Low-input Succession Planting on Small Farms

Case studies at Eagle Heights and Troy Farm in Madison

Malachi Persche ♦ mpersche@wisc.edu

Mutual Aid Garden at Eagle Heights

Intensive raised bed successions

- Compost-rich raised beds support a system in which the next crop is planted within the existing crops.
- Combines elements of 19th c. French intensive market gardening with intercropping and relay cropping

Above: prototype of succession idea for roots, greens, culinary herbs, and nightshade family crops.
Drawing by Malachi Persche

Above: 2020 mixed raised bed succession, Mutual Aid Garden at Eagle Heights. See more info on the Mutual Aid Garden here.

Establishing permanent raised beds

Above: Raised beds prepared for planting at the Mutual Aid Garden, spring 2020. Permanent raised beds built up by annual compost additions make for reliable crop production over time, even in places lacking arable soils.

Low-tech raised bed method, Mutual Aid Garden 2020

First delineate bed outlines (5’ wide separated by 3’ pathways is my standard), then break up the sod within the bed outline, shovel soil from the pathway on to the bed outline and rake it smooth. Allow 2-3 weeks for light weeding while the beds settle. All work is possible using only sharp shovels and garden rakes.

Completed raised beds, Mutual Aid Garden 2020

Another method: leaf compost windrows

Mutual Aid Garden, April 2020

- Useful method in places lacking arable soil (parking lots, compacted lawns etc.)
- In early spring, make a pile of partially decomposed autumn leaves 2-3’ high, 5-8’ wide.
- Add an organic nitrogen source (feather meal, legume meal etc.)
- Try for a C:N ratio of 35:1-40:1 (slightly higher than a hot compost pile).
- Turn weekly with pitchforks for 4-6 weeks before planting.

Leaf compost windrows, summer 2020

TradeRoots project at Troy Farm est. 2021

Above: Google Maps aerial image of main growing area at Troy Farm with numbered TradeRoots project locations.

- TradeRoots is a Madison-based farm-to-table business established 2021.
- We focus on adapting crops and varieties significant to the African diaspora to Madison and tuning the harvest into affordable food for the community.

Growing areas numbered on the map:

1. Raised Beds South Plot: year-round crop successions of mixed veggies
2. Raised Beds North Plot: same as Block 1
3. Polyculture Plantings zone: Cucurbits (muskmelon, squash, watermelon) interplanted with heritage varieties of grain sorghum and flour corn.

Goals of TradeRoots at Troy:

- Integrate varieties of okra, garden eggs, collard greens, sweet potatoes, sorghum, sesame, etc. into existing Wisconsin cropping systems.
- Develop economically viable methods for these crops.

Afrodiaspora Gardens examples

Okra, amaranth, and millet at the West Madison Agricultural Research Station in 2020

Our work at Troy contributes to the Afrodiaspora Gardens Project, a UW and community research collaboration looking at African crops in different farming contexts around Madison

Above: sweet potato and corn intercropping at the Mutual Aid Garden.

Three information categories for planning successions

1. **Crop Successions:** the order of crops that will occupy a given bed during the growing season.
2. **Crop Profiles:** standard planting density and growing information for each crop.
3. **Bed Dimensions:** each bed in the system has a permanent name and recorded size (length x width)

These three info categories are the roots of the planning system.

Planning Category 1: Crop Successions

Bed	Succession 1	Succession 2	Succession 3
1	okra	beets	
2	okra	carrots	
3	okra	cabbage	
4	okra	collards	
5	carrots	okra	collards
6	collards	okra	spinach
7	beets	okra	carrots
8	collards	okra	carrots
9	peppers	okra	carrots
10	peppers	okra	carrots
11	peppers	okra	carrots
12	peppers	okra	garlic
13	peppers	okra	garlic
14	peppers	okra	garlic
15	collards	peppers	
16	collards	peppers	
17	carrots	peppers	
18	carrots	peppers	
19	carrots	peppers	
20	carrots	peppers	

