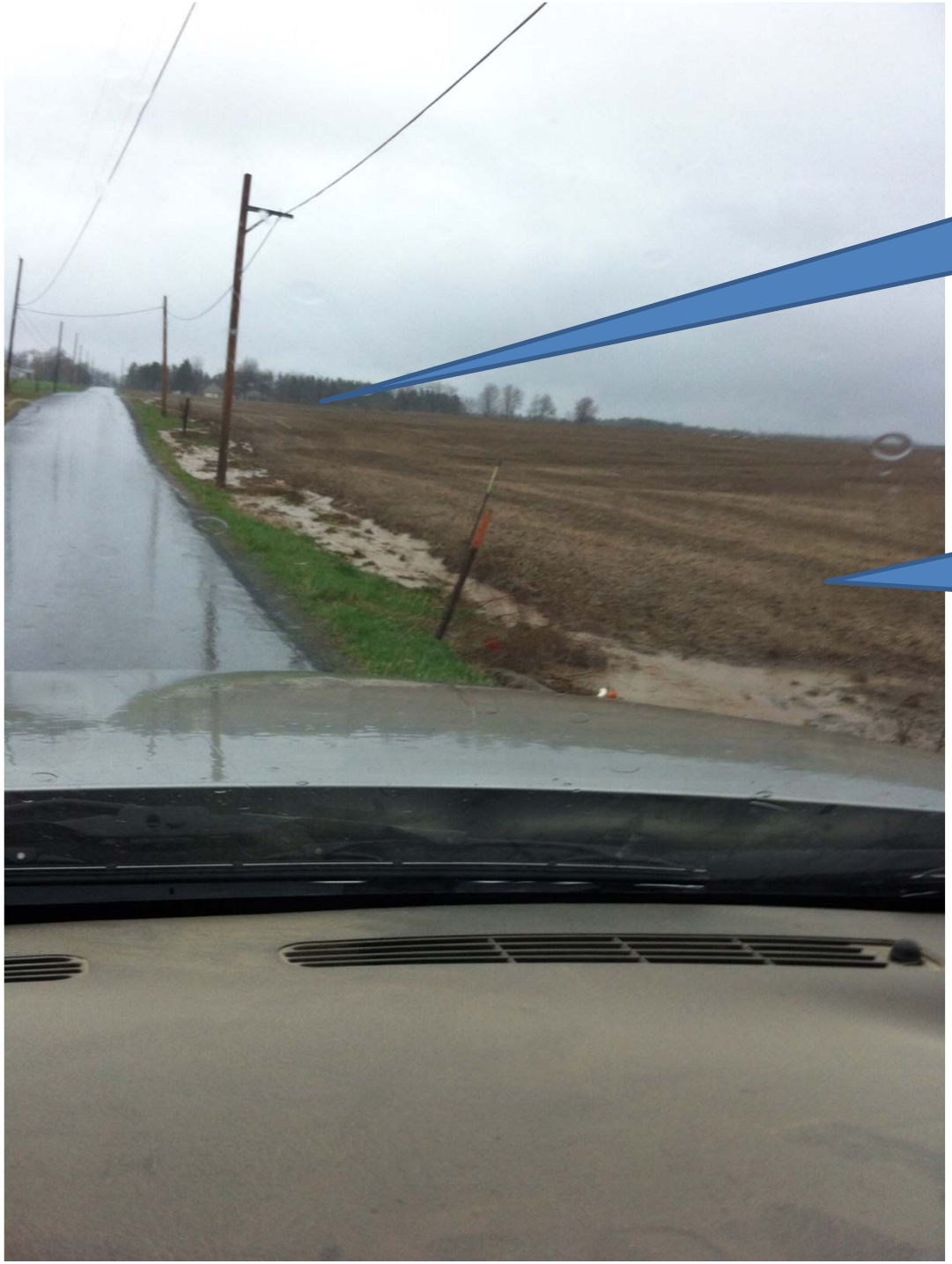
The same field just before frost

Same field while soil testing after frost…note tillage radish are still growing after frost.

Point of reference for next few slides



Plowed alfalfa seeding, plowed because of DEP regulation for water authorities involving expensive water testing.



