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Managing Weeds on Organic Vegetable Farms: Case Studies

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MANAGING WEEDS ON ORGANIC VEGETABLES FARMS

THREE CASE STUDIES WITH EXPERIENCED GROWERS

Fort Hill Farm, Kent CT

Hurricane Flats, South Royalton VT

River Berry Farm, Fairfax VT

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Organic Weed Management at Fort Hill Farm - a Case Study

Background. Paul Bucciaglia has been farming at Fort Hill Farm in New Milford, CT, since 2002. The farm has a 22-acre field with about 17 acres in vegetables and cover crops. Paul's market is 90% CSA (currently 400 shares) and about 10% farmers' market with a little wholesale of excess produce. The farm is certified organic by Bay State Organic Certifiers. It has a sandy loam soil, and was in hay for a decade before vegetable production. Prior to that, the farm was cropped for a large dairy. The soils are uniformly high in phosphorus, with an organic matter level around 2.5 percent.

Diversified vegetable beds at Fort Hill Farm in New Milford, CT

Primary weeds. Paul has been dealing with the same weeds since he's farmed here: the major species are large crabgrass, redroot pigweed, common lambsquarters, and purslane. Although still a minor weed, there has been a noticeable increase in hairy galinsoga.

Production practices. The land is kept covered as much as possible over winter; roughly a third of the fields has fall planted oats and peas, a third has hairy vetch/rye and the other third has mowed cover crop residues or vegetable crop residues where crops were grown into the late fall. In the spring, every 2 out of 3 years, 10 to 15 tons per acre of leaf compost and/or horse manure compost is applied. This is primarily for adding organic matter to the soil, since these composts are relatively low in nutrients. The soil is low in K, B and Ca so these are added by broadcasting mineral fertilizers around the same time as the compost is spread. Then the amendments are incorporated with 6-foot-wide Imants spader; it requires one pass over the entire field, but the machine is rather slow so 1 to 2 acres are tilled at a time.

"We try and grow as much rye and vetch as we can but it's tricky to time its incorporation in the spring. We want to spade early so we can stale seed bed before planting crops; sometimes we allow too much time for the cover to grow, then we get more N but the residue is not as decomposed as I'd like. We want at least 10 days between spading and planting, even more if it's early in the season. If it doesn't rain, we irrigate to promote weed seed germination."

A Case 1194 tractor with a 5-foot wheel base is used to mark the beds while dropping fertilizer from a Schafer 5-foot drop spreader. All his tractors have narrow tires, from 8 inches to a maximum of 12 inches, which maximizes useable bed space. The drop spreader applies material to a 4-foot wide area on the surface. Lately Paul has used a 6-0-4 McGeary fertilizer preplant, then an 8-1-1 if needed for sidedressing.

Total N from the fertilizer blend is generally 40 to 75 lbs/acre, depending on the crop and the quality of the preceding cover crop (e.g. legume density and maturity). An old IH 140 tractor has a Buddingh basket weeder permanently belly mounted with the baskets as close as they will go. It is used to run over the beds to make them perfectly level, and to mix the preplant fertilizer into the soil. This is done immediately after application to avoid N volatilization. Then it either rains or overhead irrigation is used to apply a half inch of water to get the weeds started. In early spring large row covers may also be applied to create heat to make the weeds grow, so they can be killed by stale seed bedding.

Buddingh baskets belly mounted on an old IH 140 tractor are used to incorporate pre-plant fertilizer into beds and for stale seedbed control of small weeds before planting crops.

Cultivation tools. The belly-mounted Buddingh baskets are used for stale seedbedding prior to planting crops. “If there’s water and heat after forming the fertilized beds then in 3 to 5 days we get some weed germination; I like to wait a little longer than that and then go through with the baskets on the 140 to stale bed the growing areas; the 140 also has C-shanks with sweeps to cover tire tracks. The first stale bed pass is usually 5 to 10 days after the initial pass to level beds and incorporate the fertilizer.

We try to do two stale seed bed cycles of weed germination/basketweeding. That knocks about 90% of the weeds down. After that I hate to bring up any new weed seeds. We’ll often plant right after the last stale seed bedding; then we irrigate again to get a good crop stand because our soil is so light.”

