

# Soil Management for Optimum Soil Health and Grower Profit



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Practicing agriculture the way we have been doing it since the 1950s has led to lower nutrition in the crops we grow, a greater dependence on synthetic inputs, and less profit every year for the farmer. Moving to an ecosystem-based growing model will not only improve the quality of the food we grow, but it will also increase plant resistance to diseases and pests and increase profits.

With the Green Revolution, the agricultural practice which emerged and more commonly referred to as conventional growing practices, has led to the fall of crop nutrition, increased our dependency on synthetic inputs, and managed to reduce farmers' profits.

## What Are the Different Types of Soil Management?

There are as many ways of farming as there are farmers but for the sake of simplicity, let's divide these farming practices into two major categories: conventional and regenerative. They both are physically quite different, but they also differ in Mindset.

### Conventional Soil Management

This type of farm management originated in the 1950s with synthetic inputs and the replacement of horse-drawn plows with tractors. Synthetics and the strength of tractors allowed farmers to plow up areas that had been considered non-farmable. Applications of pesticides, fungicides, herbicides and synthetic fertilizers are

common conventional soil management practices. Land Grant Universities started offering low-cost soil tests for the soil nitrogen, phosphorus, potassium, and pH, as well as organic content. Soil scientists at the Large Agricultural Universities advise growers on how much of any kind of synthetic fertilizer to add to the soil for crop growth.

### Regenerative Soil Management

This type of farm management takes a holistic approach to the farm. Tractors are used not for tilling but for pulling crimping equipment across the field. Cover crops are an integral part of a holistic soil management program. To regenerate soil, there must be living roots in the soil all year long. Regenerative growers have their soil tested not only for NPK and pH but also for the number of microorganisms in their soil. Soil is alive with millions of microscopic organisms as well as earthworms, moles, and other soil dwellers which are all part of the soil food web. The food web includes animals and humans who eat the food grown in the soil. In regenerative soil

*Regenerative agriculture is a holistic approach that emphasizes the idea that the soil should be disturbed as little as possible and always covered, hence cover crops.*

management there is no waste. It is a circular system - soil feeds humans who create compost which, in the decay process, feeds microorganisms, and becomes soil in which nutrient-dense food is grown.



These two soil management practices have been around for a long time. Each of them impacts soil health, crop yield, and farm profitability. Whether you are looking at the long-term or the short-term, there are some soil management practices that need to be reconsidered for the health of the farm. The way you SEE your land is very different in these two soil management practices. In conventional agriculture, you see the soil as a medium to grow crops, adding nutrients and toxic chemicals to create a good yield. The focus is on bushels per acre or yield in the short term. With regenerative agriculture practices, you SEE your soil as alive, which it is. The focus is on the soil, which will increase the yield and the nutritional profile of your crops. Regenerative agriculture is a holistic approach that emphasizes the idea that the soil should be disturbed as little as possible and always covered, hence cover crops. Conventional

agriculture involves tillage and synthetics, often in excessive amounts. Soil health is not considered.

### Tillage as a Primary Soil Management Practice

Agriculture has included some form of a plow since pre-historic times. The Ancient Egyptian hieroglyphs show ox-drawn plows.<sup>(1)</sup> There have been many improvements on the plow over the centuries. As technology has advanced so has the ability of farmers to plow, first with moldboard plows made of wood, then metal, and now with precision plowing that incorporates GPS systems for field conditions and sensors that can read soil nutrient levels. Farming keeps becoming more efficient. But an efficiency gained at what cost?

#### Pros of Tilling

A smoothly diced field on a spring day when you're ready to plant has been a beautiful sight for farmers for generations. There is a feeling of a job well done. A field your grandfather would be proud of, neat and tidy, all vegetation turned under, and ready to plant. It's easy to get the planter into a field that is so smooth and it's easy to see where you've been. You know where you've planted because the tractor tires have left tracks. As you make more passes over your field those "tracks" become areas of compaction you remedy with more plowing the following year.



