

## **Innovative Crop Rotation Systems: Targeting Weed Control and Soil Health**

David Fisher

Natural Roots Farm

888 Shelburne Falls Rd.

Conway, MA 01341

413-369-4269

[csa@naturalroots.com](mailto:csa@naturalroots.com)

We have designed crop rotations on our farm to meet our management goals. Our primary goals are to minimize weed pressure, to nurture the health of the soil, and ultimately to raise top quality produce. There are several secondary goals, which rise or decline in priority in response to the changing conditions we face. These secondary goals may include things like creating beneficial insect habitat or reducing off-farm inputs by diversifying production.

At its most basic level, our rotation employs a two-field system. Quite simply, in any given field we will grow vegetables one year, and rest the field from production the next. We till seven acres on our farm and crop half of those, or 3 ½ acres, each year. The other 3 ½ acres are fallow. The management of the fallow field is key to attaining our primary goals of minimizing weed pressure and nurturing soil health, so I would like to focus on the management of the fallow field.

The start of this cycle, however, begins with the establishment of a cover crop in the vegetable production year. The precise timing of the sowing of the cover crops may vary based on the conditions we face and is influenced by our various goals. For instance, one of our goals is to have zero weed seed set in our fields. If we are feeling concerned with weed pressure, we may delay establishing cover crops in our vegetable beds until later in the summer. Once we establish cover crops in the vegetable fields, we forgo any further opportunities to control weeds with mechanical cultivation. If weeds do become established amongst the cover crops we sow, then labor-intensive hand weeding is the only option we have left to prevent these weeds from setting seed. Delaying cover crop seeding will give us more opportunities to cultivate the soil and kill germinating weeds later into the season. On the flip side, if building organic matter in our sandy soils is feeling most important, we may establish cover crops as early as possible, making for the longest possible period of protecting the soil from erosion, compaction, and building soil structure and organic matter. This would mean under sowing cover crop seed at the time of the last cultivation of each crop (just prior to the point at which the crop will be too large to straddle with the riding cultivator). The final pass with the cultivator incorporates the seed into the soil and the cover crop will emerge in the understory of the vegetables. Usually we do not under sow crops like lettuce, bok choy, or Napa cabbage, or other short-season crops like arugula, dill, or cilantro for fear of seeds or young sprouts becoming lodged in the head or bunch of the harvested crop. Instead we will wait until these crops are harvested off, renovate the bed and then seed our covers. Whether earlier or later, we like to see the entire farm seeded to cover crop by the end of August. As temperatures cool at this point in the season we don't see nearly as much weed germination as we do in June and July. Also most annual weeds, which do emerge amongst the cover crops, do not have time to mature viable seed before freezing. We don't want to wait any later than the end of August because we want allow ample time for a thick sod to carpet the growing fields before winter sets in. By establishing a thick cover before winter we will effectively smother any winter weeds, which may germinate very late in the season or very early in the following spring. Furthermore, any soil that is not firmly held in place by the

root system of a cover crop will be vulnerable to erosion in the event of flooding, which is not uncommon in our bottomland fields during hurricane season.

Now, what cover crops we choose to sow will also vary based on the changing conditions of the farm. For many years we raised sheep and would overseed a forage mix for them to graze during the fallow year. For several years we grew oats in the fallow fields for grain or straw to feed and bed our working horses with or for crop mulch. In preparation for the early-seeded oat crop we would overseed our vegetables with crimson clover - a good choice for a cover crop that will neither overwinter nor compete with vegetable crops. At this point in time, we are mainly over seeding with biennial cover crops: either rye and vetch or rye and sweet clover because they are easy to manage in the fallow year.

After the snows of winter recede, these over seeded biennial cover crops are already thickly carpeting the now fallow fields. Our first task is to spread soil amendments - a light dose of a custom blend of rock minerals, trace minerals, inoculants, and other probiotics. We like to feed this blend to the cover crops in more frequent, smaller doses in the hope of having the soil biology and the growing covers digest the minerals to make them more available to the vegetable crops to follow while not overwhelming them with too large of a dose.

Before they grow a foot tall, while they are in a strictly vegetative state, we will clip the cover crops with the sickle bar mower partly to encourage the rye to tiller and regrow with a thicker crown and root system, and partly to set back any “winter weeds,” such as shepherd's purse, which may threaten to set seed early in the spring.

After clipping we will let the cover crop continue to grow until it reaches its reproductive stage. When the rye has headed out and is shedding pollen from its yellow anthers, most of the plants energy is directed upwards towards its reproductive process. It is in a vulnerable state, which makes it an ideal time to kill it with the sickle bar mower. At this stage we have also grown the maximum amount of biomass from the rye and have a high carbon to nitrogen ratio. Conveniently the vetch and sweet clover are also coming into full bloom around this time and have fixed their maximum potential of nitrogen into the soil.

After mow-killing these biennials we are ready to turn them into the soil with the moldboard plow. By turning under a healthy dose of carbon and nitrogen into our well aerated and quickly warming sandy soils, we have excellent conditions for sheet composting. In addition, the fibrous roots of the rye and the taproot of the legumes have made an incredible contribution towards improving the structure of our soil. Now we experience a biological population explosion in the soil. Respiration can almost be seen as early morning mists rise from the active soils and earthworm castings cover the surface of the field.

This is the point in the rotation where we turn our attention towards field-scale weed control with a bare fallow period. Approaching the summer solstice there is ample sunlight and warmth for prime conditions to germinate weed seeds. At the first signs of germination we will till the field thoroughly, but shallowly, about one to two inches, usually with a spring tooth harrow. We hitch a cultipacker in tandem to firm the seedbed immediately to promote the next round of weed seed germination as quickly as possible, thereby getting as many successions of weed germination in the bare fallow period as possible. We may maintain this bare fallow period for as much as eight weeks, lightly harrowing the field every 7 to 14 days, depending on the germination we see.

In early August we prepare to sow the fallow fields to another round of cover crops. For those fields, which will be planted to early vegetable crops in the following year, we will spread another round of amendments. We use the same custom dry blend layered into a manure

spreader full of compost. Once spread, we work the compost and amendments into the soil with one last pass of the springtooth harrow. For those fields, which will be planted to later vegetable crops in the following year, we will wait to spread amendments until the next spring, partly due to our limited production of compost.

Finally we will drill all of the fallow fields to their second round of cover crops for the season. In the fields which will be growing early vegetables in the next season we will sow oats and peas, which will reliably die back over winter. This enables us to plant early after a quick tillage of the winterkilled residue in the following spring. In the fields which will be growing late-planted vegetables in the next season, we will sow another biennial cover crop – usually rye and vetch or rye and sweet clover again. These biennials will survive overwinter and will provide the same weed competitive cover late in the fall and early in the next spring. In the spring of the next crop year, we will spread our compost and amendments right into the vigorously growing cover crops. Again, we count on these covers to help digest another dose of amendments and make them more available to the vegetables to follow. We manage these biennials just as we did in the previous fallow year, only instead of beginning the bare fallow period after tillage, we begin planting our vegetable crops.

Before long the cycle repeats itself, and this is how we use rotations to achieve our goals of minimizing weed pressure and nurturing soil health.