Williams cultivator with tines over the entire bed and C shanks with sweeps in tire tracks.

"We also have a 5-foot-wide Williams cultivator and we use it with just the Lely tines and the wheel track eradicators on it, which are C-sharks with duck feet. However, I don't like using the tine weeder for stale bedding. The window is much narrower for stale bedding with the tine weeder and if weeds have emerged we'll nearly always use the basket weeder because it will kill bigger weeds, especially if they are grasses."

After the stale bedding, once crops are sown, Paul relies on 3-row and 4-row basket weeders for weed control, as well as the tine weeder, depending on the crop and the type of weed pressure. "Typically we'll basket weed carrots twice and hand weed once. For bigger crops like corn or broccoli that will form a canopy, there will be a pass or two with the basket weeder and possibly the tine weeder if the crop is well rooted (i.e. it passes the 'tug test'), then there may be a final cultivation by hilling, but generally only rouging of large weeds is required. I have a large and a small set of disk hillers. I make the call whether it's worth it to bring up new weed seeds in order to control the weeds that are there before the canopy closes. If the stale bedding works well then a lot of subsequent cultivating isn't needed."

Cover crops. The main covers Paul uses are: rye and hairy vetch planted before Sept. 20, rye alone planted after late September, oats and field peas planted before Sept. 5 or in early spring preceding mid summer planted vegetables, and crimson clover which is undersown into crops (usually after last cultivation, or after last hilling in crops like leeks, and under peas before trellising). "Crimson clover is an aggressive cover crop that establishes well on our sandy soil. The clover winter kills and is easy to incorporate in the spring."

Crimson clover in fall Brassicas has been a fairly reliable cover crop at Fort Hill farm. The seed is scratched in with a tine weeder or hilling disks early in the season, sown at 15 to 20 lbs/acre. The crop winter kills completely and the residue is easily incorporated with a spader in the spring.

"I don't grow spring planted clover any more; the potential damage of weeds setting seed in there doesn't make sense. Soy plus Sudax, rye plus vetch, and spring planted oats plus peas have very few weeds maturing seed in them. I don't buy the thinking that cover crops automatically suppress weeds; they may suppress weeds from growing as much as they would have compared to bare ground, but if you get weeds maturing and setting seed in the cover crops then you are going backwards from a soil weed seed bank perspective."

"We really like soybeans and Sudax; we'll sow that instead of oats and peas if we can get in by the second week of August. Soybeans and Sudax can be planted deeply and will germinate reliably in hot, dry soil. We get 3 to 4 feet of growth from the soy/Sudax mix planted by mid August; we'll get 8 to 10 feet if we plant it by early July. We favor the soy in the mix by using 10 to 15 lb/acre of Sudax and 100 to 150 lb/acre of soybeans; we do that because we want the nitrogen. We'll flail chop that cover sometime after soybean flowering (for a July sowing), or in the fall after a light frost stops growth (for an August sowing). We leave the residue on the surface, to be spaded in the spring.

Flail mowing a July-sown soybean/Sudax cover crop in September. The cover was pretty effective at suppressing weeds but is being cut before broadleaves go to seed. The seed mix was too heavy on the Sudax in this case – it did not allow for the desired amount of soybean growth to add nitrogen to the soil.

Labor for weed management. "We have 30 five-foot wide beds to an acre; you can stale bed one bed in 3 minutes, it's very efficient. To cultivate one bed with a crop in place takes about 6 or 7 minutes. So, taking a bed of carrots for example, 2 stale beds passes is 6 minutes, 2 passes cultivating is about 14 minutes, so there is a total of 20 minute of tractor work per bed, equal to 10 hours per acre.

Hand weeding to keep the beds very clean requires 1 to 2 hours per bed depending on how well the stale bedding worked, so that can be 30 to 60 hours per acre. At $10 per hour labor it sounds like a lot but the retail value of carrots is high, probably $18,000 to $25,000 an acre so you need to keep that in perspective."

Other observations. “In terms of weed management, I would like to move our crop rotations toward two categories: weed generators and weed victims. We tend to generate weeds in crops like potatoes, corn, and winter squash that cannot be cultivated or even hand weeded late in their growth cycle. Then we get slammed in the subsequent victim crops which cannot compete with the weeds and need to be kept very clean, like arugula, mesclun, carrots, onions, and spinach. In the future I want to move to a system where we set aside land for the weed victims and we don’t grow any of the weed generators in that area, which would really reduce hand weeding time.”