Crop successions at Troy continued

Bed	Succession 1	Succession 2	Succession 3
21	sweet potatoes	parsnips	
22	sweet potatoes	parsnips	
23	sweet potatoes	carrots	
24	sweet potatoes	carrots	
25	beets	sweet potatoes	garlic
26	beets	sweet potatoes	garlic
27	beets	sweet potatoes	spinach
28	beets	sweet potatoes	spinach
29	tomatoes	kale	
30	tomatoes	kale	
31	lettuce	tomatoes	
32	lettuce	tomatoes	
33	garden eggs	rutabaga	
34	garden eggs	rutabaga	
35	beets	garden eggs	
36	beets	garden eggs	

Planning categories 2 and 3: Crop Profiles and Bed Dimensions

Crop	rows/bed	seeds/row foot
beets	3	8
cabbage	2	1
carrots	4	8
collards	3	1
garden eggs	2	1
garlic	4	4
kale	4	4
lettuce	6	10
okra	3	1
parsnips	4	6
peppers	2	1
rutabaga	3	4
spinach	4	5
sweet potatoes	3	1

- Crop Profiles (left) are standardized spatial information for each crop about planting density.
- All raised beds have a standard 5’ width separated by 3’ pathways.
- Each bed has a permanent name and a recorded length in my planning database.
- With this info stored on a spreadsheet, calculating seed amounts per crop succession or per bed becomes a simple search-and-sum function.
- Useful for demand-driven crop planning (poll your customers over winter to find out how much of each crop to plant the next year). Learn more about this kind of thinking by reading The Lean Farm.

Crop planning spreadsheet example

Excerpt from bed dimension and crop succession database sheet.

Bed ID	Length	S1	S2	S3
1	70	peppers	okra	carrots
2	65	peppers	okra	carrots
3	60	peppers	okra	garlic
4	55	peppers	okra	garlic
5	50	peppers	okra	garlic
6	57	beets	sweet potatoes	garlic
7	55	beets	sweet potatoes	garlic
8	53	beets	sweet potatoes	spinach
9	51	beets	sweet potatoes	spinach

Below: seed requirements calculator sheet links to the database sheet, adds this info and multiplies by crop profile info to calculate total seed needs.

Crop	rows/ bed	seeds/ row ft	bed feet	row feet	total seed #
peppers	2	1	300	600	600
beets	3	8	216	648	5184
okra	3	1	300	900	900
sweet potatoes	3	1	216	648	648
carrots	4	8	135	540	4320
garlic	4	4	277	1108	4432
spinach	4	5	104	416	2080

Pros: spreadsheet filters easily to calculate seed and transplant needs per bed or per crop succession.

Cons: works well only in a well-defined production system (hard to accommodate a wide range of crops and varieties efficiently).

Transplant production schedule

Transplants Batch 1

Crop	# of plants	planting window	transplanting window
Cabbage	None	NA	NA
Collards	300	4/1-4/15	5/1 – 5/15
Garden eggs	100	4/20 – 5/1	5/15 – 6/1
Okra	600	4/20 – 5/1	5/15 – 6/1
Peppers	200	4/20 – 5/1	5/15 – 6/1
Sweet potatoes	600	4/20 – 5/1	5/15 – 6/1
Tomatoes	120	4/20 – 5/1	5/15 – 6/1

Transplants Batch 2

Crop	# of plants	planting window	transplanting window
Cabbage	120	6/15 – 7/1	7/1 – 7/15
Collards	250	7/1 – 7/15	7/20 – 8/1
Garden eggs	50	6/1 -6/15	7/1 – 7/15
Okra	500	6/1 -6/15	7/1 – 7/15
Peppers	100	6/1 -6/15	7/1 – 7/15
Sweet Potatoes	500	6/1 -6/15	7/1 – 7/15
Tomatoes	100	5/15-6/1	6/15-7/1

- Use Crop Profile info and succession map to determine number of transplants needed per succession.
- Instead of precise planting days, I use planting/transplanting windows to accommodate weather conditions.
- I start Batch 2 transplants in a field nursery of row cover stretched over PVC hoops.

