A Milpa Lifeway: Re-growing An Ecstatic Bioregional Culture of Self-Reliant Living In the Midst of Climate Chaos (abbreviated)

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Primary permaculture principles informing milpa

1) Work with succession (ecological and cultural!)
2) Use and value diversity
3) Use edges and value the marginal
4) Creatively use and respond to change, and accept feedback
5) Stack and pack

Honeycomb Milpa

After growing milpa in mounds and contoured rows for years and trying to figure out how to get the best of both worlds, finally one day in an inspired moment while installing sheets of foundation wax into honey supers for my beehives, I hit on the idea of the honeycomb milpa.

In the honeycomb milpa, the soil is literally shaped into a honeycomb geometry. The cells of the honeycomb are about 5.5' from one "face" of the cell to the opposite face. The edges of each cell are raised slightly by soil that is scooped out of the center of each cell, thereby creating a shallow depression which catches water.

In the interior of the milpa, corn and beans are grown on the ridges on the edges of the cells, while squash is grown inside the depression in a contoured crescent berm that is mounded up in the depression, bisecting the depression and thereby creating 2 spaces and causing water caught in the depression to be distributed even more evenly. I plant corn at 3" spacing and thin to 6-8". I plant beans 2 weeks after the corn sprouts, and I ideally plant squash starts 1 week after the corn sprouts.

On the exterior of the milpa, I grow tobacco, cotton and Cleomes on the ridges of the south end of the milpa and sweet potatoes in the interior crescent mound. On the west and northern edges I grow sunflowers, yacon, and amaranth.

This idea is only about 7 years old, and I'm still definitely refining it, but it does seem that the benefits of honeycomb milpa are real. Because the rows of corn are not parallel, they don't compete with each other for light. The depressions catch water and store it distributed throughout the milpa. The honeycomb milpa is beautiful to look at and can be very productive. **A major advantage of honeycomb versus rows that I didn't anticipate at first is that when the corn is planted in a hexagon, the plants in each cell can be tied gently together in late summer into "tipis" when they're at full height, so the group of plants is stable, thereby preventing "lodging", or falling over of the plants due to loose, wet soil and/or strong wind. This single action can save your whole crop from animals and fungal rot.**

It's also complex, and dependent on good timing of each action-push. For instance, if the squash don't get planted soon enough, the corn will get too tall too fast and stunt the squash, which will never spread out and suppress weeds, in which case weeds will become an issue. Or, if the beans are planted too soon (or are the wrong variety for the corn variety) they will grow too fast and overwhelm the corn, actually pulling it down (squash plants can do this too, which is a good reason to prune squash vine tips once or twice- which also causes the squash plant to put more energy into fruit and less into rampant vegetation). Or, if you are growing a weak-stalked or tall corn variety and it's a windy, wet year and you don't tie the corn plants in each honeycomb cell together at the top to stabilize them, many of them will blow over and you will have a vast, confusing tangle of rotting corn and bean plants.

Each year we make little changes based on our accumulating experience, such as adding contoured swale-pathways a couple years ago to allow better access (we had not pathways before, which was fine once the squash spread out, as long as no watering was necessary, but then we had a big drought and getting into the interior to water was very difficult), or deciding not to plant squash in the middle of every honeycomb cell.