“Right now we try to limit weed seed production in the weed generators by going in after crop harvest and removing any remaining large weeds. There may be as many as 200 large broadleaf weeds per acre after a crop like winter squash, which we cut with lopping shears, load in a truck, and dump in the woods. At 200 large broadleaf weeds per acre, multiplied by approximately 150,000 seeds per large weed, that removes something on the order of three million weed seeds per acre from the soil weed seed bank. That is worth doing if the next crop is a going to be a weed victim, but I might not bother to do that if the next crop was a weed competitive weed generator. Removing the large broadleaf weeds is very cost effective, but it is much harder to remove crabgrass that has matured seed, which is one reason that crabgrass populations continue to increase on our farm.”

Organic Weed Management at Hurricane Flats – a Case Study

Background. 'Geo' Honigford has been farming at Hurricane Flats in S. Royalton, Vermont, since 1994. The farm has a total of 37 acres; 8 acres are in mixed vegetables and cover crops, the rest in hay. He primarily markets at a busy farmers' market about 20 miles away. There is a small self-serve roadside stand at the farm, and excess produce is wholesaled when necessary. Two high tunnels on the farm are used for early plantings of a variety of crops. The field has a wide array of vegetables, with the largest acreage in popcorn, sweet corn, potatoes, and cantaloupe. Tomatoes, mesclun mix, cole crops and sweet potatoes are also significant crops on the farm.

A view of the fields at Hurricane Flats, S. Royalton VT. The farm is certified organic by Vermont Organic Farmers.

The farm has sandy loam soils, and it sits along a river which provides irrigation. The land was mostly in hay prior to becoming a vegetable farm. Geo started out with just a couple of acres in production and gradually converted hay land until the vegetable growing area reached its current size.

Production practices. First thing in the spring, purchased composted poultry manure is spread on all 8 acres at approximately 5 tons/acre. Geo is looking into alternative sources of fertility to reduce P applications over time, but this has been an affordable source of nutrients and organic matter, with good results in terms of crop health and yields. After spreading the compost is tilled in with a 5-foot-wide rotovator, usually within a few hours, to avoid nutrient losses. A 6-foot-wide cultipacker is then used to firm the soil to make a good seedbed.

The cultipacker marks the rows; the tractor tires mark the aisles and the area in between, about 5 feet wide, mark the beds. Some crops are grown one row to a bed (melons, winter squash, sweet potatoes on plastic, staked tomatoes) some are two rows to a bed (potatoes, cole crops) and some are 3 rows (onions, carrots) or 5 rows (mesclun mix). A 2-row planter is used for corn seeding, and a Planet Jr. is used for seeding everything else. Transplants that are started in a small germination greenhouse on the farm are set out by hand. "I'm still not big enough to justify the cost of a transplanter" says Geo.

Primary weeds. “When we started, there was a garden and mostly a hay field, and the main weeds were lambsquarter and pigweed and another weed that has since gone away. Over the years large crabgrass came in, it is now our worst weed.”

“We keep a close eye on the hairy galinsoga, pulling maybe 50 plants a year. When we see it, we pull it up and walk it out of the field. I will stop the tractor and get off to pull up galinsoga; we never cultivate it in, and this way we have been able to keep under control. We’re also starting to get some purslane in a couple of areas. It is hard to kill and I am converting one of the areas to asparagus because it does not do well with the heavy layer of hay mulch that we use on that crop.”

“Quackgrass is the initial foe when I break up new sod for vegetable production. To get it under control I’ll plow in the spring, let the quack come up, then disk or rotovate it, let in come up again, then disk or rotovate again. I till it at least twice, about 2 weeks apart, until I see its vigor decline, then I sow buckwheat at 100 pounds to the acre, in mid- to late June. I broadcast the seed and lightly disk harrow it in, and let it go until it’s ready to set seed. Then I rotovate it in, let quack come up again, and see how much there is. If there’s still a lot of quack I’ll rotovate it, wait a couple weeks, and hit it again. Once the quack regrowth is minimal I’ll plant oats right away. That could be anytime from mid-August to early September. The next year the field will be very clean. There are always a few quackgrass plants, but they have no vigor and don’t take over. They usually die on their own in the course of regular field traffic.”

