

Fungal Duff Management

Prioritizing *the biology*
in the orchard landscape



- Carbon dioxide and the photosynthesis process creates sugars.
- Nitrogen combines with these carbohydrates to create proteins.
- Poor metabolism results in soluble amino acids attractive to pests.
- Surplus energy enables the storage of lipids and fats in plant cells.
- Essential oils and other phenolic compounds define “disease resistance”

The Making of a Healthy Plant



Translation

- Insect pressures cue (in part) to incomplete protein synthesis.
- Numerous beneficial insect allies await given extreme biodiversity.
- Mycorrhizal networking delivers immune stimulation as well as pest alert messaging.
- Arboreal biology is integral to warding off disease pathogens.

Phytochemical Response

The impetus behind *green immune function* is threefold:

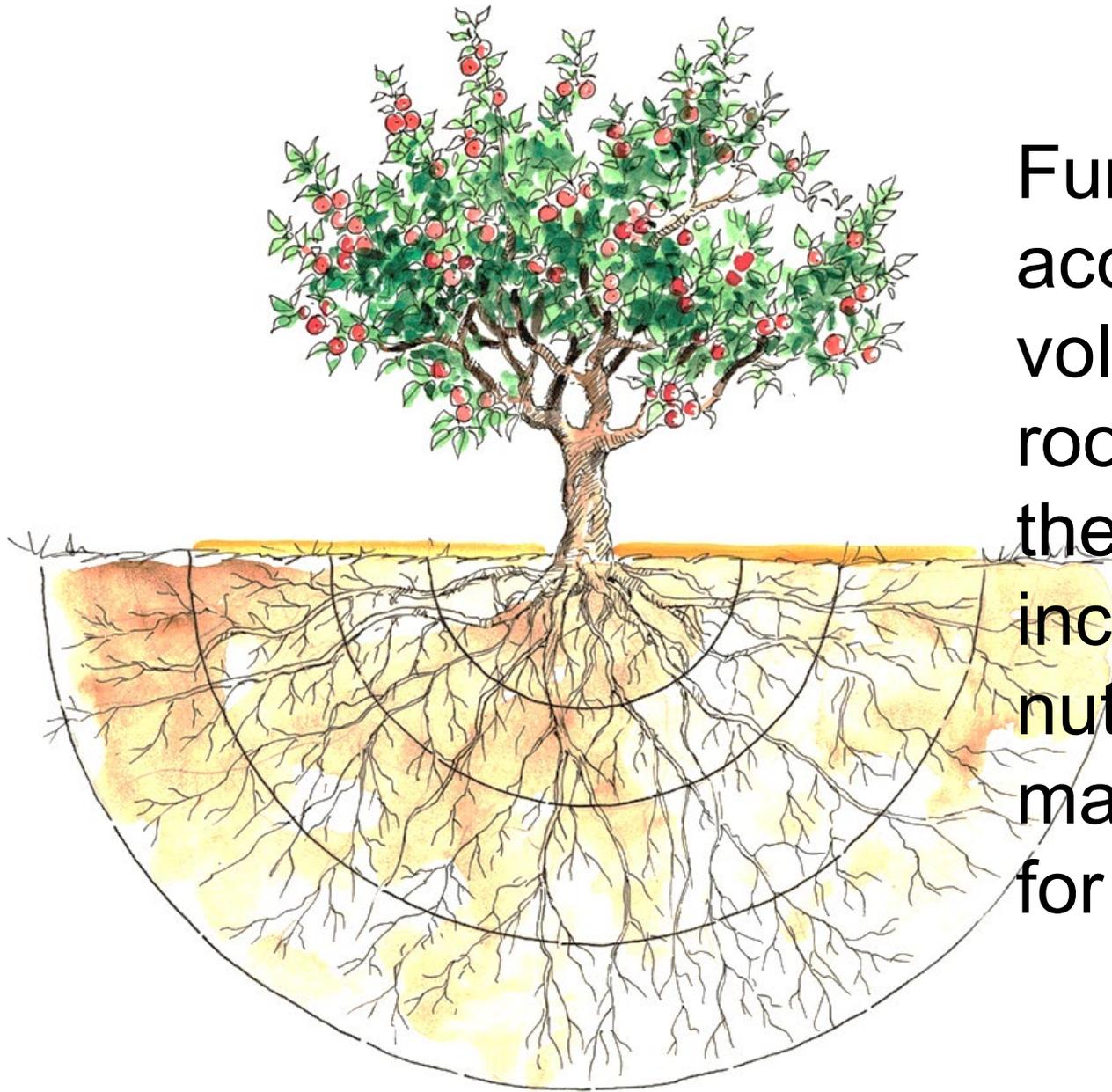
- presence of disease
- foliar elicitors
- reserve energy made available by fungi