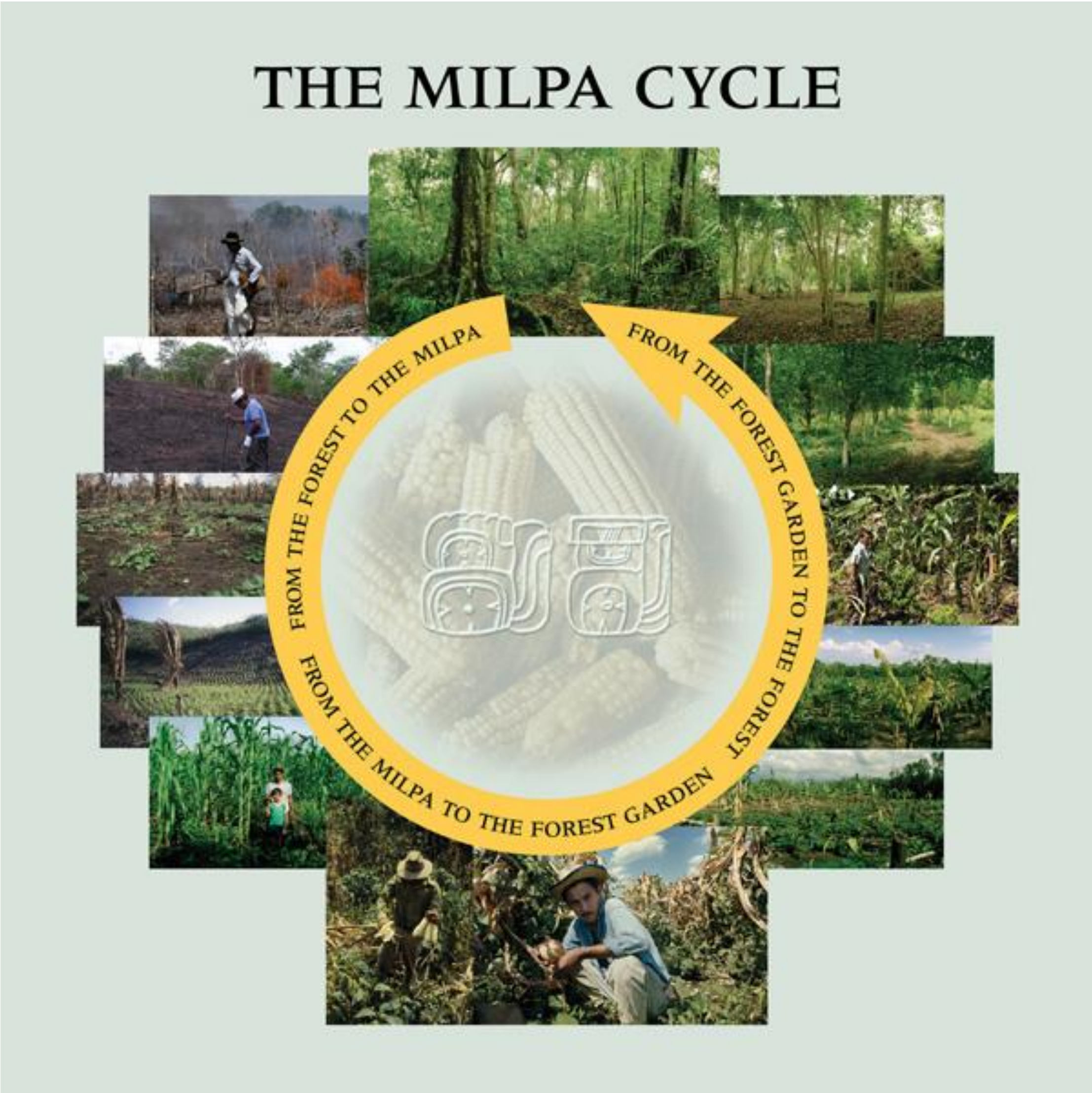

image credit: Dr. Anabel Ford

<u>Timing is everything: from charcoal to spring jump to summer love to winter cover</u>

Understanding the timing of each action in the milpa is essential to success. This means not the mathematical timing (plant corn on the 1st of June, or beans 2 weeks after corn) -which is pretty arbitrary since plants grow in response to conditions, not counting of days - but the biological sequence (plant beans when the corn is hand high, tie corn up when tasseling and so on).