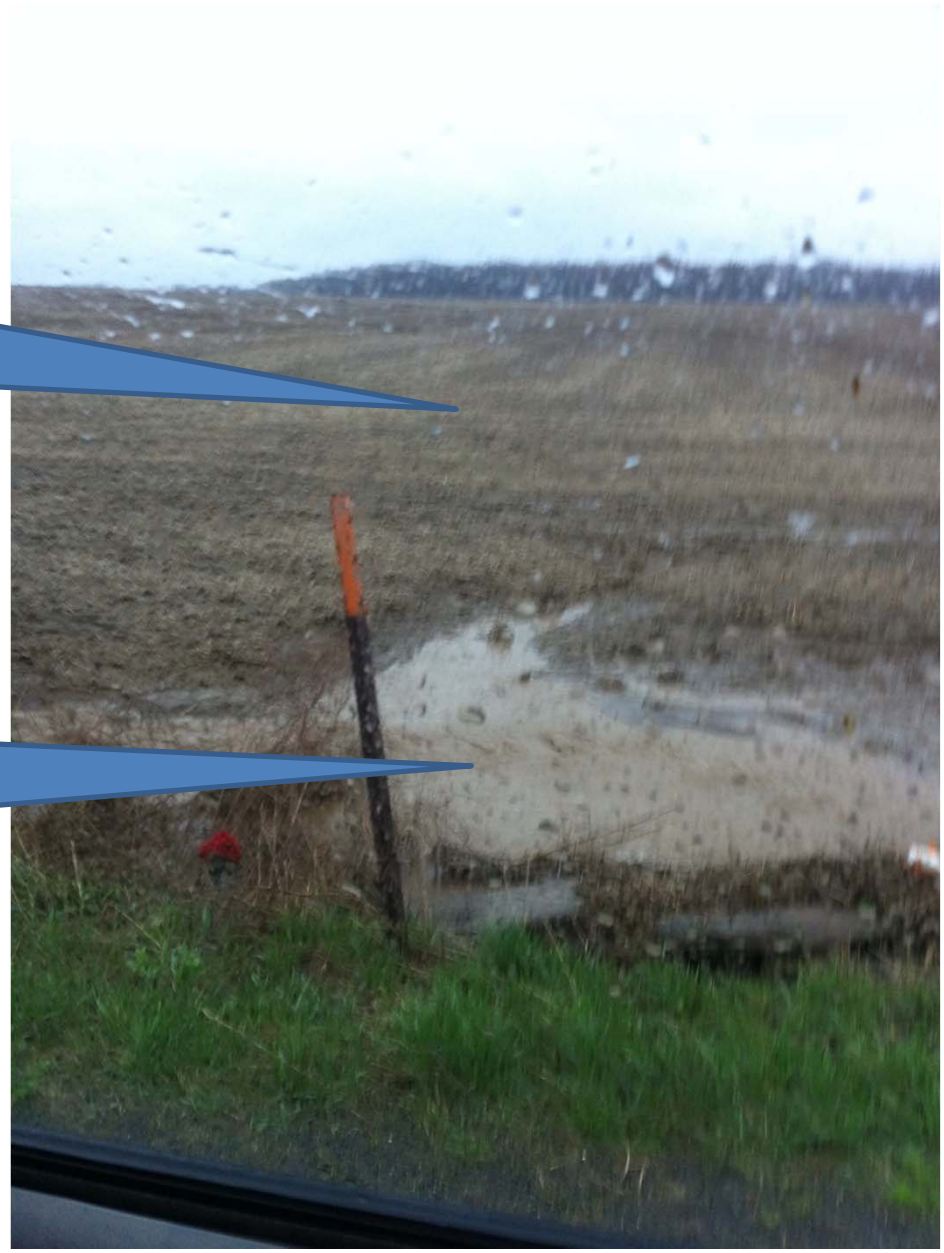
Plowed field sheading soil and water during storm event

Long term no-tilled field not sheading any water or soil

Both class A soils
Both practices in compliance

Another view of no-till field looking up slope showing zero run-off

Muddy water backing up at road culvert from tilled field.



Clear water discharging of no-till field onto drive way…most is soaking in.