There are numerous types of tilling, some leaving the field with no crop residue and others with a portion of residue. State Ag Universities have been studying the impact of tilling and many now suggest some type of "conservation" tillage. That means leaving some portion of vegetation from last year's crop on the surface. This is a technique that cuts down on wind and water erosion while also helping to reduce compaction.

Large farm machinery leads to larger fields. No matter what kind of conventional or conservation tillage, larger fields appear to be more cost-effective with monocrops. Garry Niemeyer, a farmer in Illinois, is quoted in the Washington Post. He grows commodity crops and "rotates his fields in what he calls a duo crop. In any given year, he still has thousands of acres in one crop. Mr. Niemeyer is perfectly aware that continuous planting will degrade his soil, and he rotates in other crops before that happens. "Two years of corn and one year of soy works pretty well for us."

But when Tim Griffin, director of the Agriculture, Food, and Environment program at Tufts University was asked if the duo crop rotation was better soil management than a monoculture, he said "... it's a little better". But then pointed out that the problem of bare soil after harvest, all winter, still led to erosion. Griffin added that it's a matter of economics for many farmers. When asked if Niemeyer knew duo cropping was degrading his soil, why did he do it?

"...economics... There's an economic advantage to specialization. One of the

reasons for the duo culture is that the equipment for corn and soy is identical. If you add one more crop, and grow wheat, just that one change requires a specialized planter."<sup>(2)</sup>

But growing only one crop in a large field (up to thousands of acres, depending on the crop) leaves a farmer vulnerable to insects and diseases that can wipe out an entire harvest. Machinery manufacturers have attempted to partially solve that problem with high clearance front and rear axle tractors so you can spray toxic chemicals without destroying a single plant. But they haven't solved the basic problem, acres of uniform insect forage.

### Cons of Tilling

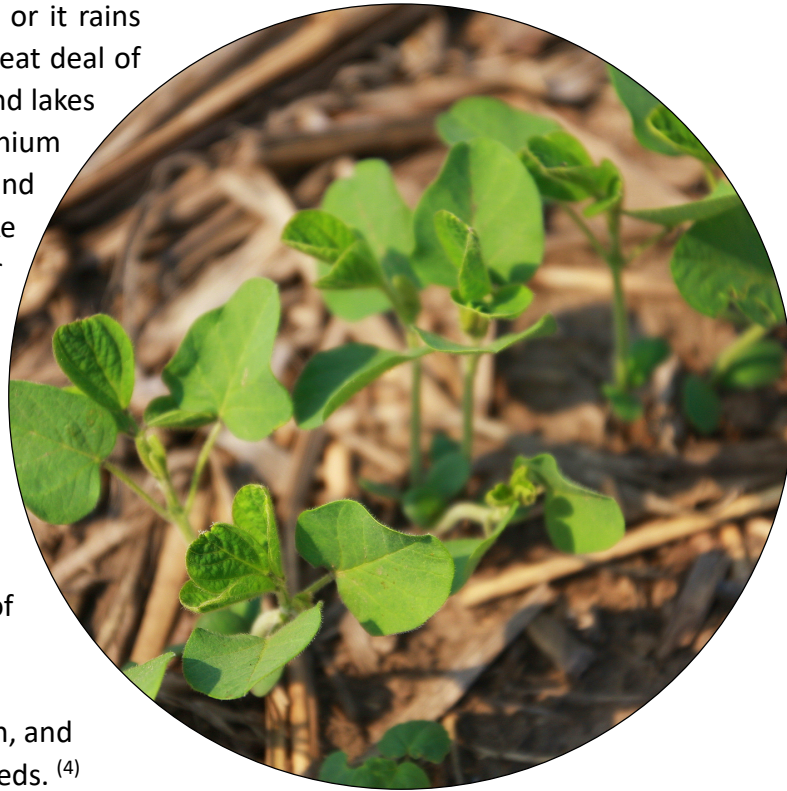
Multiple trips through your fields spraying toxic chemicals can add up in diesel costs, not to mention the compaction of the field by the tractor implement tires, and the deep compaction layers caused by the force of the tiller blades. In the long run a mono-crop, although appearing to be easier, ends up costing more for fuel, time, wear and tear on machinery, and the cost of spraying toxic chemicals.