1) September-October- site selection, determine scale of growing, source animal manure, make or source charcoal availability, establish winter cover-crops, ascertain fencing needs, assess or acquire seeds, prelim design layout and shape paths and beds, consider strategies for managing weedy edges and weeds in general depending on site history
2) Winter- observe water flow onsite, re-seed cover crop where necessary, make char and biochar and add urine/animal manure to biochar, identify biodynamic action date options throughout year using calendar, gather compost and seeds and tools; harvest dry kudzu vines for stropharia innoculation
3) March- broadcast charged biochar over winter covercrop
4) Mid-late April- fell and rake covercrop (save patches for seed-saving and/or food saving), finesse path and beds edges, spread and lightly fork in biochar; harvest poplar and basswood for retting for fiber for tying corn up later- big push
5) Mid May-early June- hoe weeds then 3-5 days later plant corn, squash, sunflowers- big push
6) Immediately after planting- defend corn sprouts from corvids via plastic owls and hawks, real owls enticed through owl houses, decoy cereal seeds sprinkled elsewhere, scare crows, flashy tape ("bluejay disco tape), hanging CD's, trained Mountain Curr dogs, camping in tree house or tarped clearing in middle or on edge of milpa and shooting with pellet guns or blowguns etc.- big push
7) 2-3 weeks later (when corn is 1 hand high and has ostensibly survived birds)- hoe weeds, corn hilling, bean planting, plant tobacco, cleomes, yacon, cotton, sweet potato starts; broadcast amaranth and molokhia on sunny edges if these plants are not present already- big community push
8) Late June/early July- 1st hoeing, train beans, add stropharia innoculated mulch (ex: dry kudzu vines); carefully think through appropriate storage facilities for various yields and create infrastructure if you don't already have it (see below)
9) Late July/early August- 2nd hoeing if necessary, trim squash vine tips out of paths, train beans; release ducks into milpa and they can now roam freely in milpa until harvest time
10) late July/early August- tie corn plants together in honeycomb cells, tight enough to make tension not so tight to prevent sun access
11) When silking begins (August)- do any hand pollination necessary, innoculate huitlacoche, hand cut and remove undesirable seedy weeds; thin corn ears via Green corn harvest
12) Late August- begin animal defense strategies
13) September --> late October- harvest time (depending on varieties and planting time)- big community push
14) Late October --> November- have a big feast and eat the last of previous year's milpa foods; shell corn and beans for storage; remove organic matter, separating into 3 piles: corn stalks, vines, seedy weeds; do big char including seedy weeds, can do in pathways to beat back weed seed bank in paths; covercrop and begin again!

Milpa Planting and Management Zones

1) Main milpa pattern- different cell size depending on corn variety and height, squash in the middle of some but not all cells, sweet potatoes or buckwheat or american groundnut in middle of other cells; quelites on edges nearest gates
2) South edge of each bed- tobacco, cleomes, quelites, cotton, yacon
3) North edge- sunflowers
4) Squash spacing depending on variety and intensity of growth habit
5) covercrop seed-saving zone in milpa during warm season
6) variations with sweet potatoes, millet, yacon and so on

7) live fences on edge- black locust and mulberry pollarded living posts (pollarded at 8-10' height), live willow, sea buckthorn
8) poultry runs and inclusion in the milpa (use chickens in spring before planting, ducks once corn gets knee high, chickens when corn is full height)
9) stropharia and other fungi in the milpa (grow stropharia under shade trees on dry kudzu vines, japanese knotweed, covercrop rye straw etc, spread out as mulch under corn once corn gets chest high)
10) Shade trees in center and on NE and NW corners, with tree houses for perching at critical times with a blowgun or pellet gun to hunt squirrels, crows etc.
11) Comfrey/angelica/sochan/ elecampagne/strawberry/egyptian walking onion/red clover guild around edges
12) Tiny seed milpas near the house versus big milpa farther away within walking distance versus milpa that you have to drive to.

Biochar amendment and Milpa in the Big Picture of Succession and Permaculture
Why is biochar such a big deal that everyone is obsessed with? First of all, let's define "biochar". Alot of people use the word biochar to refer to simple charcoal. I think the use of the term in that way is confusing since it is simply inserting the prefix "bio" but there is no distinction between that substance and "char" or "charcoal". Instead, I use the word biochar to refer to charcoal that has been crushed or sifted down to optimal soil amendment particle size (dust to small marble size, it's actually good to have multiple particle sizes together) and then "charged" by mixing with active compost and/or soaking with urine for at least 4-8 weeks. This charging fills the charcoal's microscopic porous coral reef structure with diverse soil microbes and water soluble nutrients that lightly bond to the crystalline carbon structure of the charcoal, awaiting plant root tips to scavenge them from the soil. This charged substance I call biochar. In this way, biochar becomes a useful word that means something unique, instead of just a marketing term for the commercial organic farming industry. Then other hybrid terms like "biochar compost" (charged biochar mixed with a higher ratio of composted animal manure), "chickenchar" (charcoal charged via proximity to chicken manure, see below), "seedchar" (biochar mixed with diverse seeds of pioneer annual and perennial crops and broadcast over soil) and so on can be used to really refine our language and created a useful shared vocabulary.