Understory Ramifications

Nutrient uptake in more complex forms allows plants the **reserve energy** necessary to produce greater amounts of secondary plant metabolites. This keys to **fungus ascendancy** in the soil beneath our tree and berry plantings.



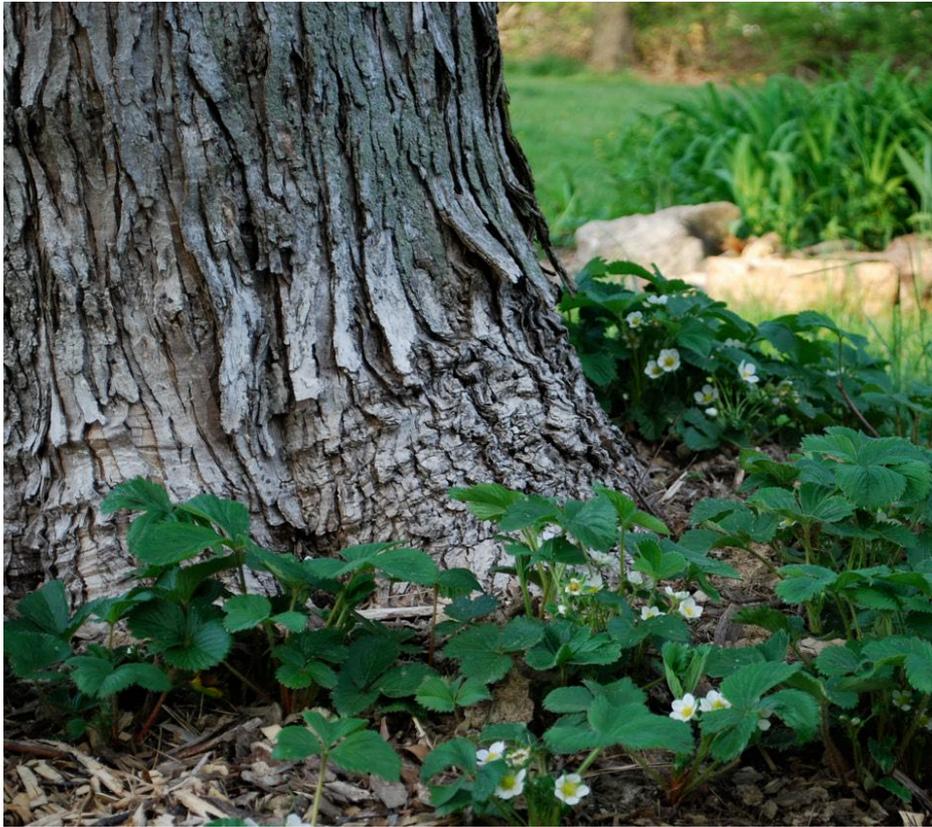
Fungal hyphae access soil volume beyond root reach, thereby increasing nutrient access many times over for the plant.



Forest Edge Ecology

The first tenet of healthy orcharding is to emulate the way Nature builds soils via fungal connections on the edge of the forest.

