TAPPING THE SOIL RESERVOIR: A TRANSITION FROM HIGH INPUT CONVENTIONAL FARMING TO REGENERATIVE ORGANIC SYSTEMS

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Farm Background

- Mason’s Heritage – 5th Generation Farm
  - Recognized as Maryland Century Farm Spring 2022
  - Currently growing certified organic grain: corn, soybeans, small grains

- Background – followed local crop and farming trends
  - Multiple livestock dairy
    - Hogs, horses, fowl
    - Extended, more diverse operation: grain, silage, rotational forage
  - Cash Crops
    - Corn and soybeans
    - Custom farming
  - Vegetables
    - Local canneries created demand for peas, sweet corn, spinach, beans
    - First irrigation systems installed
  - RoundUp Ready Row Crops
    - Advent of Prescription Farming
Conventional Row Crop Production

- **Apply**: crops are dependent on artificial systems tailored to mass balances
  - *Fertility welfare*
- **Deplete**: soil as a static, linear medium
  - *One way street*
- **Rinse**: create a sterile environment
- **Repeat**: predictable, unchanging systems
- A means to achieve an end, designed to homogenize the environment and minimize diversity
Conventional Row Crop Production

- Prescription Agriculture identifies and addresses the effects, rarely the causes
  - Reactive approach rather than Proactive
- Pest “management” centered on “eradication” makes for a contradiction of philosophies
- Chemical Cocktails – too many components to keep track of
  - Fate in the environment
  - Persistence, carryover, residues -> exposure
- Some Gains Have Been Made
  - Minimum, vertical tillage and no-till have improved soil condition
  - Robust participation in MDA’s cover crop program
    - Introduces farmers to different species and gives flexibility for establishment
    - Still, too many farmers erase a cover crop’s potential early March (burndown)
Mason’s Heritage Soil Health Philosophy

■ (1) Better Nutrient Balance
  - Grow your **Fertility**: Legumes and Mycorrhizae
  - Stepped N mineralization from different sources reduces losses to environment and continually feeds crops
  - *Reduce* imports

■ (2) Reduced Tillage
  - Save **Time, Money & Soil**
  - Field practices must be compatible with soil health practices

■ (3) Purposeful Cover Cropping
  - Staggered Fertility
  - Treat **Cover Crops** like **Cash Crops**
  - *Living Roots* = *Living Soil*
Growing Fertility

- Annual legumes produce the most biomass
  - *Crimson Clover*

- Seeded and established in fall following crop harvest -> dormancy and overwinters through early spring -> rapid spring growth

- A well established crimson cover crop can provide 70 to 90 lbs PAN for the growing season
  - *Fully mature in early May*

- Roughly **HALF** the corn Nitrogen requirement!

- **Challenge**: legume monoculture offers little flexibility during cover crop termination, field fitting, planting and cultivation
Growing Fertility v2.0

- Coordinate a cover crop’s niche with planting schedule
- Sticking with annual legumes, but adding species to stagger the maturity
  - Crimson Clover: early May
  - Hairy Vetch: mid to late May
  - Winter Pea: late May
- Viny legumes (vetch & pea) remain succulent and continue to grow and produce fertility
- Even greater Nitrogen potential
  - 80 to 100 lbs PAN
Reduced Tillage - Soybeans

<table>
<thead>
<tr>
<th>Field</th>
<th>NRCS Match</th>
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</thead>
<tbody>
<tr>
<td>H10</td>
<td>Disk, tandem heavy primary op.</td>
</tr>
<tr>
<td>H10</td>
<td>Disk, tandem secondary op.</td>
</tr>
<tr>
<td>H10</td>
<td>Disk, tandem light finishing</td>
</tr>
<tr>
<td>H10</td>
<td>Harrow, rolling</td>
</tr>
<tr>
<td>H10</td>
<td>Cultivator, row 1 in ridge</td>
</tr>
<tr>
<td>H10</td>
<td>Planter, double disk opnr</td>
</tr>
<tr>
<td>H10</td>
<td>Drill or air seeder single disk openers 7-10 in spac.</td>
</tr>
<tr>
<td>H10</td>
<td>Cultivator, row, finger weeder</td>
</tr>
<tr>
<td>H10</td>
<td>Manure spreader, solid and semi-solid</td>
</tr>
<tr>
<td>H10</td>
<td>Cultivator, flame</td>
</tr>
<tr>
<td>H10</td>
<td>Harvest, stalk chopping corn header</td>
</tr>
<tr>
<td>H10</td>
<td>Planting, broadcast seeder</td>
</tr>
<tr>
<td>H7</td>
<td>Planter, double disk opnr</td>
</tr>
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<tr>
<td>H7</td>
<td>Roller, crimp, covercrop</td>
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</tbody>
</table>