Geo avoids a long crop rotation with hay and vegetables because he feels he’d have to fight the quackgrass all over again. “I don’t want to let it come back in, once the field’s mine, it’s mine.”

Cultivation tools. A 5-foot-wide tine weeder is a mainstay of mechanical weed control on the farm. “I bought it used for $75 and it’s probably 50 years old; I think it’s a Ferguson implement. I look at newer tine weeders out there and ask: are they $1500 better?”

Geo Honigford describes his tillage and cultivation tools at an on-farm workshop. From left to right: cultipacker, 2-row hilling disk set up, rotovator, and an old Ferguson row crop cultivator with C-shanks and shovels.

The tine weeder is used for stale seedbedding before planting and then blind cultivation shortly after crops are planted. “I want to weed every square inch of the field every two weeks, that’s my goal. It only takes about 5 to 10 minutes to do an acre since I use the tines at high speed, probably 7 to 8 mph, or as fast as I can go and stay on the tractor. I run over the fields every couple of weeks, depending on the weather. That will take care of most weeds, although some always survive.”

As fields are planted, they may get tine weeded again when the crop is still small, if it’s a crop that can tolerate blind cultivation, such as corn. Thus, since the beds are typically made in mid-April, they get stale bedded once or twice before the first plantings in early May. Then blind cultivation begins as soon as the corn is up and there is a small flush of weeds.

“The tine weeder rips up some corn but very little. Once the corn is up I go right back in with the tines as soon as weeds emerge; if the weeds area half inch tall I am all over them; it could be 4 days after planting the corn or it may be a couple of weeks, it depends on the conditions. Sometimes the tines work great and sometimes they don’t, especially if it rains and the weeds aren’t as easily killed.” With this system, late plantings of corn have been stale bedded with the tines repeatedly before the last sowing around the fourth of July. Those fields typically have very little weed pressure.

This old Ferguson tine weeder is used for stale bedding fields prior to planting and for blind cultivation over crops like corn while they are still small.

“I have tried flame weeding for stale seed bedding, but I don’t flame anymore since it doesn’t work on one of my main weeds - crabgrass. Its growing point is below ground so the flame only burns off the leaves; it does not kill the plant like mechanical cultivation can.”

Once the crops are too large for blind cultivation, a row crop cultivator, also an old Ferguson implement, is the main weed control tool. It has sets of C-shanks fitted with shovels; there are 3 offset shanks between each row, which are pretty aggressive.

“The unit used to have guards on it to shield the crop rows but I took them off because they stopped the shanks from throwing some dirt up into the row, which seems to help with weed control. The shields were blocking this without really protecting the plants.”

“Sometimes I go through a crop like sweet corn twice with the row crop cultivator but when the tines have done a great job, like in some late corn plantings, there’s not much weed flush left so I won’t need the row cultivator at all.”

The last mechanical cultivation on large crops is with a 2-row set of hilling disks, they are about a foot in diameter and one disk in on each side of the row, moving soil up into the crop to cover small weeds. I generally don’t have to adjust the disks, but sometimes the angle needs to be changed to get the right amount of action to throw up enough soil to kill the weeds by burying them.

“On some smaller crops that are 3 rows to a bed, like carrots, I might also use the row cultivator, and I’ll move the shanks to one side or another and take some off to get the coverage I need without damaging the crop. Using the cultivator is not much faster than using wheel hoes given the diversity of crops and spacing that I have on the farm.”

“I really like the old wheel hoes like those you find at flea market; the new ones have thin steel and on our sandy loam soil they cut too deep. I like the heavier blades that can ride on the surface, cutting off weeds without going too deep and bring up new weed seeds.”
With crops like mesclun mix that are 5 rows to a bed, all the weeding is done with hand hoes.

“We only need to hit it once, just after it comes up. That’s because we grow these crops in areas that have been stale bedded with the tine weeder. The exception therefore is in the early spring, where there hasn’t been time for stale bedding. “In the spring it’s sometimes a mess in the small crops.”

