

# The Art of Crop Rotation

Create a line-up that ensures healthy soil; deters erosion, pests and weeds; makes effective use of resources and earns a profit. Mary-Howell reviews the process that is part science, part agronomics, part economics, part field history and part farmer intuition.

By Mary-Howell Martens (with Klaas' help!)  
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## Farm-at-a-Glance



## The Martens' Farm

**Location:** about 60 miles southeast of Rochester, NY, on the western shore of Seneca Lake

**Important people:** Klaas and Mary-Howell Martens, Peter, Elizabeth, and Daniel. Plus Robert Hall (employee/asst farm manager)

**Years farming:** We've farmed this farm together since 1991. Klaas has farmed all his life.

**Total acreage:** 1500

**Tillable acres:** 1300

**Soil type:** Honeoye Lima silt loam

**Crops:** corn, soybeans, spelt, wheat, barley, oats, triticale, red kidney beans, sweet corn, snap beans, cabbage, edamame soybeans

**Livestock:** sheep, pigs, chickens for our own use

### Regenerative farm

**practices:** diverse long term crop rotations that incorporate legumes and small grains, under seeding all small grains with red clover, actively increasing soil organic matter

**Marketing:** corn & small grains are sold to Lakeview Organic Grain LLC, our

Back in the mid 1980's, when I was working in the grape breeding program at Cornell University, I spent many weekends doing volunteer promotions for the New York grape and wine industry at tastings around the state.

The 1980's were a time of great transition for New York grape farmers. The

traditional highly flavored 'labrusca' varieties and many of the French hybrid varieties were falling out at favor, replaced by the more tender 'vinifera' varieties that only the most fortunate growers had suitable land for. Many grape growers were saddled with vineyards producing varieties that had little market and poor prices. In a valiant effort to turn these unwanted grapes into money, a group of farmers pooled their grapes and pressed and bottled their own juice, marketing it through grocery stores in the area.

I remember one Saturday afternoon, standing behind the Vinefresh table at a large grocery store in Syracuse, I eagerly urged a mother and her children to try this product. They willingly took their free little cups of the pink juice, but set them down unfinished and the little girl said "Mommy, this doesn't taste good." The family walked away and I had to admit that, to be perfectly honest, the little girl was right. The juice that so many good people worked so hard to produce and promote simply didn't taste very good.

This memory has recurred to me frequently over the years, as we have considered how and why farmers choose



**Covering their bases:** The Martens' have a solution and a cover crop for every situation learn more about why we plant what we plant.

organic feed business. Soybeans, red kidney beans, and spelt sold to brokers and processors. Some spelt is sold as kosher organic spelt. Sweet corn, snap beans and edamame are sold to processors who freeze them under brand name labels. Cabbage is made into sauerkraut and packed under the Cascadian Farms label. Some of the oats, wheat and barley are being grown from Foundation Seed to produce Certified Organic Certified Seed.



For the story of the Martens' transition to organic, check out [How Mary-Howell and Klaas Martens made the transition to organic.](#)

### Editor's NOTE

If you have any questions for the Martens, or any reflections on the role of community in your own farm life, [please share them with us.](#)

which crops to grow. Do we grow what we want to grow and then try to find markets, or do we grow what the market wants? Do we choose crops best suited to our farms, or do we choose crops that we think will make us the most money? Do we plan rotations with the long term health of our soil in mind, or do we try to maximize this year's profits?

If you answered 'yes' to all six of these questions, you score perfectly, because in reality, we must balance all these needs and more. Identifying suitable crops for our farm and using them to plan good crop rotations is partly hard agronomic science and experience, partly the sheer luck of being at the right place at the right time, and partly a lesson in high stakes finance. It is also one of the most important things that a farmer must do.

### Crop rotation planning ... for the long haul

Many American crop farmers grow two crops - corn and soybeans, or, if they are unusually lucky, "corn, soybeans and Florida." To organic farmers, this is not crop rotation, indeed, this is what our certifier calls 'crop oscillation'. With mesmerizing images of crops endlessly oscillating up and down, tall and short, we know that we can't get away with this approach to crop rotation, nor do we really want to. We do not feel that alternating two row crops provides what is best for our farms and for ourselves. Nor do we feel it satisfies the intent of the USDA National Organic Program standards which states that crop rotation must maintain or improve soil organic matter content; provide for pest management in annual and perennial crops; manage deficient or excess plant nutrients and provide erosion control.

