Regenerative Agriculture in Action

Tim Vos

Southwest Grain Collaborative

Part I:
Our Current NIFA OT Project:
"Cultivating Drought Tolerant, Regionally Adapted, Locally Grown, Certified Organic Cover/Forage Crop Seed for New Mexico"

Project Background

1. SGC/CSRP at NMSU

2. Recreating diversified cropping systems focused on heritage corn, beans, and small grains, using regenerative-organic practices

3. Establishing crop rotations and using multi-species cover crop mixes

4. The need for cover crop seed
    a. Seed provided free to farmers; expensive, shipped long distance, not adapted to local conditions

Blue Corn at Tsaile/Wheatfields, Navajo

Sonoran White Wheat – Mesilla Valley near Anthony – April 2020

Same field two months later

The Next Evolution:
SGC/CSRP new cover/forage crop initiative

- The 2022 *State of Organic Seed Report* from the Organic Seed Alliance
- Developing drought-tolerant, regionally adapted, locally grown and certified organic cover/forage crop seed for NM farmers and ranchers.
- Using a participatory plant breeding approach, the goal of the project is to produce high quality cover/forage crop seed at scale.
- **Cover crops are foundational for regenerative agriculture.**

Pearl Millet at NMSU Las Cruces – September 2022

Regenerative guidelines from Rodale

- Builds Soil Organic Matter
- Cover Crops
- Crop Rotations
- Conservation Tillage
- Integrates Livestock
- Promotes Biodiversity

Regenerative Soil Health Principles
(NM Soil Health Working Group)

- Cover the Soil
- Minimize Soil Disturbance
- Increase Diversity
- Maintain Continuous Living Plants/Roots
- Integrate Livestock

Cover/forage crops and ecosystem services

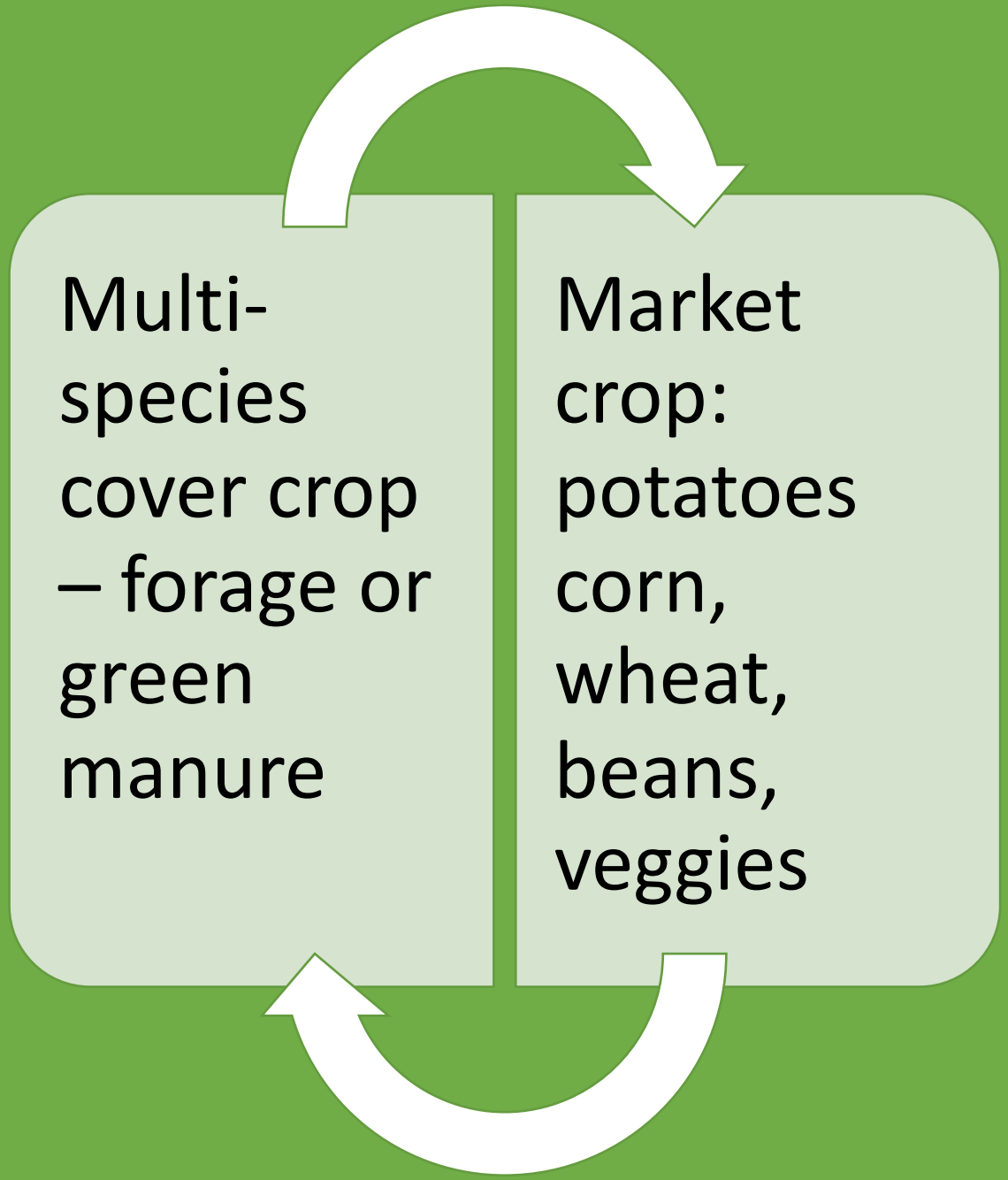
1. Actual cover, protection from erosion; wind, rain, runoff; also shade from sun and regulating soil temp.
2. Weed suppression
3. Providing forage – for livestock and soil microbes
4. Soil organic matter to feed the soil microbiome
5. Supporting mineralization and nutrient cycling
6. Enhancing soil aggregate structure, sponginess, porosity, water holding capacity and good tilth
7. Habitat for biodiversity

