

Workshop Title: Crop Rotations for Soil Health (Slides for this presentation unavailable)

Speaker(s) & their title(s): Jeff Moyer, *Executive Director of Rodale Institute*

Executive Summary

Jeff Moyer outlines how crop rotations can be incorporated into vegetable production for increased soil health, yield and lower pest pressure. He uses examples from his farm in Pennsylvania and other farms around the United States. He emphasizes the importance of complexity in rotations, planting any cover crops on time and never leaving the soil bare.

Detailed Notes

Soil: The key to unlocking our sustainability

- Soil health is key to crop rotations and it informs all of our decisions as farmers.
- Nature likes complex systems; this is an important concept to incorporate into our crop rotations.
- We need complex rotations, which create opportunities for many different plants including cover crops to be in the ground.
- The real purpose of the cover crop is to capture energy and transfer it into the soil.
- When one plant leaves the system its roots remain and start decomposing - this is where all the microbial life lives.

Changes in soil based management (slide not available)

- Left: small grains and forages Right: 1% organic matter corn, soybean monoculture corn, corn beans.

Impacts of those changes

- Wheat could barely be incorporated into conventional system the soil was so poor.

The Biology of the Soil

- In a handful of soil there are more living life forms than people on the planet.

Soil Microorganisms

- All these life forms depend on a complex crop rotation to survive. The less complex the rotation, the less organisms living in the soil.
- We as farmers must test our soil; we can't see the life in the soil so we have to make some assumptions about what's happening.
- Tests are just a snapshot of what is happening in the soil.
- Jeff samples his soil every year and he looks at the trend of his soil health and nutrient levels over time.
- He does not overreact to the results of the annual tests.
- He fertilizes very little on his farm, he lets nature take care of the health of his soil.
- If your soil test results are heading in a downward trend you may need to do something but if the trend is heading up you don't need to do anything.
- Organic vs Conventional corn, the difference in crops is impacted by crop rotation.

Nutrient Use Efficiency

- How can we manage the diversity of the system to improve the availability of nutrients?
- The nutrients are there but they are not available.
- If we improve the microbiology we make the nutrients more available.

- We want to improve the efficiency of our soil and increase the amount of nutrients that are available.

Plants = proven carbon sequestration

- Rearrange your rotation to create as many opportunities for cover crops as possible.
- You should be planting one crop the day another is harvested - never leaving soil bare.
- Plant must form a symbiotic relationship with the mycorrhizal fungi in the soil to access wider range of nutrients.

Arbuscular Mycorrhizal fungi

- Organic growing systems are efficient due to the mycorrhizal fungi because nature is doing the work.
- Why would a plant allow a foreign fungus bore into its root to steal sugar and carbon? -
- Mycorrhizal fungi magnify the surface of the plant's roots by thousands of times allowing it to take up more nutrients and work even more efficiently.
- Roundup kills all this fungi even if this is not intended purpose of its use.
- Fungi also allow bacteria to move from one plant to another.

Evaporation

- If the soil is too hot than the fungi will die but if there is something green growing on the surface it helps keep the soil temperature down.

Crop Rotations

- Complex rotations are very important, more complex the better.
- Monoculture sets you up for pest and disease problems and needing more and more inputs.
- Moving time of tillage and moving crops to different fields confuses the pest, weeds and diseases.

Successful Rotation

- A successful rotation has to be as long and as diverse as possible.
- The challenge isn't growing all the different crops in a successful rotation but rather marketing them.
- However, finding new markets can be an easier task than fighting all the pests and diseases experience in an overly simple rotation.
- Once you find or create new markets for your diversity of crops you may find that you could have even diversity.
- If you change one thing it affects the whole system.
- It is important to work with the resources you have available.
- Your rotation must be planned.
- You should be able to tell someone what will be planted in every field in your farm in 5 years and know what was planted 5 years before.
- It is important to build flexibility into your rotation by having a plan B and C.

Crop rotations on Organic Farms

- There are many ways to arrange crops into a rotation, thousands of ways to arrange only 10 crops.
- Complex crop rotations take your farming to the next level.
- These rotations add new challenges and keeps things interesting as a farmer.

Different Types of Rotations

- There are many types of rotations.
- What is the goal of your rotation? There are many aspects for you to consider.
- If you have an insect management plan that's working - change the plan! Nature will catch up to you (this advice is specifically aimed at grape growers).

Concepts to Consider

- If the market doesn't exist and you want to grow a crop build the market.
- There are many potential constraints to consider when building a rotation. Refer to the "year/entry point" slide (not available)
- This is a crop rotation from long-term research project.
- Third could be vegetable rotation of sweet corn and green beans.
- In a conventional system the soil is bare 75% of the time.
- Organic systems are starting to change that.
- There are so many ways to arrange your rotation.
- Try to create gaps in your rotation big enough to fill with cover crops.
- Can you rotate vegetables with forage areas? There are farmers in States are doing this successfully.
- Every farmer has a different rotation based on their own unique situation.
- It is important to get the right varieties for your crop rotation - not all varieties are created equal for cover crops.

Weed impacts

- In trials different varieties of corn lost different amounts of yield based on number of weeds.
- You need to do your homework to find out how the varieties perform in the presence of weeds - not something that seed companies know, we need to do this research on our own farms.
- Jeff challenges farmers to grow something unusual on their farms and see how it does in the presence of weeds and other challenges.

Cover Crops; Why & How

- Cover crops are the most important crops we grow on our farm.
- Must be thick dense stands of cover crops and must be planted on time, at a good seeding rate.
- Jeff will till to establish cover crops if needed, they are that important to have do well.
- Refer to "Benefits of cover crops" slide (not available)
- Refer to "Cover Crop Selection Criteria" slide (not available)
- Rye is allelopathic to other grasses and sunflowers.
- On time planting very important to your system
- Planting using a combination of drilling and broadcast seeding helps to create solid cover of soil. This technique uses the same amount of seed and is the same cost but the drilling helps ensure good soil-seed contact.
- Cover crops can work well growing together and this further increases complexity of system.
- Biology is a "messy science" - same process yields different results based on so many factors including location, weather etc.
- Complex cover crop systems can work anywhere but the mix of crops will differ.
- We want to use cover crops to prepare our soil for the cash crops.

- Refer to slide "many cover crop benefits" (Not available)
- Even a conventional corn farmer found a 15% bump in yield using compost tea to add microbial life.
- Diverse mixture of cover crops will help by responding to different circumstances (soil fertility levels) in the field.
- You need to understand what's in your soil to know what is the best mix of cover crops to use.
- The seeding rate important! Calibrate your drill and make sure you know your seeding rate. Too low a rate = not enough cover and too high a rate = waste of money/seed.
- You can double amount of available nitrogen with a few extra weeks of growth (refer to ladino clover slide – not available)
- We tend to kill our cover crops too early as organic farmers.
- Winterkill cover crops can also be a useful tool when creating crop rotations.

Seed Selection

- Important to consider what weeds may come in your cover crop weeds.
- It is so easy to bring weed seeds onto your farm accidentally.

Perennial Grasses in Farming Systems

- Conventional farmer in Florida who went from down to 100 acres from 200 acres and increased his profits from 5000 to 40,000 because he increased his diversity.
- Refer to related slides (slides not available)
- Reduced irrigation needs, charged fees to have cows grazing, doubled yield of peanuts.
- He made all of these changes with only switching from a 2 crop to a 3 crop rotation.
- Rethinking how you are using your resources.

Presenter ran out of time