So, to plan crop rotations, we must consider long term and whole farm effects and address the following questions:

1. Which crops are agronomically well-adapted to my soils and climate and will maintain and improve the long term productivity and health of my soil?
2. Will my intended crop rotation control erosion, minimize pest damage and disease, break weed cycles, and add organic matter to the soil?
3. Will my intended whole-farm crop rotation produce a consistent and adequate income over multiple years by producing a variety of crops that have a reliable market and price?
4. Will my intended crop rotation make effective use of my available resources, including labor, time and equipment?

It is important to recognize that a crop rotation that works well for 5 years won't necessarily work well for 20 years. Dr. William Albrecht, professor of soil science at the University of Missouri College of Agriculture in the early 1900's, studied experimental plots of different crop rotations over many years. He found that when high yields were the main goal in planning a crop rotation, even with a variety of crops but without a regular addition of mineral fertilizers, there was a gradual but significant decline in soil

fertility. Over a long period of time, too much of the soil fertility was being extracted and removed even when a reasonable crop rotation was being followed. In contrast, we know of organic vegetable farmers, growing their crops intensively on very small acreages and supplementing heavily with compost and manure, who are quickly building up excessive fertility, especially nitrogen. While both approaches technically meet organic standards, neither is sustainable or productive over a long period of time.

When considering both soil fertility management and crop rotation, we shouldn't concentrate simply on extracting or replacing minerals. Conventional farming certainly produces high crop yields using synthetic fertilizers, but this depletes soil microbial diversity and organic matter, often resulting in a long term loss of soil productivity. When Klaas and his brothers began using large amounts of synthetic fertilizers and pesticides in the 1970's, they saw a huge increase in yield, it was a very impressive example of the green revolution for a few years.

Unfortunately, these gains were not easily maintained. In a few years, it took ever larger and more expensive applications of fertilizer to achieve the same results. New pest and weed problems appeared, and the soil became harder and lost its earthy smell. Over a very short period of time, the soil changed dramatically as microbial life and organic matter declined and free mineral nutrients built up.

**"Our crop rotations need to address both the immediate needs of each crop and the long term productivity and health of the soil, the farm and the farmers. "**

Our good friend, Dave Mattocks of the Fertrell Company, likens the soil to the stomach of a cow. Whether nutrients are available from the food the cow eats depends as much on the activity of her resident microbes as it does on her digestive juices. As these friendly microbes break down the feed, they provide her with easily metabolized nutrients and keep her healthy and resistant to disease and stress.

When a cow is treated with antibiotics that kill off microbes indiscriminately or when she is fed in a way that upsets normal digestion, she can become sick and her stomach may shut down. When our soils are treated with harsh chemicals or not handled in an appropriate manner, they too can essentially shut down and pathogenic microbes can predominate. Inadequate or poor quality 'feed' can result in starvation and poor performance in both the cow and the soil.

Each type of crop has a distinctive effect on the soil, though exactly what the effect is and how it influences the growth of subsequent crops has not been well studied. It is known that many plants release large amounts of sugary exudates from their roots which stimulate the growth of a signature population of microbes. A special type of

beneficial root fungi, called mycorrhizae, actually grow into plant roots, feeding off plant sap but also providing water and nutrients to the plant. It is undoubtedly due in part to these characteristic 'farmed' microbe populations that some crops do better following certain crops than others.

### **Crop rotations: the basic principles**

Our crop rotations need to address both the immediate needs of each crop and the long term productivity and health of the soil, the farm and the farmers. Every region has a group of crops best adapted to grow there, so we can't make actual rotation suggestions except for the area we're familiar with. However, in general, our rotations should:

1. Alternate legumes with non-legumes to provide nitrogen, but not create situations where there is excess unused nutrients that can leach;
2. Alternate row crops with solid seeded crops, and fall-planted and spring-planted crops to break pest and weed cycles
3. Use cover crops and other crop residue that leave enough high quality plant material to build healthy actively cycling soil organic matter;
4. Employ deep shading crops and allelopathic crops where we need extra weed control;
5. Alternate deep rooting crops with shallow rooting crops to help keep soil structure open and assist with drainage;
6. Avoid bare soil during the winter and allow for bio-till and low-till management when practical for erosion control;
7. Spread out peak labor demand over the year by staggering planting, cultivating and harvest of a variety of different crops and crop maturities;
8. Produce a stable and predictable supply of different high quality crops over multiple years to attract and keep reliable buyers.