Left: we start our own sweet potato slips by sprouting roots in potting soil, then clipping the shoots and rooting them in water a few days before transplanting.

Soil test results from UW Soil and Forage Lab

Sample	pH	O.M. %	P	K	Ca	Mg	CEC	Mn	Zn	S
1	6.6	2.6	43	86	1280	336	11	10	4.8	4.1
2	6.6	2.7	61	138	1320	38	8	9	4.8	4
3	5.5	2.4	16	78	970	268	9	14	2.3	3.1

- All nutrient quantities in the table are in mg plant-available element/kg soil [aka ppm].
- Soil samples are composites of 10 random soil probe samples from within the sampling area.
- I'll address low pH and plant-available phosphorus in sample 3 by tilling powdered limestone into the area in spring and planting crops directly into small hills of high-P compost.
- For Samples 1 and 2 (raised bed areas) the micronutrients, Ca, and Mg are sufficient, only need to apply organic-approved N, P, K during the growing season.
- This year I'll only purchase organic N sources. I'll supply P and K using a balanced compost made using lakeweed, wood ash and other local inputs.
- Potassium sulfate and rock phosphate are my preferred inputs for very low P and K situations.
- For good soil nutrient info, check out UWEX Nutrient Application Guidelines.

Nitrogen application

Feather meal (FM) application rates by crop and season tally

Crop	rate [#N/ac]	# FM/100 sq ft	Total bed area	# FM/season
beets	80	1.3	2140	28
cabbage	100	1.6	350	6
carrots	80	1.3	3575	46
collards	100	1.6	1825	29
garden eggs	60	1.6	760	8
garlic	60	1.6	1385	14
kale	80	1.3	480	6
lettuce	80	1.3	440	6
okra	60	1	4650	47
parsnips	60	1	640	6
peppers	80	1.3	2825	37
rutabaga	60	1	400	4
spinach	80	1.3	870	11
sweet potatoes	60	1	2320	23
tomatoes	100	1.6	920	15
			Total # FM	**286**

- This year's N source is poultry feather meal (14% N), mostly slow-release organic N.
- Standard N application rates in # N/acre are part of the Crop Profiles. I convert this rate into a table of # feather meal/10 square feet per crop and post this table where I store the fertilizer for quick reference.
- I divide total FM needed per crop into three applications: planting time, 2 weeks later, and 3 weeks before harvest.
- Incorporate lightly into soil surface for the biota to distribute.
- In future I plan to combine a locally-grown high N biomass source with high P and K inputs (lakeweed, wood ash) to create a high-potency NPK compost to use in place of purchased fertilizers. More info about this idea next year!

$$\left(\frac{\#N}{acre}\right) * \left(\frac{1\#\ FM}{0.14\ \#\ N}\right) * \left(\frac{1\ acre}{43560\ sq\ ft}\right) * (total\ bed\ area\ [sq\ ft]) = \#\ FM/season$$