Biochar has a deep basis in the cultural history (and current life) of American First Peoples who have farmed corn as a sacred way of life. The whole biochar craze began after researchers began "discovering" soils that they called terra pretas (dark earths) in the Amazon rain forest, which typically has sandy soils with low organic matter content because insects eat the leaves and debris before fungi can break them down into humates. These soils were created exactly by the kind of milpa cycle described here, where successive accumulations of charcoal, feces, pottery shards and other "waste" created permanently rich, nutrient and water retaining soils. So by making and charging charcoal we are mimicking that process, perhaps even more effectively than some indigenous farmers' methods.

And of course making charcoal from wood and burying it permanently in the ground is maybe the single most effective strategy for long-term carbon sequestration that we have available to us. James Lovelock, the climate scientist and author of the Gaia Hypothesis, has stated that burying lots of charcoal might be the only way to avoid the most catastrophic trajectory of climate change. Of course this is only true if the charcoal is produced from forests managed in sustainable ways that don't cause topsoil loss or require other giant carbon footprints to produce, transport or process materials.

It's important not to apply charcoal that hasn't been charged, as it can actually soak up nutrients from the soil the first year and stunt plants due to low available nitrogen. Even if you do so, then in year 2 or 3 the yields should increase again as the saturated charcoal starts to give back to the plants. I actually had this sequence happen to me one year because I didn't get it together to charge the char first and just applied. Sure enough, the corn was stunted that year, but the following year it flourished and gave high grain yield.

As I've evolved in my personal and homestead scale use of charcoal, I've found just how broadly useful a substance it is, and that I can stack functions by letting it perform one or more cascading functions in the system which then leave it charged and ready to go as a planting medium. For instance, I learned in the past year from an excellent

article entitled "55 Uses For Charcoal" by the Ithaka Institute that charcoal is actually an amazing insulative material because of all its tiny isolated air pockets (think fiberglass insulation, straw, styrofoam or felt), and that its usually alkaline pH is mold resistant (mold requires an acidic pH to thrive). They asserted that for this reason it could be used for food storage. So this past winter I packed winter squash into charcoal in a metal bin in an un-insulated crawl space. We had an extremely cold winter with temperatures below) 0 degrees Fahrenheit and the squash are fine; moreover, the squash stored in the warmer house not buried in charcoal had mold problems but the ones in the char bin have no mold (by the way, the Ithaka Institute is also experimenting with charcoal as insulative wall infill material in buildings and as a mold resistant plaster on interior building 10
walls). After that initial use, as I'm using up the squash, I'm putting crushed charcoal from that char bin into a yogurt container with holes punched in the lid in the fridge, where it serves a second function of reducing humidity and ethylene levels in the fridge atmosphere, making food last longer. After a couple months of that application, I take out that char and put it in a 2-gallon bucket in the composting toilet outhouse to be used on top of deposits, about 1 cup per poop directly on top of the poop, with some sawdust on top of that. Charcoal is notorious for cutting odors because those odors are sulfur and nitrogen compounds (plant nutrients) which the char rapidly and effectively absorbs. Then when our composting toilet bucket is emptied into the composting bin, it's pre-innoculated with charcoal, which we're learning changes the ecology and food web of the compost bin and reduces smell, and by the time the compost batch is done the finished product is charged biochar compost. That's 4 cascading uses of the same charcoal before it even goes in the ground as biochar!

Another way I use char is by digging contoured urine infiltration trenches on the uphill edges of perennial and forest garden patches and filling them with charcoal (this could be cascaded charcoal as described above). The trenches are about 6" wide and 12" deep. I pee in a jar in my living space and every morning have a nice little ritual of walking out into the garden and pouring the pee onto the charcoal trench. The smell immediately goes away even on a hot summer day. Any urine that makes its way through the char without its nitrogen being absorbed soaks into the soil and percolates downhill towards the plant roots as nitrogen fertilizer for them. Every 4-8 weeks I excavate this charged char (biochar) and use it in planting mixes or on top of freshly hoed beds. The act of digging out the biochar from this edge trench also serves to maintain the edge of the planting bed/path, where weeds tend to pop up and migrate into the bed from the path.