Ditch 30 to 40 yards from the field in previous slide, note there is no run-off in this historical waterway into neighbors pasture

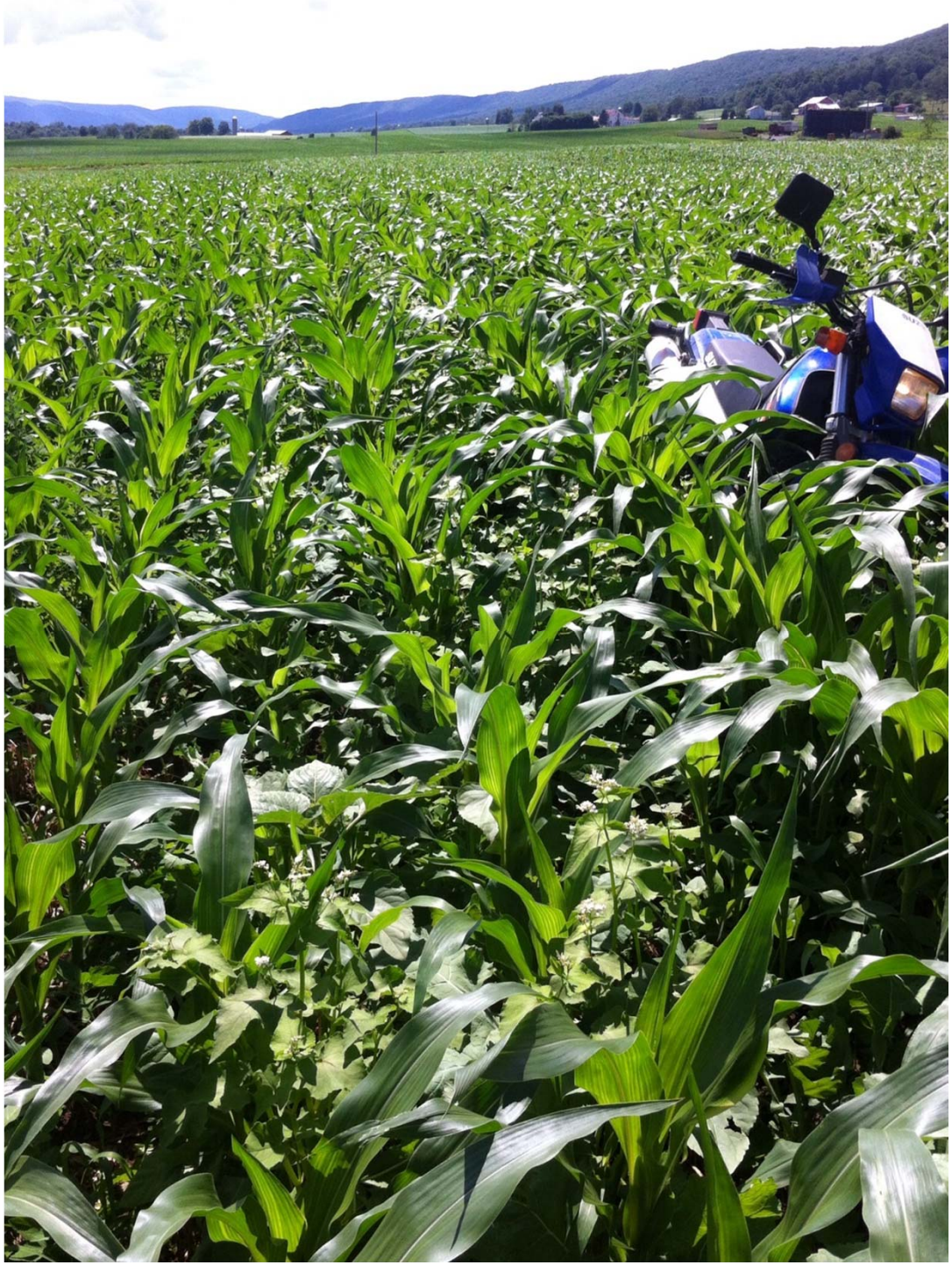
Narrow strip…sod strip above…are we really on the right tract with current Ag E&S? How effective is this approved plan at protecting soil and water?