**"Dr. Nicolas Lampkin, the Welsh agricultural researcher, reported that mixtures of two different crops sown together will often yield about 10% more than if the crops had been planted separately on the same acreage. "**

### **New crop—and crop mix—ideas**

How do we break the great American cycle of corn, soybeans and the lender's office? The best way is to develop a broad and diverse repertoire of crops. Certainly it is easy to find markets for organic corn, tofu soybeans and wheat. But there are many other crops well worth considering, especially those for the human food market and for organic dairy and chicken feed.

- Barley, oats, triticale and rye are all valuable in animal feed, and if managed carefully, can produce profitable yields.
- Oats and barley are also enjoying an increasing human food market.
- Many of the dairy farmers we know would love to put field peas in their rations, cows seem to really milk on peas, but there is very little supply in the East.
- There are increasing opportunities for organic fresh market and processing vegetables. We have had success growing processing sweet corn, snap beans, cabbage for

sauerkraut and edamame soybeans. These shorter season vegetables help stagger work demands, since they are planted later in the season after other crops are underway and often are harvested before soybeans.

- Sunflowers, beautiful as they are on a summer day, are valuable as a source of both oil and meal, and sunflowers are also powerfully allelopathic against many tough weeds.
- There is a strong demand for different types of organic dry edible beans, like red kidney, navy, black, blackeyed peas and garbanzo beans.

Crop mixtures offer some interesting opportunities. Dr. Nicolas Lampkin, the Welsh agricultural researcher, reported that mixtures of two different crops sown together will often yield about 10% more than if the crops had been planted separately on the same acreage.

- Some dairy and crop farmers are becoming interested in a barley/pea/oat mixture which can be used either for forage or as a high protein mixed grain.
- Other farmers are trying soybeans/sorghum, barley/oats, and, in more southern areas, fava bean/wheat mixtures.
- European farmers also sometimes mix several different varieties of the same crop to take advantage of complimentary growth patterns.
- There are several interesting and highly nutritious root crops that can be used for animal feed, such as turnips, fodder beets and rutabagas.

Cover crop and hay opportunities: There is a potentially much wider range of cover crop and hay opportunities than most of us realize. Each region has cover crops that are well adapted to the climate and crops produced.

Hay also has untapped potential. At a recent NYCO meeting, dairy farmers begged the crop farmers to consider producing more high quality hay, since this has been difficult for them to grow or purchase. Here is a ready market, willing to pay top dollar for a specific product, as long as we produce to the buyers definition of what 'high quality' means. Dairy farmers also like high quality baleage, as long as it is cut young and handled so it will keep.

## **The next agricultural revolution**

Back at the turn of the last century, a remarkable scientist in Georgia recognized that lack of crop diversity was resulting in a decline in soil health, crop productivity and farm profitability. He encouraged farmers to try new crops, like peanuts, cowpeas and sweet potatoes, and to try new rotations, better cultural practices and more appropriate machinery. He also helped to develop more uses for the new crops, creating additional markets. Weaving together new and old crops into a system that improved the soil and improved yields, George Washington Carver revolutionized the farming in an impoverished region and gave many people hope. Out of his work, the infrastructure to handle the crops grew, creating more jobs and opportunities. With all the resources and advantages available to organic

farmers today, we certainly should be able to do as well.

As we start this new season, it is well worth considering this lesson of George Washington Carver and to realize that we don't have to 'wait for times to get better'. We need to actively make things get better ourselves. Planning improved crop rotations is a very good place to start. But there is, of course, more to crop rotation than simply the technical. When asked how he plans crop rotations, Jean-Paul Courtens, the manager of the Roxbury Farm, a biodynamic farm in the Hudson Valley of New York, says that early in the spring, he goes out and stands in the field to sense what crop feels right. Klaas too will comment sometimes that "this field doesn't want to grow corn this year." Experienced farmers will blend science, agronomics, economics and field histories with that indefinable intuitive sense and then will decide which crop will do best this year. And hopefully they will be right! 