If I really get my timing down, I will have just weeded out an area of a bed that day, then I'll spread covercrop seed (buckwheat and cowpeas in the warm season, rye and winter peas and crimson clover in the cold season) on that freshly disturbed soil, then spread biochar over the top of the seeds where it acts to retain moisture and increase seed germination rates (without digging or even forking in the seeds or the biochar compost!) as well as increase soil temperature because of its dark sun-absorbing color (especially useful for germinating fall covercrops or marginally early summer covercrops). So between the previous 4 cascading uses in the homestead, then acting as seed germination enhancer, soil warmer and finally as long-term soil enhancer as it works its way deeper into the soil profile through layering, the charcoal is serving 7 cascading uses at different points in time. Add in a very beginning use of building a house with it, where it gets to sequester carbon and create a healthy indoor living environment for 50-500 years as part of the house, at which point the house falls apart or is torn down and can be used in the above sequence, and you've got a multi-generational sequence of 8 cascading uses. Back up our awareness into the making of the charcoal, when waste heat can be used to cook, heat water for domestic use or greenhouse heating, generate electricity and create salable co-products from the wood biochemistry, or where a primitive char can be wisely located based on previous observation to kill weed seeds and weed root systems and prepare an area physically for planting, and you have even more uses.

Just one more use to speak about with charcoal at this time is in integration with animals in your milpa (or other) system. Even with free ranged chickens or ducks or goats or cows or pigs used for managing succession, the animals usually spend some time concentrated in a shelter to protect them from weather and/or predators. We use 30-50 chickens at a time, managed by a neighborhood chicken co-op of 10 adults, rotated through an 8 acre landscape with Premier electric fencing and a moveable chicken house on an old trailer frame, to scratch weedy areas back to bare soil in order to covercrop those areas and bring them back into managed succession farming (milpa). At night the chickens are trained to go into their house (a person has to close the door around sunset), which is also where they lay eggs in nesting boxes. This time in a concentrated location can be a major problem, creating bad smells, nutrient runoff and unhealthy animals, or it can be an opportunity where the irreplaceable resource of animal waste, which is nutrients that have been painstakingly accumulated and concentrated by the animals through their feeding and life cycle process, is harvested for use in feeding plants. Charcoal is a major ally in the latter approach, for reasons described above. What I'm experimenting with is simply putting down a layer of charcoal on the floor of the chicken house where they roost at night. The 11 chickens scratch around and break the charcoal into smaller pieces for me. The poop falls on the char and when that layer of char is pretty much covered, I add another layer. Some research shows that having this bed of manure in their coop actually helps chicken immune systems and microbial health as long as it doesn't get out of hand. After 3 or 4 such layers, I scrape it all out and put it in a pile layered with straw or other high carbon, dry organic matter to compost. The charcoal captures the volatile nitrogen compounds from the manure, up to 80% of which will evaporate from a standard thermophylic compost pile, and thereby also reduces odor. Finally, according to the Ithaka Institute, a small amount of crushed charcoal (3-5%) directly added to feed can reduce parasite effects in poultry and increase the birds' health by increasing their ability to absorb nutrients from the food they eat. Then the manure comes out pre-innoculated with char! Similarly, in Belize, at least one farm is charring rice husks from rice they grow, then feeding those charred husks to pigs. The char cleans out pigs' digestive systems and yields pre-mixed pig manure biochar.

Once it begins to dawn on us how pivotal the role of crystalline carbon (charcoal) is in the matrix of biochemistry that we are part of, we quickly begin to wonder where we will get enough charcoal to do all the things we want to do with it. This is not a trivial question, as charcoal production (mostly for metallurgy and the autoclaving of lime for cement, not as a soil amendment) has been a main driver of deforestation, especially in central Africa, the middle East and western Europe, for about 5,000 years. In fact, it's likely that coppice forestry originated by accident from people doing their best to harvest enough wood for their needs from previously forested landscapes that had been over harvested. So instead of repeating the same mistakes over and over again, here are some ideas for generating charcoal renewably within an integrated succession farming system where we don't get to rotate our farming through a vast forested landscape without private property rights.