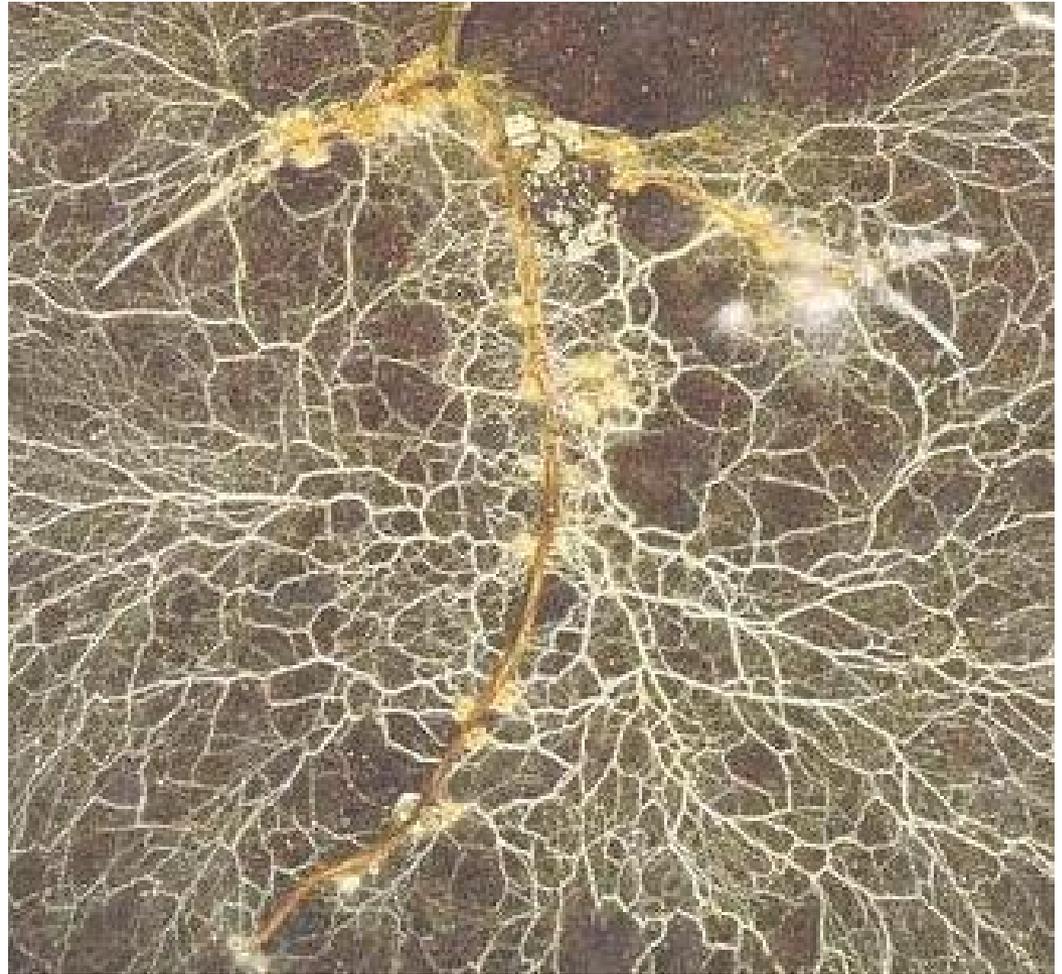
Robust tree health begins with the “right” soil biology