Hand weeding. “We try to hand weed the entire farm to keep and surviving weeds from getting away from us. Every 3 to 4 weeks we go through each bed with hand hoes to kill crabgrass survivors while they are still small and to hand pull any big weeds that have escaped. It’s quick if everything works according to plan; it only takes a few minutes to do an entire acre.”

“If an area really gets away from us we do what I call triage, and we leave it for last, so we can keep the rest of the farm under control. Then we’ll do whatever it takes. For example, this year I had planted carrots and beets and got a perfect flush of crabgrass –it was a solid stand, a mess. So we left it and then plowed part of that area under and replanted, but I needed to keep some so I could have a steady supply of those crops. Even though it was a money loser I had a worker go through the really weedy area and clean it up by hand.”

“After harvest we’ll also go thru fields and pull weeds. For example, when the sweet corn harvest is over, before I mow it down, we’ll walk through and look for weeds that have viable seeds, pull them into baskets, and remove from the field. It’s usually pretty fast work and well worth it. In a crop like cantaloupe, it’s hard to get in once the vines run, but later, as we pick, we’ll also pull weeds. We don’t let weeds go to seed, so we are constantly in weeding situations.”

"Basically I have a 4 pronged attack: tractor cultivation first, wheel hoe second, scuffle hoe third, then hand pulling. We always end up there, because we let nothing go to seed that we know of."

Cover crops. "I stopped using winter rye as a winter cover crop; it was hard to kill, and was like a bad weed in the spring. Now I use oats since they are all dead in the spring and easy to work with."

This field of Japanese millet in mid-August was recently mowed to make it easier to incorporate in the fall and to allow Geo to more easily scout it for weeds that may have established in the cover. This field will be turned in and planted to oats in September.

In addition to oats over the winter, Geo sows buckwheat for a short-lived cover in summer, and hairy vetch as a source of nitrogen, often mixed with another cover crop. He has used a lot of Japanese millet to provide a longer summer and fall cover. "If you get a nice stand, it gets very tall, and you can mow and it down and let it come back. But it is a little fussy about growing in cold temperatures; it can't take the frost so you have to wait to plant it until June in my area. It's nice that we have a local organic source of seed from a nearby farm."

Geo is always on the lookout for weeds in his stands of cover crops. "One year we had quite a flush of weeds in a Japanese millet and vetch mix, mostly pigweed and lambsquarter. I decided it was not worth the labor of trying to pull that may weeds out of an acre of cover crops, so I let the cover winter kill and then put potatoes in there the next year so I could easily control the weeds mechanically."

Labor devoted to weed management. "I record my time on farm tasks. Last year I spent 154 hours weeding, and my main worker did the same, so we had about 300 hours into weed control, divided by 8 is about 37 hours per acre. That number has been pretty steady; it's gone up some as I've added acreage over the years but on a per-acre basis I am actually spending less time weeding every year; that allows me to spend more time harvesting and marketing, both of which have increased as my farm has grown."

Make weed control a priority. Good weed control has lot of benefits. My farm is highly visible from the road so customers see my fields and they like the fact that they are clean; it makes them want to support me. Clean fields also encourage high employee morale; when the place looks good they are proud of it. And finally, good weed control makes picking a lot easier. When there are no weeds in mesclun, we are just picking, not sorting through weeds."

“My advice to new farmers is: don’t rush to be mechanized; figure out your system first on a few acres with hand tools. There is no payback on a tractor at that scale. You have to buy equipment and use technology that’s right for your size - avoid equipment envy. If you can’t keep up, either your systems aren’t right or you need more help. Usually I think it’s the former. We have 2 guys that do all the work on 8 acres, and we keep up. Of course, we work hard, and my employee is well compensated; it keeps him thinking about how to do things better and more efficiently.”

Organic Weed Management at River Berry Farm – a Case Study

Background. David Marchant and Jane Sorensen are the owner/operators of River Berry Farm where they have farmed since 1991. The farm is located in Fairfax, Vermont, along the LaMoille River. The soils are primarily river bottom silt loams with some sandy loams on the uplands. The farm totals 150 acres, with 90 acres tillable in a rotation with cash crops and cover crops. The primary cash crops are: root crops (carrots, parsnips, beets,) winter squash, leaf lettuce, zucchini and summer squash, kale and collard greens, cabbage, broccoli, sweet corn, strawberries and raspberries. Several greenhouses also produce bedding plants and tomatoes. About two-thirds of the crops are marketed through wholesale channels and the other third is direct markets at the farm stand, through a CSA and at farmers' market.