Spraying those toxic chemicals (fungicides especially) destroys the soil biology. Without the soil food web to move nutrients around and convert them into plant soluble forms you need to use more fertilizers. One fertilizer that is used in many fields in ammonium nitrate. It is an odorless, nearly colorless crystal salt. Plants take up the nitrate for growth, but if too



much nitrate is sprayed on a field, or it rains right after application, there is a great deal of runoff, into nearby creeks, rivers, and lakes – creating algal blooms. Ammonium nitrate is also a salt compound and over time fertilizing with it will make your soil saline. This is a major problem in many soils of the Midwest plains. <sup>(3)</sup>

Have you ever wondered how deserts came into being? Every year, deserts around the world are expanding – and it's not a natural process. They are expanding every year "...by an area around the size of Ireland". That desertification is happening because of overgrazing, increasing agriculture, deforestation, and growing use of water for human needs. <sup>(4)</sup>



Conventional agriculture is fueling that desertification through unnecessary tillage, synthetic toxic chemicals and fertilizers, and large-scale irrigation that diverts water from its natural environment.

## No-Till for Soil Management

As we have learned more about the microbiology of the soil it has become apparent that tilling, or plowing, the soil not only causes erosion but also decreases the number of microorganisms in the soil, leading to lower fertility. No-till is associated with cover crops, mulch, crop residues, or straw. It is good practice to combine no-till with cover crops to both cover the soil and increase microbial activity in the soil. If you do not cover the soil with something you want, nature will cover it for you.

No-till is not an overnight fix for years of tilling. That's why you want to start with a small part of your farm. No-till also is the most productive when you don't use any synthetics on that part of your farm. So, what benefits can you hope to achieve by not tilling a parcel of land?

- Increased water retention in sandy soils
- Decreased water logging in clay soil
- Increased microbial activity
- Increased yield (over time)
- Decreased compaction
- Decreased erosion

Look around at your farm, find the least productive area and use that as your lab. You don't have much to lose and you have the potential to gain a great deal.

When you first change your management practices from conventional to no-till you will probably have a short-term loss of yield. You can always give your soil a boost with a humic acid and microorganism product, such as [Humic Land](#). In the long-run, and sometimes in the first few years, your soil health will improve, giving you a harvest of high-density crops.

One of the best parts of no-till is that you make fewer passes over your field. And because you have a cover crop as a cushion you create less compaction. If that well-diced field in spring was something that you found satisfying and even aesthetically pleasing, you will see a no-till field as messy. But that mess is the home of multiple benefits. The plant roots and microorganisms in the soil are communicating and creating fertile soil. You can think of that mess as a "soil fertility bank," one with a savings account that is always growing.

## Cover Crops as a Part of Your Soil Management System

Planting seeds to cover your farm soil is akin to sowing seeds for a lawn. Most lawns are mixes of grasses, clovers, and other low-growing plants dependent on your growing conditions. Cover crops can be short like your lawn or tall as oats and barley. You need to consider what you need those cover crops to do. Are you trying to reduce compaction? Do you want to add organic matter? Are you trying to reduce erosion? Perhaps all three.