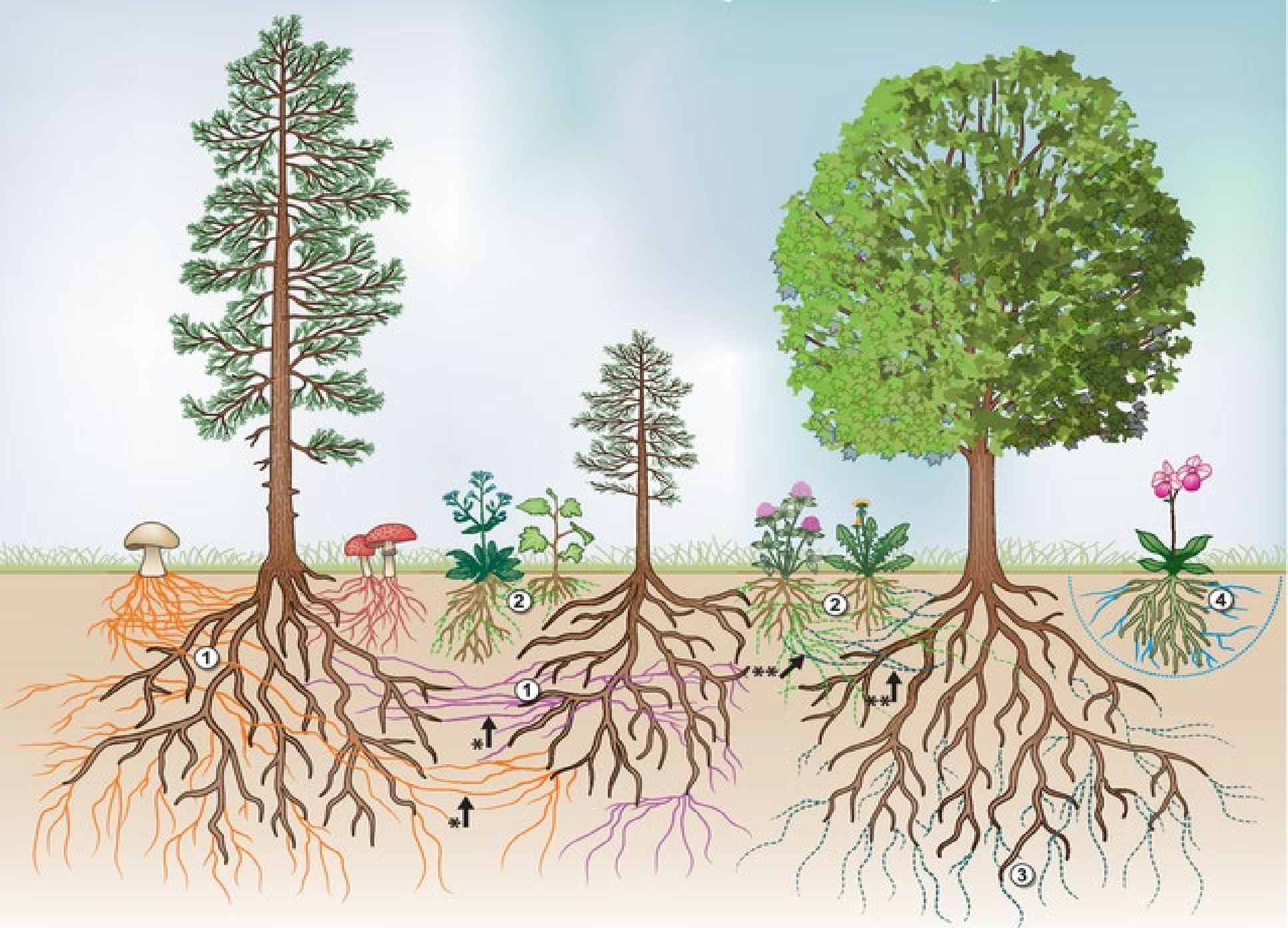


Fruiting plants belong in the biological transition zone where the fungal biomass is ten times that of the bacterial biomass.

Mycorrhizal fungi increase the “soil volume reach” of the tree’s feeder roots by 100 times.

But that’s not all folks!





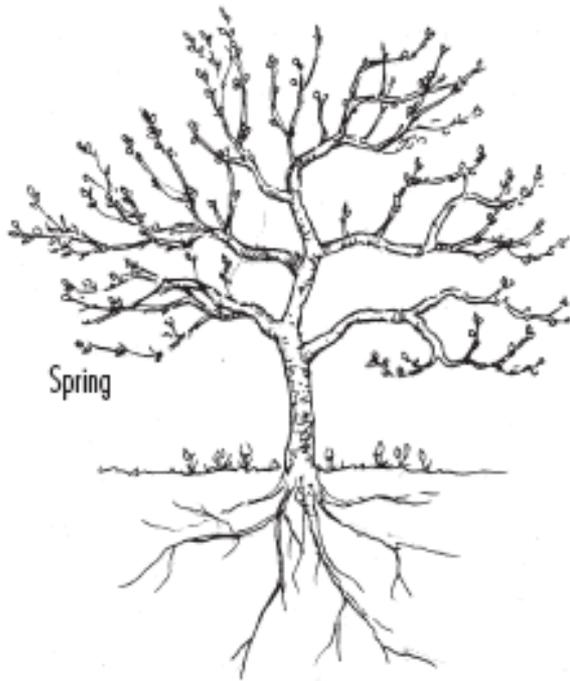
Spore Assemblage

Non-disturbed
ecosystems
typically contain
20 to 50 different
species of
mycorrhizal fungi