"Our farm was a dairy farm and the fields were in sod when we arrived so the weed pressure was very low when we started vegetable farming" says David. "Early on it was mostly pigweed and lambsquarters that were the main weed issues. Bringing in manure brought us hairy galinsoga. Now crabgrass and galinsoga are our main problem weeds. Also hairy vetch left over from our production of our own cover crop seed is a real weed problem in matted row strawberries in the fruiting year."

Production practices. There are over a dozen different fields on the farm and they are managed differently in order to meet the needs of the wide variety of crops that are grown. A combination of cover crops, farm-produced compost and bagged fertilizers are used to maintain soil fertility, applied where they fit best in the rotation. Weed control tools include: a Lely tine weeder used on young sweet corn, Brassicas and first year strawberries; Buddingh baskets used on all lettuce and direct seeded root crops; C-shanks with shovels used for hilling established corn and Brassicas, Lilliston rolling cultivators between beds of plastic mulch and sometimes in place of shovels. "We also use hand hoes; with our weed pressure we definitely find ourselves needing to hand weed quite a bit."

These carrot beds at Riverberry Farm were recently hand weeded to remove large weeds that grew after surviving earlier mechanical cultivations; the weeds were dropped in the walkways where they will dry out and die.

The following systems are used for growing and weeding specific crops:

“Lettuce usually follows carrots, which are harvested late in the season so the ground is bare in spring. We apply a 5-1-9 fertilizer for first 2 plantings, and then we use compost on later plantings when soil will have warmed enough for microbial activity to release nutrients. The field is disk harrowed then shaped into 54-inch wide beds; our bed shaper has 3 deep chisel shanks which line up with the 3 planting rows, spaced 16 inches apart, and it has a fertilizer box to place nutrients right into the bed, not the walkways. Then the crop is transplanted 12 inches apart in the rows. In a week or ten days, once the weeds are up, it is cultivated with the Buddingh basket weeder, and usually another pass is made about 2 weeks later. All lettuce is hand weeded one time.”

Making beds and applying fertilizer prior to seeding or transplanting crops.

“Carrots follow a rye/vetch cover crop that is harrowed in mid-May, and then disked twice in the next month; then the beds are shaped and planting starts mid-June. Before seeding we stale seed bed by waiting a week after bed shaping and then flaming the beds with a tractor-mounted propane flamer; after seeding, the beds are flamed again in six days, just before the crop emerges. Bagged organic fertilizer is sidedressed a week or so after the crop is up, at the same time it is cultivated with the basket weeder.”

“There may be another one or two passes with the baskets depending on weed pressure and weather conditions. The crop is handweeded once approximately 2 weeks after emergence, and there is usually another quick handweeding a month after that; this involves walking and pulling weeds that were missed. The crop is machine harvested. Parsnips are managed the same as carrots except they’re planted from mid-May to early June.”

“Kale, collards, broccoli and cabbage are planted early, from late April through early May into fields with a cover of young rye. Compost is spread at about 4 tons per acre, then the field is disk harrowed, beds are shaped, and the crops are transplanted. The first cultivation is a blind tine-weeding about 7 to 10 days after transplanting; the key is that the plants are well rooted so they don’t get pulled up. Then there are several passes with the S-tines and shovels. There’s usually one hoeing with cabbage, but no hoeing with broccoli. With kale and collards we often hoe after picking.”

Basket weeding while the crop is young and the weeds are very small.

"Winter squash fields are prepared like cole crop fields, except instead of forming beds the fields are stale seed bed cultivated with rolling baskets a week or two after harrowing. For our bare ground planting we use transplants and these are tine weeded as a blind cultivation one week after planting. The next cultivation is one pass with belly-mounted Lilliston rolling cultivators. We use the Reigi weeder for the next cultivation, to get a lot of the in-row weeds. Then we usual hoe about two weeks or so after Reigi weeding to get any weeds that were missed. The final pass is with Lilliston rolling cultivators on a 3-point hitch, just before the vines run. Once they run, we try to do one walk thru and handweed the tall weeds above the crop, though we don't always get to it."

