REGENERATING YOUR SOILS
Brown’s Ranch
Bismarck, ND
Cropping System:
- 15” Total Yearly Precipitation
- Tillage – Half Summer Fallow, Half Crop
- Monocultures – Spring Wheat, Oats, Barley
- Continual Use of Synthetics: Herbicides, Pesticides, and Fungicides
- Organic Matter Levels: 1.7 to 1.9%
- Infiltration Rate: ½” per hour
Grazing System:
- Three Pastures – Season Long
- Pairs Run on Crop Aftermath Following Harvest
- Calving in April in Corrals
- Cattle Confined To Lots During Winter Months
- Fed Hay 6+ Months
Conventional Practices
1994 Purchased A 750 No-till Drill
1994 Added Peas for N Fixation
32,000 tons of atmospheric nitrogen above every acre!
I needed to take advantage of it!
1995 Hail
1995 Winter Triticale & Hairy Vetch
Plants Interacting with Mycorrhizal Fungi

- Assists with P uptake from the soil
- Moves P from the non-legume plant to the legume plant
- Moves N from the legume plant to the non-legume plant

The Nature and Property of Soils, Brady and Weil
1996 Added Corn to the Rotation
Again...
1997 Drought
And yet again...
Cowpea & Sudan Grass
Livestock Integration
Tracking Organic Matter...

Upward Trend
I Came To The Realization That Through Tillage I Had Eroded My Topsoil
This soil is naked, hungry, thirsty and running a fever!

Ray Archuleta 2007
I Had Come To Accept A Degraded Resource
Symptoms of a Degraded Resource

- Lack of Moisture
- Poor Fertility
- Compaction
- Weeds
- Low Yields
- High Input Costs
- Too Much Moisture
- Salinity
- Disease
- Pests
- Litter: Too Much/Too Little
- Labor
- Erosion
- Poor Infiltration
“If you want to make small changes, change how you do things. If you want to make major changes, change how you SEE things!”

Don Campbell
The greatest roadblock in solving a problem is the human mind!

Gabe and Paul Brown: ND Rancher
Focus On:

Solving Problems

NOT

Treating Symptoms
How Do We Improve Soil Health?
The Answer is to Imitate a Native Ecosystem
Nature’s Way:

- No mechanical disturbance
- Armor on the soil surface
- Cycles water
- Living plant-root networks
- Nutrient cycling via biology
- Thousands of years of R & D
I Needed To Educate Myself!
Same Soils: Dynamic Soil Properties Changed!

62.8% loss of SOM after 17 yr intensive tillage

Forest SOM = 4.3 %

17 yr- Soybean monoculture SOM = 1.6 %
Forest

\[ \text{SOM} = 4.3\% \]

CT

17 yr - Soybean monoculture

\[ \text{SOM} = 1.6\% \]

20 cm layer

Anti-fragile - Fragile
1) Least Amount of Mechanical Disturbance Possible
Mycorrhizal Fungi
Increased Surface Area Leads To Nutrient Uptake Efficiency
AMF – Protect their host plants from pathogens and nematodes in the soil
Ways To Increase Mycorrhizal Fungi

- Reduce/Eliminate Chemical Use
- Reduce/Eliminate Tillage
- Reduce/Eliminate Synthetic Fertilizers
- Living Plant Cover As Long As Possible
“Your soils will never become sustainable as long as high rates of synthetic fertilizers are used”
Fertilizer Usage

- We Eliminated All Synthetic Fertilizer On Our Owned Land in 2008
- On Rented Land In 2010
3 Year No-till vs. Conventional Till

Michael Thompson Farm
2) Armor On The Soil
Bare Soil Is Detrimental To Soil Health
Colorado 1-12-14
Emerging Warm Season Cover Crop
Soil Temperatures
140 degrees, soil bacteria die.
130 degrees, 100% moisture lost through evaporation and transpiration.
100 degrees, 15% moisture used for growth, 85% moisture lost through evaporation and transpiration.
70 degrees, 100% moisture used for growth.
3) Diversity
The Importance Of Diversity
“Cover crops should be seeded as multi-specie cocktails”
2006 Burleigh Co. ND

Cover Crop Demonstration Plots
Turnip July 31
Oilseed Radish July 31
<table>
<thead>
<tr>
<th>Crop</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oilseed Radish</td>
<td>1260 Lbs.</td>
</tr>
<tr>
<td>Purple Top Turnip</td>
<td>1513 Lbs.</td>
</tr>
<tr>
<td>Pasja Turnip</td>
<td>2070 Lbs.</td>
</tr>
<tr>
<td>Soybean</td>
<td>1496 Lbs.</td>
</tr>
<tr>
<td>Cowpea</td>
<td>1914 Lbs.</td>
</tr>
<tr>
<td>Lupin</td>
<td>1232 Lbs.</td>
</tr>
<tr>
<td>Cocktail Mix (1/2 Rate)</td>
<td>4785 Lbs.</td>
</tr>
<tr>
<td>Cocktail Mix (Full Rate)</td>
<td>4350 Lbs.</td>
</tr>
</tbody>
</table>
“Not only do the fungi provide for the needs of one plant but the fungal/hyphae pipeline connect to multiple plants... This helps satisfy the nutritional and energy needs of microorganisms and the plants”

Dr. Kris Nichols, ARS Mandan, ND
Monocultures: A Detriment to Soil Health
Diversity Drives Soil Health
Roots: Build OM, and Cycle Nutrients
Brown’s Ranch Cash Crops

<table>
<thead>
<tr>
<th>Wheat – CSG</th>
<th>Hairy Vetch – CSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats – CSG</td>
<td>Peas - CSB</td>
</tr>
<tr>
<td>Triticale - CSG</td>
<td></td>
</tr>
<tr>
<td>Barley – CSG</td>
<td></td>
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<tr>
<td>Rye - CSG</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Corn – WSG</th>
<th>Sunflower – WSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMR Sorg.-WSG</td>
<td></td>
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</tbody>
</table>
Diversity in the Cropping System

- Cool-Season Grass
- Cool-Season Broadleaf
- Warm-Season Grass
- Warm-Season Broadleaf
Fall Seeded Biennials
Oats:
No Fertilizer, Pesticides or Fungicides
## Yields

<table>
<thead>
<tr>
<th>Crop</th>
<th>Brown’s</th>
<th>County Average</th>
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</thead>
<tbody>
<tr>
<td>Corn</td>
<td>127</td>
<td>98</td>
</tr>
<tr>
<td>Spring Wheat</td>
<td>62</td>
<td>39</td>
</tr>
<tr>
<td>Oats</td>
<td>112</td>
<td>62</td>
</tr>
<tr>
<td>Barley</td>
<td>72</td>
<td>48</td>
</tr>
</tbody>
</table>