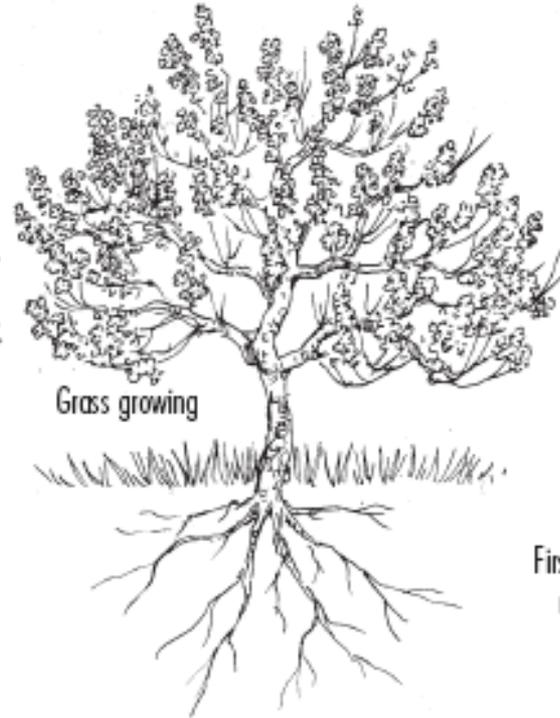


The growth cycle of the apple tree suggests that tasks ...

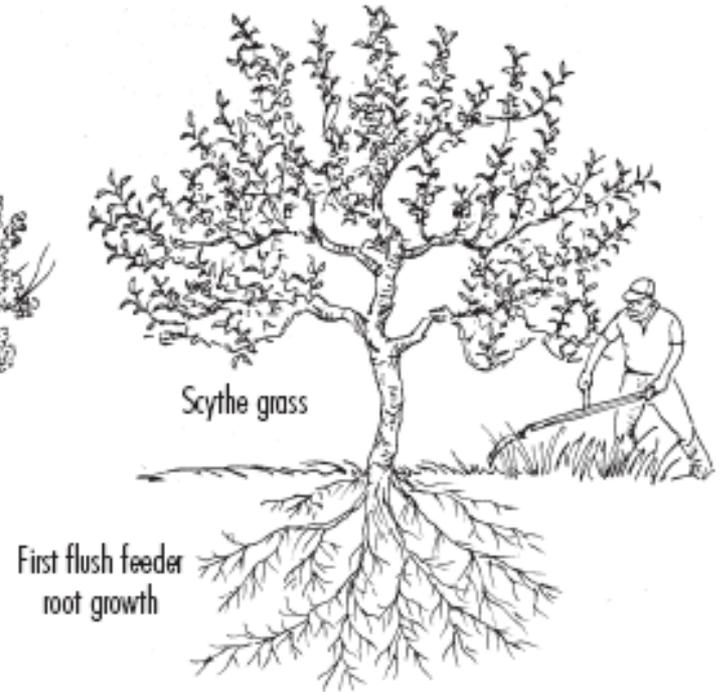
Bud break



First flush shoot growth at bloom

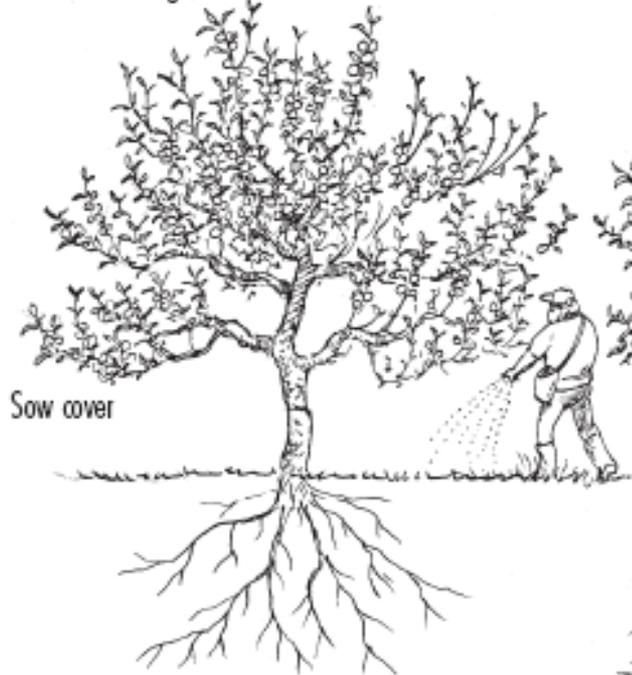


Fruit set



... be timed to influence disease resistance and winter hardiness alike.