"To reduce the need for cultivation some winter squash is grown on plastic is direct seeded and row covered immediately. In squash grown on bare ground we use a Rabewerk tine weeder on the young squash and then a 3-point hitch Lilliston rolling cultivator as the squash matures. When squash is grown on plastic then sweeps are used for the wheel tracks. We have moved to using more plastic, though I hate using so much plastic it speeds crop development and helps suppress weeds. Zucchini and summer squash are managed the same as winter squash on plastic, except we use transplants. We use clear plastic, for the first planting, then black when we don't need the early season heat. There is some weed growth under the clear plastic but we plant at 12-inch spacing, so the canopy keeps the weeds in check."

"Sweet corn is transplanted for the first planting in early May usually in a field with young rye. Compost is spread and then the field is harrowed and bed shaped. Transplants are planted 12 inches apart in the row, with 34 inches between rows. We use shovels several times on the corn. Early on we set up the Kubota offset cultivating tractor so it is only cultivating one row at a time, with the shovels on belly mounted straight shanks. This allows for more precision. Later we use a two-row 3-point hitch unit with shovels on S tines."

"Direct seeded corn fields are prepared the same as for transplants except instead of shaping beds the fields are field cultivated with rolling baskets no more than one day before planting. We direct seed Sweet Rhythm from Harris. We have tried many varieties, but this series has unbelievable cold soil emergence. It's the only variety we can successfully direct seed that is not treated."

“Just at spiking we blind tine weed the crop. Then we row cover for crow control; it gets moved onto the successive spiking planting so the one piece is used over the whole season. The row cover is left on for one week and then we weed again if needed using belly mounted shovels, cultivating one row at a time. We usually make two passes a couple of weeks apart. Once the corn is 30 inches tall if it’s weedy we will use hilling furrowers that are 3 point mounted.”

“Peppers are planted into a field with young rye; it is prepped with compost, harrowed and rows of black plastic are laid. We plant two rows on the plastic, 16 inches apart with 18 inches between plants. A belly mounted Lilliston works the plastic edges with sweeps for wheel tracks. Individual holes in the plastic holes are handweeded. After the plants are too tall for tractor cultivation we use a Troy-Bilt walk behind rototiller, for weeds that remain in between the plastic.”

Cover crops. “Our main cover crop is rye/vetch. Our approach is to till it in mid- to late May where we want to it to provide nitrogen to a warm season crop in that year. Otherwise we let it go until July and then mow it and harrow it, hopefully before seed is viable. Then the huge amount of vegetation keeps the soil fairly well covered and weed free until September when we disk harrow it in and then usually go to oats; then that field is used for early spring plantings. For fields that we will plant early we use oats Getting a very thick solid planting is key. We drill our cover crops. If we have had a bad weed pressure field, we try to get it into a full year cover of the rye and then oats. “When we have space to grow longer-season covers I will plant things like sweet clover to add nitrogen and organic matter to the soil while suppressing weeds and hopefully reducing soil compaction.”

David Marchant stands next to a field of yellow sweet clover. Planted the previous summer, it has put on a lot of growth by early June.

Costs. Most of our crops require 2 to 4 hours of tractor cultivation per acre to do 2 to 4 passes; hand weeding is much more expensive, with labor at an average of at $10 to $14/hr. I estimate that in the carrots and parsnips this costs $600 to $1000 per acre; for cabbage, lettuce and peppers it is about $300 per acre; first year of fruiting year of strawberries can cost $1,500 to $2,000 per acre in hand weeding to keep the crop clean.

Conclusions. "While I'd like to think I can get by without hand hoeing, I've learned it is always worth the money spent to hoe a field. It always makes harvesting quicker. We don't have a really clean farm from a weed seed bank standpoint, but I have a very good handle on the critical weed control periods where the crops must be kept weed free to avoid yield losses. Perhaps to our detriment I concentrate on the critical periods and often I am not thorough about weed control later in the season. I am learning to swallow my pride and realize we need to hoe and handweed even more than we do now, though it's not something I like to admit to."