

What's the Soil Missing? Integrated Crop Rotation and Livestock

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Clare, IL

What's the Soil Missing?

- Diversity
 - Plant species(cash crop & cover crop)
- Animal Impact
 - Manure applied by animal, grazing, stock density, rest time
- Biology
 - Earthworms, microbes
 - *If you build it, they will come*

What we have done to improve the soil while maintaining farm sustainability?

- 1. ROTATE CASH CROPS**
- 2. MINIMIZE TILLAGE**
- 3. ADD COVER CROPS**
- 4. INTEGRATE LIVESTOCK**



IMPROVE BIOLOGY

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IMPROVE BIOLOGY

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- **ROTATE CASH CROPS**

- corn, soybeans, small grains & red clover
 - Shorter season corn=earlier harvest
 - Early soybean planting, typically before corn
 - Oats, wheat, barley, cereal rye, triticale
 - Hay, straw, stalks & stubble for cattle
- Improve yield
- Reduced fertilizer inputs by 40%
 - Credit to placement & rotation
 - 120 units applied nitrogen=200bu. corn
- Reduced pesticide use

Frost Seed Red Clover #12/Acre Into Wheat



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- \$20/acre seed cost



- 1 ton per acre of dry matter in September for hay harvest(~\$100/A)
- 40 units of N credit for the following crop(~\$20/A)

Spring Oats Seeded with #12 Red Clover

- If you choose not to harvest for hay, mow to keep from flowering until termination



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IMPROVE BIOLOGY

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- **MINIMIZE TILLAGE**

- No-till all crops, strip-till corn
 - Reduced equipment
 - Reduced fuel usage
 - Reduced labor
 - Reduced fertilizer rates(placement)
 - Reduced erosion
 - Reduced weed pressure
 - Improved soil structure
 - Improved water infiltration
 - Improved water holding capacity
 - Improved fertilizer usage
 - Improved biological/microbial habitat & population