Conventional Till Corn
- Up to double the trips required for NT planting
- Tillage index: **185**
- Pattern (roughness) is a major symptom of excess tillage – early weed control, aka rotary hoe, is less effective
- Wet weather is a major issue – bottoms and mud

No-Till Soybeans
- Half the operations
- Minimal intensity
- Conventional tilled beans mimic the corn
- Tillage index: **5.1**
- Rye/clover mix can produce so much biomass that skipping cultivating operations may be possible
Reduced Tillage
Strip Till Corn

■ Spring Field Operations for Planting
  - Conventional Corn: 4.5 gal/ac
  - Strip Till Corn: 1.0 gal/ac

■ Wet weather friendly
  - Faster field access following rain
    ■ Intact roots = soil macropores

■ 2/3 less soil disturbance
  - 8 to 10 inch swath in the planting zone
  - Remaining 20 inches remains intact
Reduced Tillage: Think Infrastructure

- Analogy: think of a healthy soil as a healthy economy which depends on interconnected networks or infrastructure – roads, bridges, railways, highways
Purposeful Cover Cropping

Old Model: mono-species & mono-purpose

■ Logistical logjam
  - Weather
  - Equipment

■ Fertility losses
  - Nitrogen mineralization and leaching

■ Extra Operations
  - Flushes of weeds

■ Some species are difficult to establish late into fall season

New Model: multi-species & multi-purpose

■ Resilient

■ Achieve a balance between N production and weed suppression
  - Strip Till Corn: rye + peas

■ Greater biomass and redundancy
  - No-Till Beans: rye + crimson

■ Experimenting with rapeseed (Canola)
  - Taproot fights compaction
  - Adds tough biomass armor for better weed control
  - Flowers to attract pollinators
How Do you Implement the Alternatives to Conventional Production?

- Answer: Biomass Management
- Most producers have the equipment toolkit to implement
  - *No major new investments in machinery*
  - *Small modifications/adjustments needed*
Living Roots Create Living Soil

- 11 out of 12 months of soil with living roots and cover
  - Conventionally Tilled Corn and No Till Soybeans, 2-year rotation
  - Static soil health indicators: organic matter, soil protein, respiration, AWC, bulk density

- What is the problem??
  - Tillage seems to be erasing any gains we should be making
Build a Reservoir, Not a Drain

- Health soil can pool Nutrients, Water, Carbon
  - Aerable soil has the potential to sink more Carbon than the oceans and atmosphere

- Soil as a Savings Account!
  - Deposits are better insured, secure and more easily withdrawn . . . Talk about your fiscal fertility!!

- Efficiency!
  - Which rhizosphere finds, extracts, transports and metabolizes nutrients the most efficiently?
Humic Acids to the Rescue

- Complex hydrocarbon chains can:
  - Bind and release nutrients
  - Buffer and stabilize pH
  - Form a “spongy” network and store more water!
  - Resist compaction like a spring

- Cation Exchange Capacity (CEC)
  - Sand: 2 to 10 meq/100 g
  - Clay: 25 to 100 meq/100g
  - Organic Matter: 250 to 400 meq/100g
Cover Crops Help Reverse Anthropogenic Impacts

- Expand your weather window
  - Access fields sooner following rain events

- Disrupt weed pest cycles: know the IPM pest triangle
  - Pathogen : Susceptible Host : Favorable Environment
  - Interrupt/disrupt any of the three factors will reduce viability

- Restart nutrient cycling: Nitrogen, Phosphorus, Carbon, H₂O
  - Ubiquitous living roots continually capture, store and release Nitrogen, Phosphorus and Carbon in natural, slow-release pathways
Soil Health: Hedge your Bets on Climate

- **Warmer**, increase of 2.2 to 7.6 degrees F
  - *Crop stress: pollination, plant growth inhibited*
  - *greater plant evapotranspiration* -> *just for keeping cool*

- **Wetter**, increase in annual precipitation
  - *More rainfall events*

- **Wilder**, greater frequency of intense extremes
  - *Intense rainfall*
  - *Longer droughts* -> *depleted soil moisture later in growing season* -> *crop stress*
  - *Increased pest pressure: existing and new species*
Questions? Comments?? Chit Chat???

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