At first you may consider cover crops as an added expense to your farm budget. But consider the decreased cost of diesel because of fewer passes across the field, decreased water and wind erosion, decreased amount of toxic chemicals necessary for a successful crop, the potential for a premium price because you aren't using any toxic chemicals and some of those cover crops could even be a secondary revenue stream. Then cover crops look like a wise farm investment all the while increasing the fertility of your soil by building up the microbial activity. [This video](#) produced by UW Extension shows how great a difference no-till and cover crops can have on your soil. <sup>(5)</sup>

- Cover crops can take care of several environmental concerns
- Weed suppression
- Pollinator food and habitat
- Salinity management
- Building soil aggregates, which improves water infiltration
- Harvest CO<sub>2</sub> and sunlight, providing plant exudates to soil microorganisms

Cover crops can be annuals, biennials, perennials, or a mixture. Some covers, such as legumes, fix nitrogen from the air into the soil. Others have deep taproots that break up compacted soils. Cover crops are complex and when you are ready to begin covering your soil with what you want, as opposed to the plants mother nature sows naturally, it is best to contact a regenerative soil management consultant who is familiar with your soil type, climatic conditions, and other factors that affect yield in your fields. Having roots in your soil throughout the season is critical, watch [this video](#) to see the difference between cover-cropped soil and plowed soil. There are many



benefits to cover crops, not the least being that they look beautiful when in flower.

## Synthetic Inputs in Soil Management

Synthetic and organic inputs that kill insects on leaves, blooms, and fruits of your crops are not engineered to differentiate the "good" bugs from the "bad" bugs. When you spray your fields with a systemic herbicide or fungicide it takes out the insects you want but, depending on the time of day and season, also takes out beneficial insects and pollinators such as honeybees and bumblebees. Eventually, those synthetic or organic chemicals reach the soil and kill the soil biota that is necessary for nutrient-dense food production.

With the loss of soil microorganisms, you have to add more synthetic fertilizers to make up for their activity. The addition of more fertilizer, especially synthetic, creates an environment in which plants are no longer getting their nutrients from the soil. The soil food web is an inter-dependency of plants, microorganisms, water, and mineral components of the soil. If any part of that web is broken, it all falls apart. The fertility of your soil unravels just like a knitted sweater sleeve. Pretty soon, you have a gaping hole where the elbow used to be. When you use synthetics, you create gaping holes in the soil food web that take quite a bit of mending to repair. That's why no-till and cover crops are not overnight solutions to unraveling that has been happening for generations.

Crops grown using conventional soil management practices are less nutritionally

dense than regeneratively grown crops. A landmark study done at the University of Texas at Austin by Donald David et al. studied nutritional data from the USDA from 1950 to 1999 of

"...43 different vegetables and fruits, finding 'reliable declines' in the amount of protein, calcium phosphorus, iron, riboflavin (vitamin B2) and vitamin C over the past half-century." (6)

During this time period, a great deal of plant breeding has taken place to improve certain plant traits, such as size, growth rate, pest resistance, and storage ability. There has been no breeding for higher nutritional value. Breeding for ease of field harvest and shipping ability coupled with the loss of nutrient value in our soils leads to lower nutrition in our diets.

The problem with synthetic fertilizers and toxic chemicals is that every year more is needed. This means that as your soil loses fertility you also lose money because it keeps getting more expensive to farm. Kamala Dorsner writes in *Essentials of Environmental Science* that

"Other environmental ills include over 400 insects and mite pests and more than 70 fungal pathogens that have become resistant to one or more pesticides. Pesticides have also placed stresses on pollinators and other beneficial insect species. This, along with habitat loss due to converting wildlands into agricultural fields, has affected entire ecosystems." (7)



Along with increases in costs for diesel fuel and synthetic inputs you are also encountering more resistant pests and diseases in your fields. But there is a way to stop this vicious cycle.

## Holistic or Ecosystem Approach to Soil Management

In a holistic approach, you look at more than your fields. You take a survey of all the natural habitats surrounding your growing areas. These are some of the most important areas that you may have been overlooking. The native wildflowers and grasses along the fence line are habitat for beneficials of all types: insects, birds, amphibians, and the home of millions of microorganisms in the soil.