Ecosystem services continued

8. Total biomass of soil microbiota is directly correlated to available N for plant growth, grain fill and seed quality, and crop nutrient density

9. Ecosystem services provide economic benefits, such as lower input costs, resistance to disease and pest outbreaks, high quality product

10. Example of Rockey Farms planting multispecies cover crops in San Luis Valley


Multi-species cover crop – forage or green manure
Market crop: potatoes corn, wheat, beans, veggies

Multispecies Cover/Forage: Warm Season Soil Builder

1. Cowpeas: Pinkeyes – 16 lbs.
2. Derry Soybeans – 8 lbs.
3. Mung Beans – 8 lbs.
4. Sunn Hemp – 8 lbs.
5. Sorghum-Sudan hybrid – 16 lbs.
6. Pearl Millet: Tifleaf III – 12 lbs.
7. Sunflower: Black Oil Seed – 8 lbs.
8. Okra: Clemson Spineless – 8 lbs.
9. Flax: Golden – 12 lbs.

100 lbs. total; seeding rate 25 lbs. per acre

Cool Season Soil Builder

1. Spring Pea
2. Common Vetch
3. Crimson Clover
4. Spring Barley
5. Spring Oats
6. Rapeseed
7. Daikon (Tillage) Radish
8. Florida Mustard Broadleaf
9. Flax
10. Sunflower
11. Phacelia

Seeding rate = 65 lbs. per acre. Germination soil temperature minimum 40 degrees.

Part II:
Regenerative Agriculture and Old School Organic Farming

"Feed the soil!"
Soil organic matter and microbial abundance and diversity

- The first precept of old school organic farming is **FEED THE SOIL**, which really means feed the microbes that live in the rhizosphere – the root zone – and they in turn will provide nutrients to the crops.
- The only way to do this is to supply continuous and abundant amounts of organic matter, which comes from crop/plant residue and detritus, and animal manures. **Put in more biomass than you harvest and export**.
- Soil microorganisms feed on and breakdown organic matter, metabolizing it into nutrients that are then made available for uptake by plant roots.
- Total biomass of soil microbiota is directly correlated to available nitrogen for plant growth, grain-fill, and plant biomass production.

Benefits of SOM for soil microbes

- Providing a *continuous* supply of organic matter (crop residues and animal manures) to the soil is crucial for soil quality (health) and long term productivity…
- Feeding soil microbial populations facilitates nutrient cycling for increased availability to crops, improves overall fertility, and enhances pest and disease resistance.

SOM benefits continued

- SOM contributes to good tilth: i.e. soil texture, aggregation/crumble structure and friability etc.
- Improves water holding capacity; reduces stickiness of clay soils; reduces surface crusting.
- Stabilizes pH.
- Increases stable humus fraction over time and provides long term fertility and carbon sequestration.

“Maintaining Living Roots”
The Ecology of the Rhizosphere

- No plants, no root exudates, no SOM, no microbes.
- Up to 40% of photosynthates are rapidly transferred and released as root exudates to attract and feed soil microbial populations in the rhizosphere.
- “Plants rapidly release photo-assimilated carbon (C) to the soil via direct root exudation and associated mycorrhizal fungi, with both pathways promoting plant nutrient availability” (Kaiser et al. 2014).
- “Root exudation stimulates microbial decomposition of soil organic matter, which in turn improves nutrient availability along the rhizosphere” (ibid.).

Crop rotations and cover crop mixes

- Diverse plantings benefit overall agroecosystem function (think beneficial insect and bird populations) and soil health.
- Crop rotation planning maps out diversification across time.
- Multi-species cover crops are the best way to facilitate microbial biodiversity across the rhizosphere, which is in turn essential for crop, livestock, and human health and well-being.
- Nutrient density (deliciousness) in crops is directly correlated to mineralization process performed by diverse and abundant soil microbiota.

Central importance of agrobiodiversity

- Above ground plant diversity is directly connected to below ground microbiological diversity, which contributes important ecosystem services, especially relating to pest and disease suppression and resistance, nutrient cycling and availability, and soil structure, particle aggregation, aeration, water holding capacity
- The diversity of microorganisms in soil is critical to the maintenance of soil health and quality
- A wide range of microbial populations are involved in important soil ecosystem functions.

Barley cover sown after corn

Clover, rye, vetch, barley

Milpa style planting – corn, beans, squash

Regenerative Agriculture and Old School Organic Farming

- Traditional knowledge and leading edge science
- What is it that needs to be regenerated?
- The soil, the land, the ecosystem
- The relationship between people and nature
- We inherited, our ancestors were born into, a world of incredible natural abundance and diversity
- That system has been downgraded: hence the need for renewal, regeneration

Developing new lines of cover/forage crop cultivars adapted to the Southwest

Warm Season Candidates

1. Sorghum-Sudangrass
2. Teff
3. Pearl Millet
4. Cowpea (Iron and Clay)
5. Sunn Hemp
6. Tepary Bean (and other common beans, e.g. Bolita)

Native grass candidates

- Blue grama (perennial)
- Sideoats grama (perennial)
- Galleta grass (perennial)
- Sacaton grass perennial)

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