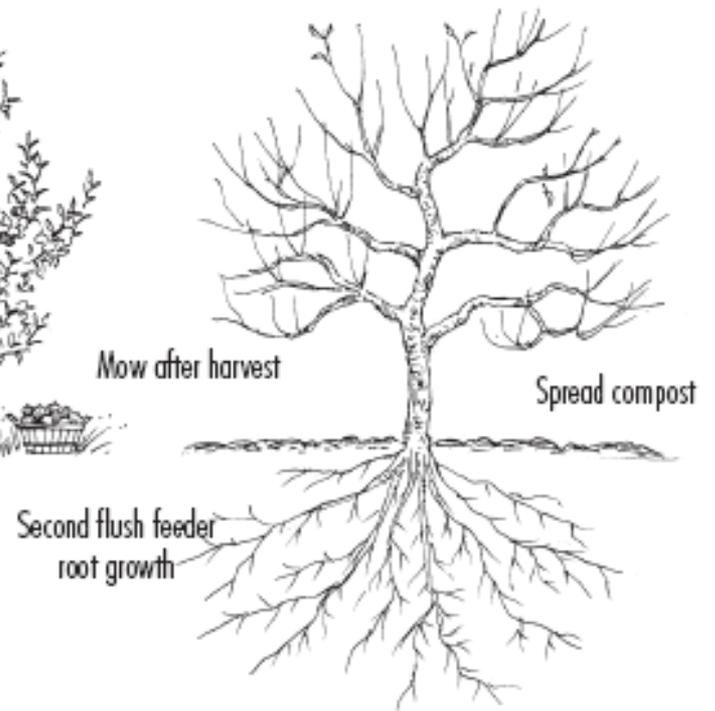
Second flush shoot growth



Terminal bud set



Leaf fall

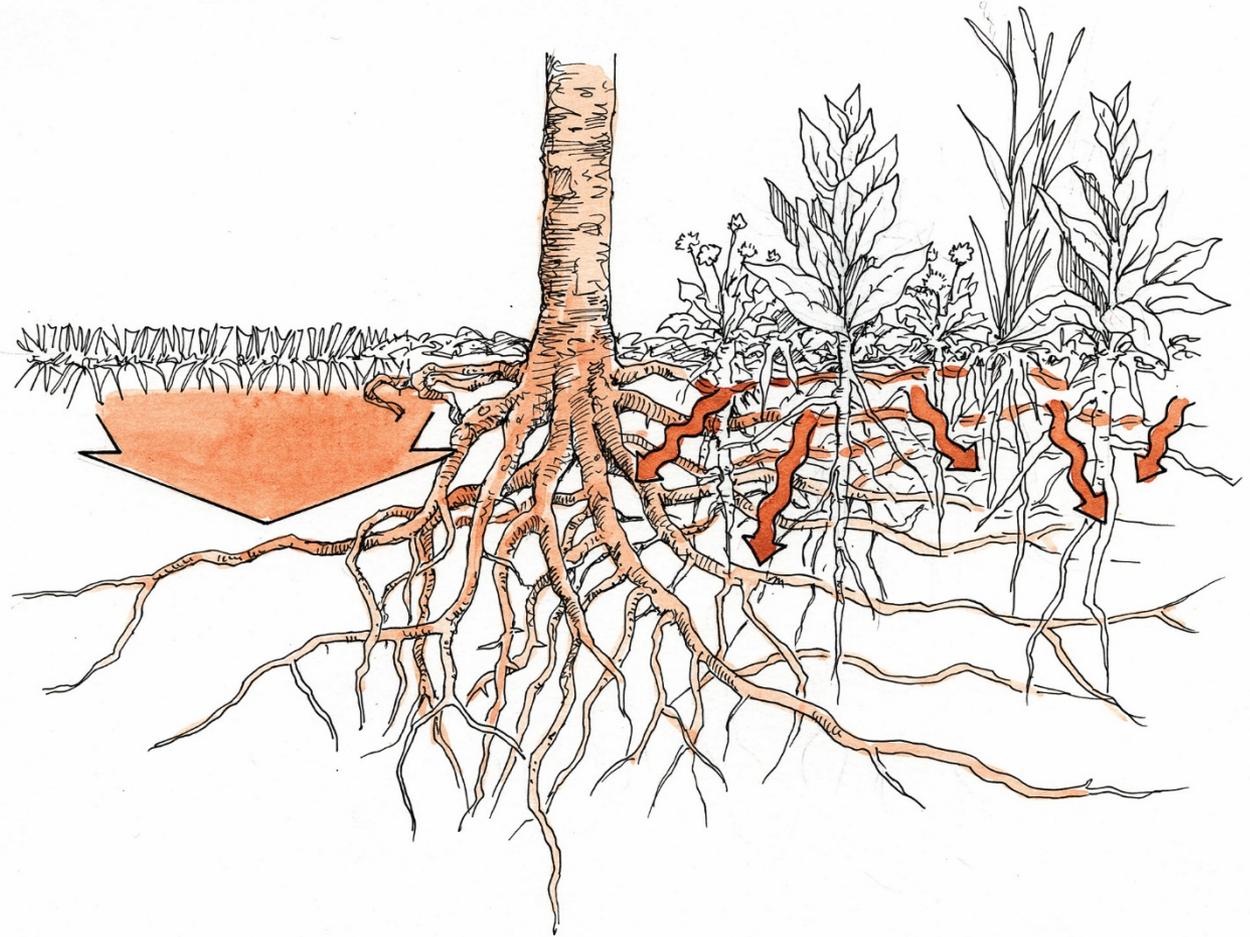


Second flush feeder root growth

Root Respiration

An all-grass understory results in carbon dioxide (CO₂) overload for tree feeder roots.

Far more “room in the humus” exists with tap rooted plants.



Biological Mowing

- Using a sharp blade to “pulse” nutrient availability
- Fungal sweet spot of plants just going into seed stage
- Opening up the humus layer for tree feeder roots



Stirring the Biological Stew

Choose three of the following beginning at 40% leaf fall:

- Lime
- Mowing
- Compost
- Fall holistic spray





Fungal Foods

Organic matter rich in soluble lignins provide fungi a chance to *rock the humic kasbah.*

Humification



The newest growth of a deciduous tree contains soluble lignins that have not yet polymerized into outright wood. Fungi convert this into humus.

Agricultural soils that have been built from the top down through fungal action has staying power and maximized nutrient recycling.



Ramial Chipped Wood

Small deciduous trees (on the order of one to two inches in trunk diameter) from field edges, overgrown pasture, and power lines are the ideal wood chip source for perennial plantings, from healing herbs to fruit trees:

- Far greater proportion of cambium, buds, and twigs in coarse chippings from small wood offer healthy nutrition that gets “banked” as long term humus.
- White rot fungi along with mycorrhizal fungi makes these nutrients available to a wide range of plants.
- Totally different from bark mulch and sawdust !!!

Ramial Resources

The biodynamic principle of the farm as a “complete organism” comes beautifully into play when overgrown pastures and alder/ willow thickets can be coppiced for an “on site” soluble lignin supply.



Sourcing the Right Stuff