Soil management in a holistic system is usually no-till or very shallowly tilled, and not often. Using cover crops to maintain soil moisture and to create soil aggregation increases the beneficial microorganisms in your fields. Taking a cue from nature and planting strips of native flowers and grasses in your fields creates more beneficial insect habitat and less insect damage to your crops.

### Nutrient Sources for Holistic Soil Management

There are many alternative nutrient sources for plants besides synthetics. Compost and aged manure are two of the oldest alternatives in agriculture. They were the ONLY sources of



soil nutrients until the 1950s when synthetic chemicals entered agriculture. Conventional agriculture has only been around since the 1950s, so is it really traditional? Science has shown healthy soil is composed of humic acids, microorganisms, and many soil dwellers that can be seen by the naked eye, such as earthworms and ground beetles. When you are converting from conventional to regenerative agriculture you will not have a strong microbial community, but you can add humic acids to kickstart the activity in your soil. Our product [Humic Land](#) is a gel-like substance sustainably derived from peat. It promotes microbial activity and is a natural source of humic and fulvic acids.

Healthy plants resist disease and pests. Just as a healthy human is less likely to get a cold, so too is a healthy plant less likely to have disease. Plants that are not healthy are unable

to convert the simple sugars given to them by the microorganisms in the soil into complex carbohydrates like starch and cellulose. Insect pests are attracted to the simple sugars.

Another source of insect pest manifestation is excess nitrogen. Sap sucking insects such as aphids are attracted to the nitrogen that the plant is unable to process. There are numerous reasons why a plant may not be processing nitrogen, including poor soil food web health as well as excess application of fertilizers. Even if sap sucking insects appear on your crops a healthy plant has a much better chance of surviving. If you are utilizing holistic farm management practices, you will also have habitat for the predators of insect pests.<sup>(8)</sup>

Spraying a pesticide will kill the pests but it will also kill the predators. And the insect predators are free and continually available if you provide habitat. Doesn't providing habitat sound like a wise business decision?

### Carbon Sink

Retaining a cover on your soil year-round creates an opportunity for microbes to convert much of that cover into carbon in the soil. The process of photosynthesis absorbs carbon dioxide from the atmosphere, then when plants die much of the carbon is retained in the soil from the plants' roots and microbial action. Plowing a field releases the stored carbon into the atmosphere as CO<sub>2</sub>, while the practice of no-till and cover crops retains a balance of carbon in the soil and atmosphere.

This process is extremely important because, according to Rinkesh Kukreja, "...carbon is the

main component of the organic matter that makes fertile agricultural soil. It also helps the soil retain water. Plants are the primary way that CO<sub>2</sub> is transferred to soil. Not all of the CO<sub>2</sub> that plants suck up for photosynthesis is needed for food. The excess goes down through their roots and feeds organisms that live in the soil. Carbon from the roots and leaves of dying plants is also captured in soil."<sup>(9)</sup>

Although we tend to consider forests our greatest source of carbon sequestration, a field maintained with cover crops and no-till is just as important. Generally, farm management practices that conserve moisture, reduce erosion, and decrease fuel costs by direct seeding in cover crop residue, planting field windbreaks, and using higher-yielding crops or varieties increase carbon sequestration while maximizing yield potential.<sup>(10)</sup>

### Nutrient-Dense Food

Our health is directly tied to the nutrient density of the food we eat. Unhealthy soil may have a stockpile of nutrients but if there aren't microbes and other biota of the soil food web active, the nutrients, especially micro nutrients and enzymes crucial for nutrient synthesis by plants, will remain in the soil or be eroded away by wind and water. Many studies have concluded that food today is not as nutrient-dense as 40 years ago. Yet conventional soil tests show soil to contain adequate levels of plant nutrients, "the same levels of nutrients."



Conventional soil tests do not measure the microbial activity in the soil, which is a major factor in transforming organic nutrients into an inorganic form that plant can uptake. Plant breeding has focused on increased production, larger plant fruits, and decreased pest issues. These breeding practices, including GMOs, have not considered nutritional value of the crops being produced.