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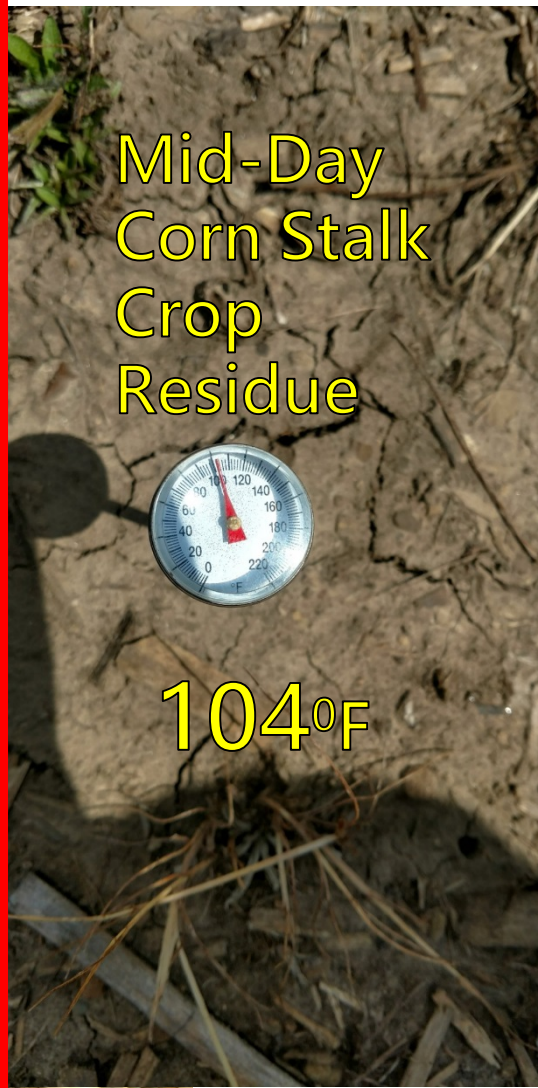
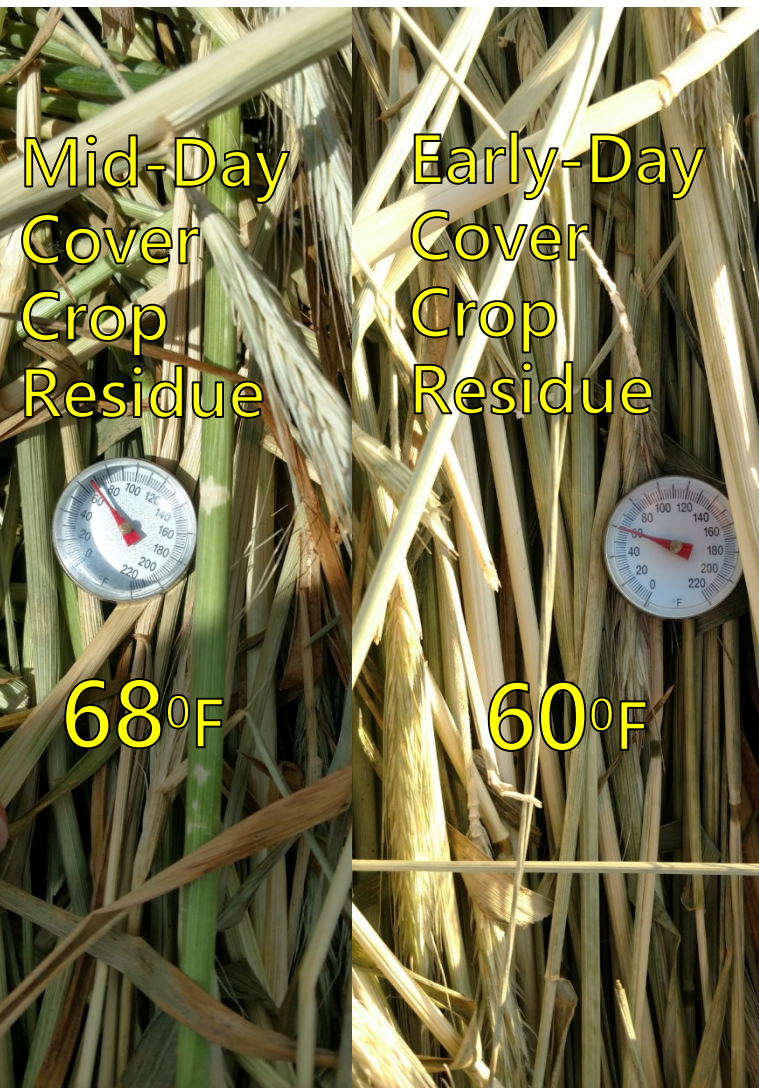


IMPROVE BIOLOGY

What we have done to improve the soil while maintaining farm sustainability?

- **COVER CROPS**

- Added diversity
 - Different species bring added benefits
 - Tillering, N fixing, C:N ratio
- Armor
 - Protect against rain impact, soil crusting, erosion, hot days/cool nights



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- Armor
 - Protect against rain impact, soil crusting, erosion, hot days/cool nights
- Harvest FREE sunlight & soil respired CO₂
 - carbon is deposited in the soil by plants
- Balance the C:N ratio
 - Low C:N -microbes consume excess N by consuming aggregate glue, reducing aggregates & pores in the soil, allowing for runoff(oat & radish residue)
 - High C:N -microbes consume N in order to digest residue(rye & corn residue)
 - When in balance, residue breaks down quicker and N becomes more available

C:N Ratio Immobilizing N Risk

Under 25, little to no risk

25-56, low to moderate immobilization

Above 56, high immobilization

	Lowest C:N	Highest C:N
Soil Microorganisms, Bacteria	5	5
Cahaba Vetch	10	16
Soil Organic Matter	11	11
Austrian Winter Pea	11	17
Purple Top Turnip	11	17
Sunn Hemp	11	17
Hairy Vetch	11	17
Dwarf Essex Rapeseed	12	35
Cowpeas	13	26
Young Alfalfa Hay	13	13
Yellow Sweet Clover	14	15
Berseem Clover	15	22
Medium Red Clover	15	22
Dixie Crimson Clover	16	25
Synergist Mix	16	38
Annual Ryegrass	17	38
Shield Broadleaf Mustard	17	27
Triticale	17	21
80/20 Nitro Mix	17	35
60/40 Nitro Mix	17	33