Coppice and pollard systems- coppicing is the phenomenon where a (usually deciduous) tree sprouts back from the cut or the ground after it is cut down. This natural survival mechanism probably originated as a way to outlive being eaten by a large herbivore. When we do it deliberately it's called coppice forestry, and it's a very old (at least 1,000 year) art in many places, most obviously in western Europe. Coppice sprouts are allowed to grow and thicken for 1-25 years depending on the desired end use and the species. When managed well, coppice creates pulses of wood, leaves, fruit, nuts and other yields that can be renewably harvested from the same root systems for centuries since coppicing actually prolongs the life cycle of the plant. In Britain for centuries there were "bodgers", coppice dwellers whose entire lifeway and economy was based on making buildings, furniture, charcoal, crafts, fences, foods, medicines, baskets and so on from coppice wood, sustaining themselves and selling those products to the town people. "Copses" (stands of coppice stumps planted at 6-10' spacing) can actually be more bio-diverse, with more types of habitat densely packed together, than more mature forests. "Pollarding" is like coppicing but instead of cutting trees to within 12" of the ground, trees are cut at 6-15' height so they repeatedly sprout branches up high where browsing herbivores can't get to them; those branches are then cut in the summer to provide fodder for goats, sheep, cows and so on when the pasture production slows down in hot, dry summer weather. Both of these techniques create plentiful small diameter wood which for centuries has been charred down through a variety of char-making techniques. In the large milpa that I currently tend, we're creating a living fence around the milpa out of mulberry and black locust tree pollards spaced at 6'. The trunks are the fence posts for either a manufactured metal fencing material or a woven organic fencing material (wattle). The dense shading creating by the pollard branches will reduce maintenance along the fenceline, as sunny fencelines tend to demand much maintenance due to vining weeds whose roots become entangled at the base of the fencing material. These pollards will be cut back every 1-2 years to provide animal fodder, mulberry fruit production, black locust flower production, nitrogen release into the soil via the locust root dieback when pollard pruning occurs, and of course a renewable source of charcoal directly adjacent to the field. In general, whether using a pollard fence or some other technique, the low hanging fruit in terms of where to locate coppice and pollards is on existing edges. These edges are sunnier than in deep forest, they are usually accessible by road or path for ease of maintenance and harvesting of coppice yields, and we already put lots of energy into managing edges by mowing or trimming (if not, they soon cease to be edges and instead 12 become part of the forest as succession continues and pioneer tree species grow up), so why not have that maintenance energy be creating better yields? Only after you've worked most of your existing edges with coppice, pollard or some other strategy should you begin any additional forest clearing for coppice production. In many successionally patchworked landscapes of America, there is enough existing edge space to get all of our firewood, charcoal and other coppice yields just from coppicing and pollarding on those edges, leaving interior forests intact or managed with other strategies.

Second renewable charcoal strategy: Applalachian Alnoculture?

This section is purely speculative at this time as I have very little experience with the technique described (in spring 2015 I did plant a small section with alders to begin a testing of this idea). The idea is based on an article on "Ligurian Alnoculture" that Dave Jacke published in the Permaculture Activist magazine spring 2012 issue based on his visit to the Italy's Liguria region, and his subsequent research. In this article he describes evidence of a historical (pre-industrial) integrated farming cycle involving alders (Alnus spp.), pastured animals and grain/vegetable production in a mid-term (10-15 year) cycle. In this system, Alder was planted at regular spacing of 10-20' and allowed to grow for 10-15 years, with animals grazing around the tree once it was beyond danger of herbivory, after which timespan the trees were cut down (coppiced). Because Alder is a highly effective nitrogen fixing genus, this cutting is assumed to release nitrogen into the soil from root tip decay corresponding to the cutting of the tree. Then annual crops were grown in that area until the alder coppice began to get tall enough to create prohibitive shade levels at which point the area returned to a silvopasture function for several years, until the trees were cut again and the cycle continued. Wood cut down was removed and used for furniture, building, crafting, firewood and presumably charcoal.

This system seems to comprise a low diversity (low tree diversity that is), more quickly cycled version of the milpa successional farming technique, and could feasibly be achieved in a smaller scale landscape than the vast forested landscape with no private property boundaries that milpa farmers originally had to work with, since the tree cutting cycle is 10-15 years rather than 100-150 years. Combined with wise animal use for clearing planting areas, along with well-timed cover-cropping practices for weed control and for tight mineral and nutrient cycling, this could very well be an excellent model for integrated post-petroleum succession farming. According to Dave Jacke,"[...] other good candidates for Alder species are European gray alder (Alnus incana ssp.incana) or, in drier locations, Italian alder (Alnus cordata). European gray has more history as a fodder plant from what we can tell. The local species [in upstate NY] speckled (A. incana spp.rugosa) and smooth or mountain Alder (A. serrulata)." I had trouble finding diverse alder species for sale at bare-root prices, so I got what was available, which was Black Alder from Cold Stream Farm.