Minimalistic overwintering

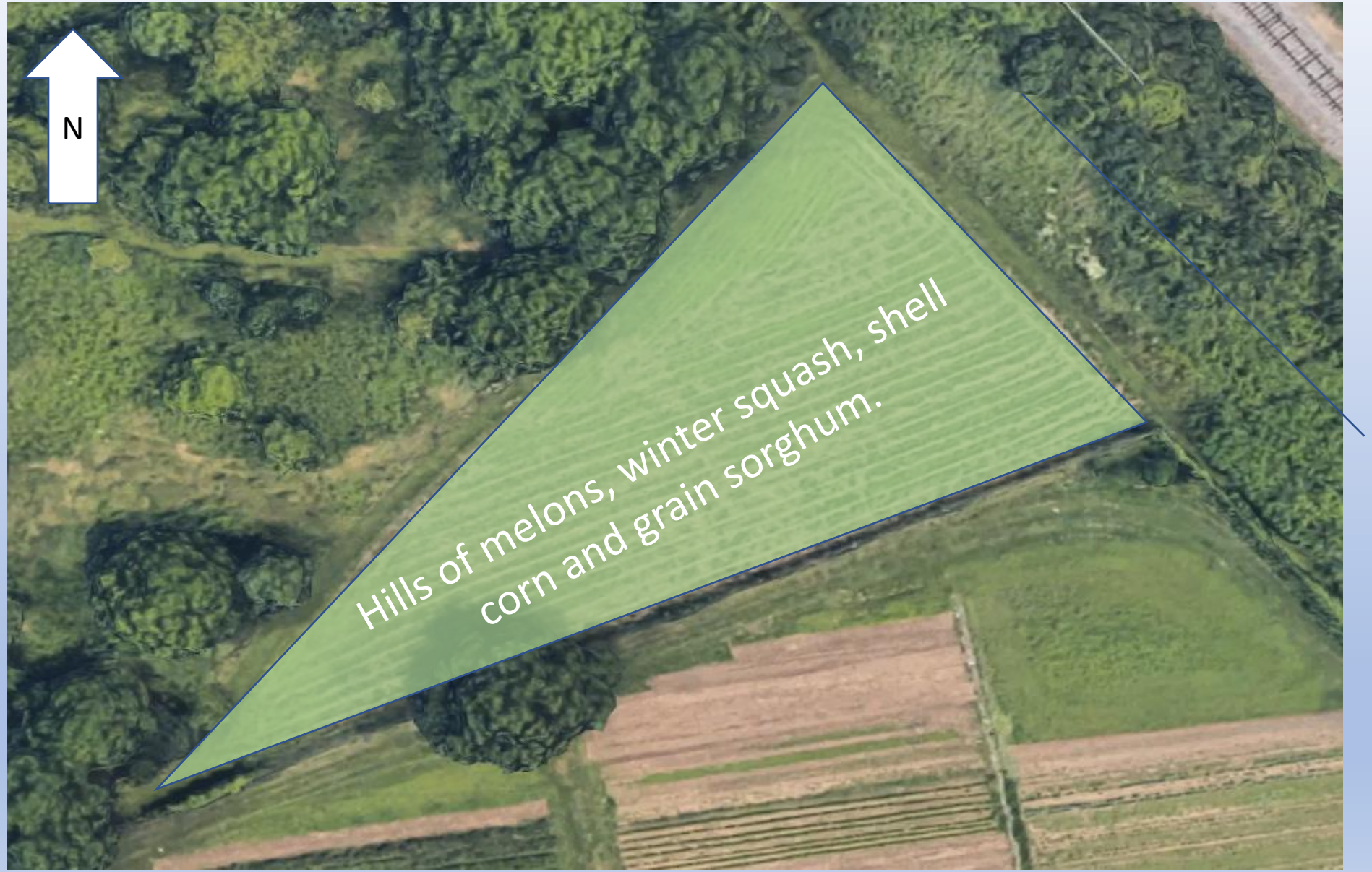
Photos show successfully overwintered beds of spinach at Eagle Heights on March 10, 2021. I use no mulching or row cover for hardy greens, a very low-input approach that minimizes winter rodent damage. I'll experiment with this same method for spinach and kale along with light mulching for carrots and alliums at Troy Farm this winter.

System backup with polyculture plantings

- Mimics natural ecosystems and provides “crop insurance” in the form of a low-labor backup revenue source.

Polyculture examples at the Mutual Aid Garden in 2020. Culinary herbs, brassicas, and alliums (left) and corn/squash (above).

Polyculture zone at Troy Farm



- Till area lightly in spring while adding soil amendments.
- Plant a thick oat cover crop to smother weeds in early April.
- Crush the oat grass flat to the ground in late May with a roller crimper.
- Form one 3’ diameter planting hill with compost every 5’ within a row, rows 10’ apart.
- Direct seed shell corn and grain sorghum in the hills, 2 weeks later transplant squash and melons.

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