Winter Mix(36AR, 60TRTCLE, 1.5Rape)	17	28
Kale Hybrid Rapeseed	18	32
Soil Buster Mix	18	38
3 Way Mix	18	38
Oilseed Radish	19	36
Buckwheat	20	35
Rotted Barnyard Manure	20	20
Soybean Residue	20	40
Millet	21	54
Oats (Vegetative)	21	42
Sunflower	22	40
Mature Alfalfa Hay	25	25
Cereal Rye (Vegetative)	26	37
Sorghum Sudangrass	29	75
Piper Sudangrass	34	56
Corn Stover	57	57
Oat Straw	70	70
Wheat Straw	80	80
Cereal Rye Straw	82	82
Newspaper	120	120
Deciduous Wood	300	300

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- Feeding biology
 - Microbes(bacteria & fungi) need a constant food source(plant residue) to survive
 - Protozoa and nematodes consume microbes, turning them into plant available N
- Keep something living on the soil at all times!





INTERSEEDING

80%
success
rate in
S. Ontario

INTERCROPPING

2 CAUTIONS

- 1.) Shade intolerance
- 2.) Herbicide residuals

**Crop grows until canopy
closes, then goes dormant.**

Pic is from Sanderson Ag, DeKalb County, Clare, IL

**V6-V7 broadcast June 27
16 lbs. Bounty RG + 4 lbs. Crimson Clover
11"- 12" June rainfall ♦♦ Pic taken Aug. 15**

Contact Trent Sanderson 815-751-2304 or sandersontrent@gmail.com with Sanderson Ag, Clare, IL







Failed Wheat Crop; Strip-Tilled to Corn









Organic Field

- 2 bu. Cereal Rye
- Soybeans planted June 1
- Drilled 280,000
- Rye roller-crimped after
- Cut worms came in high numbers, black birds grazed like cattle
- Aphids invaded in high numbers, lady bugs had a feast
- Weed pressure minimal
- Yielded 37bu/A, Net \$105/A over conventional





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IMPROVE BIOLOGY

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- **INTEGRATE LIVESTOCK**

- Graze after grain harvest
 - Hoof traffic, manure spread, consume combine grain losses
 - Daily moves with polywire
 - Graze cover crops
- Bale graze over winter months
 - Added organic matter from bale “waste”
- Gives rest to perennial pastures
- Graze annual species planted after small grains
 - Either before a killing frost, or 3+weeks after







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IMPROVE BIOLOGY

• IMPROVING BIOLOGY

- Balanced bacterial-fungal balance
 - Higher fungal ratios improve plant available nutrients, especially in early plant growth
- Increased earthworm population
 - Improve water infiltration, soil aeration, hardpan penetration, reduce soil compaction, incorporate surface residue into the soil, release crop growth stimulants, minerals brought up from subsoil, castings neutralize soil pH, carry microbes in their bodies, improve soil tilth from sugars and enzymes, consume harmful nematodes and create conditions that discourage increased nematode numbers, increased micronutrient chelation
- Increased microbial numbers = more CO_2 = lower C:N ratio = more available N = faster residue breakdown!!
 - Corn greens up after a rain from CO_2 burst, not N
- Carbon-based glues create soil aggregate, reducing runoff and adding air space in the soil profile

The results are in....

- Stopped loss of OM, per soil sample data and observation
- Rebuilt soil structure
- Increased earthworm populations
- Reduced dependency on commercial fertilizers & chemicals



What's Next For Our Farm?

- 100% No-Till
- Additional livestock grazing
- Less commercial fertilizer & chemicals
- Bioreactor compost