Loss of nutrients in our food can be exacerbated by picking fruit before it is ripe. We are now eating many fruits and vegetables "out of season" and are shipped long distances to get into supermarkets. Food starts losing nutritional value from the moment it is picked so the longer it sits the less value it has. Often artificial fertilizers are used to speed growth and create higher yields. They do not take into account the balance between micronutrients, macronutrients, and soil health.

Although you may have to ship your crop to a distant buyer, if it starts out with more nutritional value from healthy soil it will end up giving the consumer more nutrition.

## Soil Managed Regeneratively is Alive

Have you concluded you will always be farming compacted clay soil? Or that you will always have to irrigate because of your sandy soil?

Neither conclusion has to be true. Both soils need more organic matter and microbial activity so that, over time, they will become clay loam or sandy loam. It's a matter of making a commitment to your land. If you

want to leave a legacy of good farm stewardship, then you have to consider what actions you have to take in the short-term for the sake of long-term gains.

When you begin to see your soil as a living ecosystem you have made a fundamental mind shift. Only living things can support health. Soil that erodes and degrades is seen as an inert growing medium. Soil that retains water, is active with billions of microorganisms, has plant cover all year long and is the foundation of an elegant mutualistic ecosystem. When you have soil, managed with cover crops and no-till, with no synthetics, you have an ecosystem that can provide nutrients for plant growth, absorb rainwater, and hold it to release for plant use during dryer times, and filter potential pollutants from leaving your fields (and chemically change many pollutants so they are no longer a menace).

When you walk out in the field that has been regeneratively farmed and grab a handful of earth you will find dark rich soil teeming with earthworms. You will find plant roots that the soil sticks to, not like clay, but with microorganisms invisible to the naked eye that are feeding off the plant root exudates in exchange for supplying your plants with nutrients. Smell the soil, it has a rich earthy smell. It's the smell you remember from your childhood playing in the woods. Instead of degrading soil with synthetics you are now regenerating it. Healthy soil serves as a firm foundation for agricultural activities and provides habitat for the myriad soil dwellers, seen and unseen, to keep the ecosystem running smoothly. A holistic farm management system may seem like a steep

learning curve but when you get to the top of the hill you will be amazed at what you have accomplished. You will have created healthy soil which serves as a firm foundation for agricultural activities and provides habitat for the myriad soil dwellers, seen and unseen, and keeps the ecosystem that you call your "farm" running smoothly.

Farmers everywhere are hit with declining productivity, increased costs of production, market pressures, government regulations, extreme weather events, changes in attitudes about land use, and a host of other issues. But Allan Savory, of the Savory Institute, is quoted as saying

"...through making holistic choices, we can escape the false choice of being environmental stewards or making a profit. It lets us create what sustainable practitioners seek, a way to continue to live with our environment, but offers even more than they thought. We

can restore lands to their former productivity." <sup>(11)</sup>

## Farming is a complex endeavor

If you've been farming for any time at all you are doing many things out of habit. You can scoop out the right amount of food for the hogs without even being entirely awake. By the time you get to opening the chicken coop you're awake and thinking about the next chore. If it's spring you plow, if it's winter and the ground is frozen you haul manure out to your fields, if it's fall after harvest you analyze yield. Whether you till or not – whether you spread synthetic fertilizer or not – you have a system and it's been in place for a long time.

You may not be aware of it, but as you walk your land you understand what's happening even at the cellular level because you are connected to that land in a very physical sense. At some point you learn something so new that it changes your routine. Even if only that,



you are now aware, you DO have a routine. If you are continually tilling and using synthetic fertilizers then, at some point, you are going to have to change to remain in business. You can change the hard way, all by yourself, trying to figure out what's best - or you can change an easier way. We, at Rogitex, are committed to a greener future and want to help you through that process.

I hope this has been informative, but even better, I hope you have lots of questions. We're here to help answer your questions, call or contact us at [our website](#).

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We are here to help!

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