Not all Ag E&S plans protect water quality…soil health and microbiological filters are real solutions to improving water quality.

Picture after a rain…either side of a hard road same soils but different management

Cover crop following tobacco under continuous tillage…water doesn't soak in and will likely erode

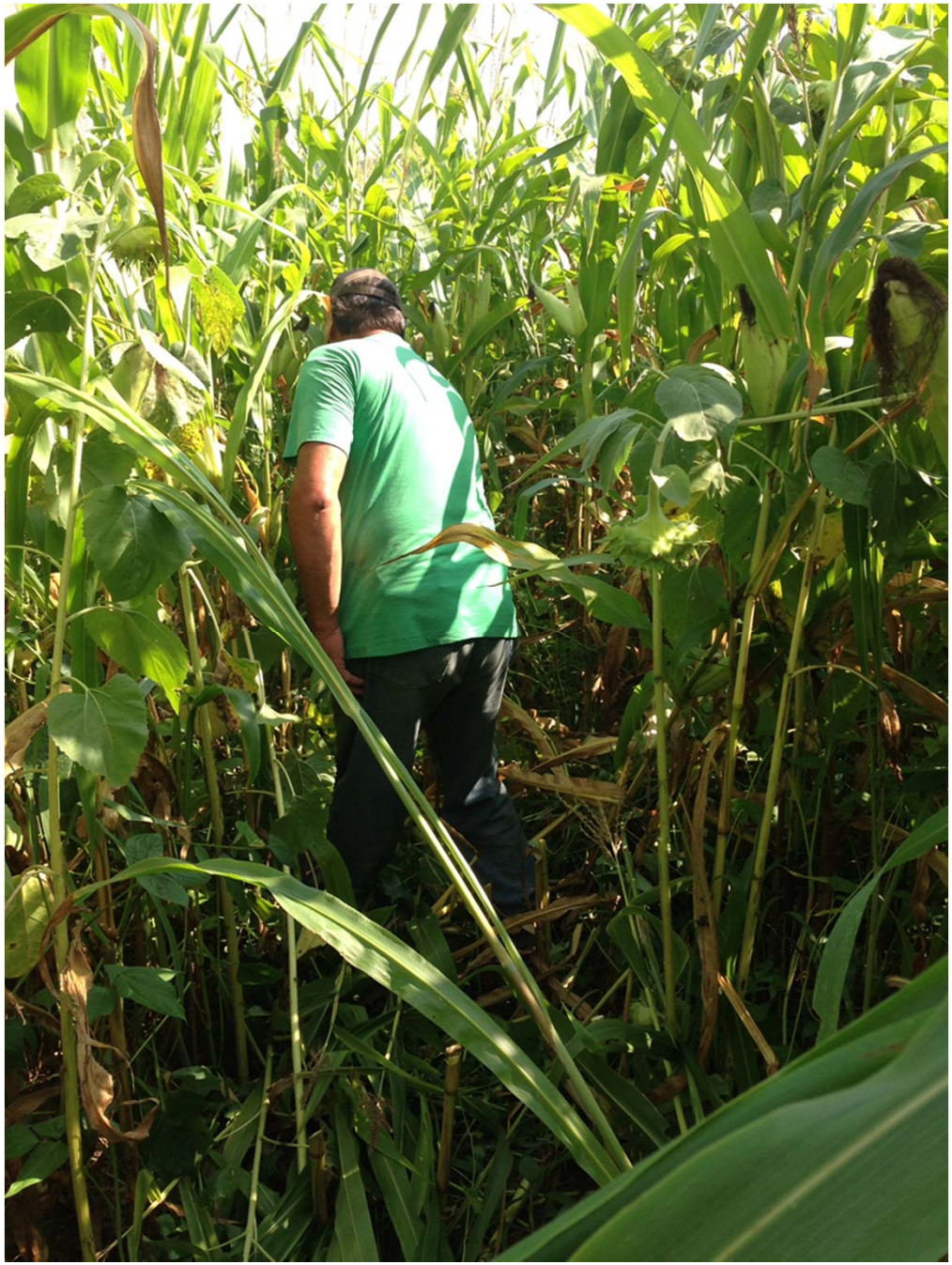
Cover crop following corn silage under continuous no-tillage…water soaks in completely



Eight way companion crop planted with corn.

