



Relationships between soil food web, plants, organic matter, and birds and mammals
 Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

Soil ecosystem basics

Plant growth is interdependent with a complex web of small, mostly soil-living organisms

- Plants take CO₂ from the air and use the energy of sunlight to create chemical energy in the form of sugars
- The plant stores and uses most of the sugars but about 1/3 is exuded through the roots into the soil
- Exuded sugars are food energy for the bacteria and fungi in the soil
- Bacteria and Fungi in turn help the plant by providing nutrients that the plant needs to grow
- Bacteria mine soil particles for nutrients, fix nitrogen, and store nutrients in their bodies
- Fungi transport nutrients to the plant via their hyphae and impart it via mycorrhizal connections to the plant roots
- Bacteria and Fungi are the food foundation of a diverse web of soil organisms that keep the ecosystem in balance
- The soil ecosystem creates and maintains the soil structure, efficiently managing moisture, nutrients, air, etc.
- Artificial disturbances such as fertilizers, herbicides, pesticides, disrupt the ecosystem balance and soil structure, killing organisms and releasing stored nutrients which escape if not recaptured by plants or other organisms.
- Diversity of organisms is essential for recovery from disturbances

Tilling disturbs the soil ecosystem

- physical changes
 - aggregates broken, pore structure disrupted, breathing and wicking impaired
 - compaction (plow pan) below till depth, and under tractor wheels
 - increased oxygen
 - surface debris buried
 - bare ground, vulnerable to wind and rain erosion, soil crust may form
- biology changes
 - plants, fungi, animals broken up, killed
 - bacteria expand quickly because of excess oxygen plus abundant fresh food
 - bacteria are consumed by predators and die back as food consumed
 - release soluble nutrients quickly, nutrients vulnerable to leaching
 - dormant annual plant (weed) seeds exposed, sprout, recapture part of soluble nutrients, grow quickly to cover bare ground
 - species diversity/resilience reduced, especially if tilling is repeated
 - if undisturbed, annuals gradually succeeded by longer lived perennials, fungi return, ecosystem recovers
- with repeated tillage
 - imbalance, less biomass, less diversity leads to
 - decreased fertility, decreased plant health, increased pest and disease problems
 - grower must compensate with compost, irrigation, weeding, fertilizers, fungicides, pesticides, cover crops, rotation, etc.
- organic no-till farming reduces or eliminates the above problems, is more natural but ...
 - diversity of plants is less than a natural ecosystem and this affects the soil life diversity
 - grower must still compensate and manage the soil but to a lesser degree than conventional organic farming

Claimed Benefits of Bryan O'Hara's No-Till System

- Better soil quality
 - Improved biological activity
 - Increased diversity of soil organisms
 - Higher worm population
 - High fungal activity
 - Much improved crumb structure (aggregates)
 - Vastly improved water characteristics
 - Wicking from below
 - Consistent moisture, very resistant to drying out
 - Better drainage, water retention, soaking in
 - Soil breathing enhanced by pore structure, excess oxygen avoided
 - Decreased erosion
 - Better nutrient retention and management (in theory)
- Significant decrease in insect pests and diseases
- Much less irrigation needed, no drip irrigation
- Higher quality vegetables
 - sweeter, more flavorful
 - few culls
 - better storage quality
 - better pigmentation
 - vibrancy apparent to customers
- Much higher yields
 - \$100K produce/acre is possible (more for some crops like garlic)
- Effort
 - more effort in bed preparation and compost making, outweighed by
 - much less effort in weed control, irrigation, tillage, and way less tractor time

Basic bed preparation/planting method (takes 2-3 days)

1. mow previous crop close to ground with BCS mulcher mower
2. solarize 1-2 days with clear plastic sheeting (long enough to kill annual plants but not soil life)
3. apply half-finished compost, <1" (by hand from wheelbarrows) (not necessary at every seeding)
4. apply inoculant (not necessary at every seeding)
5. spread seeds and cover using various appropriate methods (unless using transplants)
6. apply chopped, weed free, hay, straw and/or leaf mulch (in proper amounts, depending on crop)
7. plant transplants (if using)
8. irrigate bed, with hand held hoses

Tobacco Road Farm Details

- 373 Tobacco St, Lebanon, CT 06249, about 60 miles SW of Stearns
- Bryan O'Hara has market farmed organically for 25 years, supporting his family
- 2+acres own land + 2 acres rented
- Sandy soil, fields surrounded by woods
- Transitioned fully to no-till for 2013, after some years of experimentation
- Grows a full range of vegetables
- Farmed intensively, 4 season grower using low tunnels in cold seasons.
 - Beds replanted immediately after harvest
- Sells to a food coop, a distributor to restaurants, and at 2 farmer's markets on weekend
 - customers demand reliable quality and quantity so he must overplant
- Not certified organic (uses 'unfinished' compost)
- No-till system adapted from Korean Natural Farming (https://en.wikipedia.org/wiki/Korean_natural_farming), also French Intensive method, traditional Chinese farming, Biodynamics
- Uses interplanting, few cover crops
- Most compost/mulch material gotten free for the trucking
- Uses cub tractors, 'Super C' tractor, BCS
 - avoids taking tractors into beds to avoid compaction, prefers BCS