Corn was planted at 31,000 ppa, drilled 8 way mixture in 15 inch rows immediately afterward and included

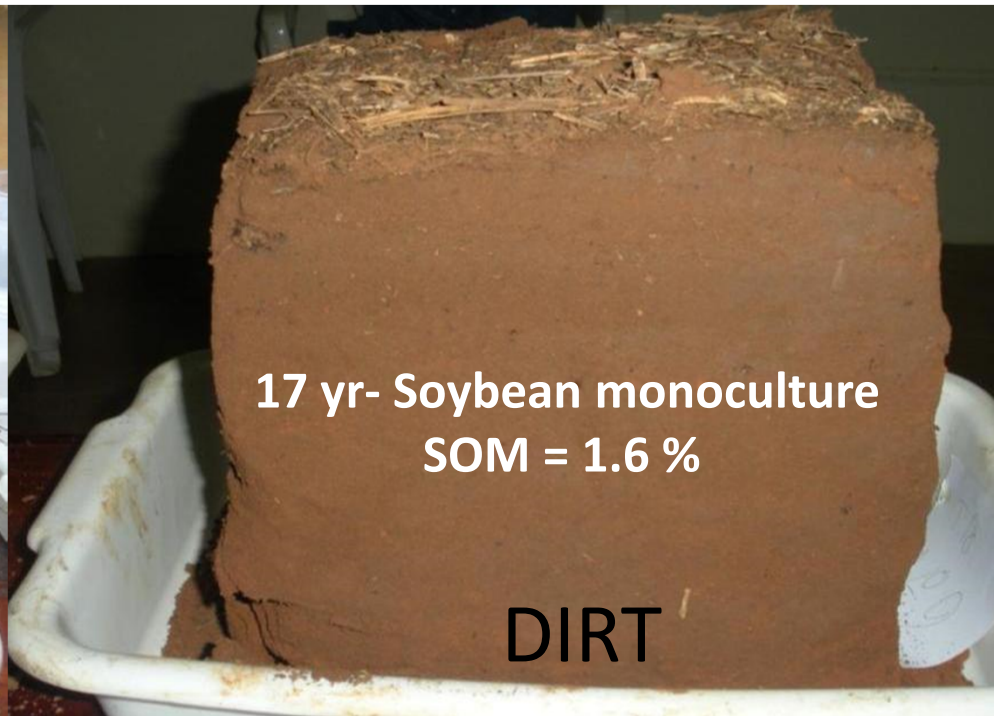
- 11# Non GMO Soybeans
- 3# Persian Clover
- 4# BMR Forage Sorghum
- 2# Graza Fodder Radish
- 2# Sunflower
- 2# Buckwheat
- 2# Canola
- 2# Impact Forage Collard



Preparing a walkway through very thick forage for a field day.

Same Soils: Dynamic Soil Properties Changed with Management!

62.8% loss of SOM after 17 yr intensive tillage



Cottage Cheese

Ohio 2012 Drought

Important points to remember

- Photosynthesis fixes carbon…the key to building soil organic matter
- Food quality and plant health is a function of soil health
- Most microbes are aerobic (need air and water), tilled soils lack the porosity to support such life

Cover Crops

- Seed cover crops as soon as possible or mother nature will
- A weed is mother natures 1st line of defense
- Cover Crops are not a cost… they are an investment
- No-till + Diversity + Cover crops = Soil Health

Healthy Soil Advantages

- There is only one pest for every 1700 beneficial insects, 22% of these eat weed seeds
- Granivores include at least 180 species of ground beetles, ants, crickets, isopods, millipedes, caterpillars and weevils.
- Insecticide applications and seed treatments have been shown to kill 85% of these beneficial insects.

- What are you feeding your micro and macro biology and what habitat are you providing?
- What are you doing to harvest all the sunlight that comes to your farm?

If you think you can or you think you can’t you are likely right.

If you think you can you’re half way there!

Schrack farms hosts a fishing derby for local youth with the Sugar Valley Watershed Association