- Prunings, not even chipped!
- Pasture edges, tree tops from logging, alder resource base
- Commercial landscapers





Ramial Pockets

- This investment in woody ecology is a priority!
- The soluble lignin factor (fresh/aged)
- Easy digging in future years to establish taprooted herbs like comfrey



Wood Chip Soil Prep

Sheet mulching to prepare individual tree sites can be as simple as a tractor bucket load of ramial wood chips to age in place.



Fungal Access

Young trees do not get the mycorrhizal benefit of developing relations with the plant community if overly (widely) mulched in the first several years.



Cruise Control

- Plant allies like comfrey maintain an openness under the tree all season long.
- This is not “bare ground” but rather a biological bonanza!
- Decomposition zones are available in different stages for the feeder roots.



Fruiting Walls

The economics of high density systems keys to the relatively low cost of synthetic inputs.

Biological compromise allows organic growers to join the fray, noting that labor costs will be substantially higher.



Orchard Compost

- Spreading biology and replenishing vital nutrients
- Fruit trees thrive with a fungal-dominated compost
- 40:1 CN ratio
- **Unturned, well-aged**





Long Term Fungality

- Undisturbed
woody
compost
- Enhanced value
of “soil
condiments”
- Catalyst sprays
for fungal
development



Biological Maturity

- Species diversity continues to increase for up to six months once compost is “mature” after which food resources begin to run out.
- Two-year compost downgrades biologically to the extent of being little more than topsoil.



Returning the Harvest



It takes 2 tons of compost to the acre to supplement orchard-generated organic matter. That amounts to a cubic foot plus of “black gold” per tree on a 16x24 grid spacing.

Fungal Banking

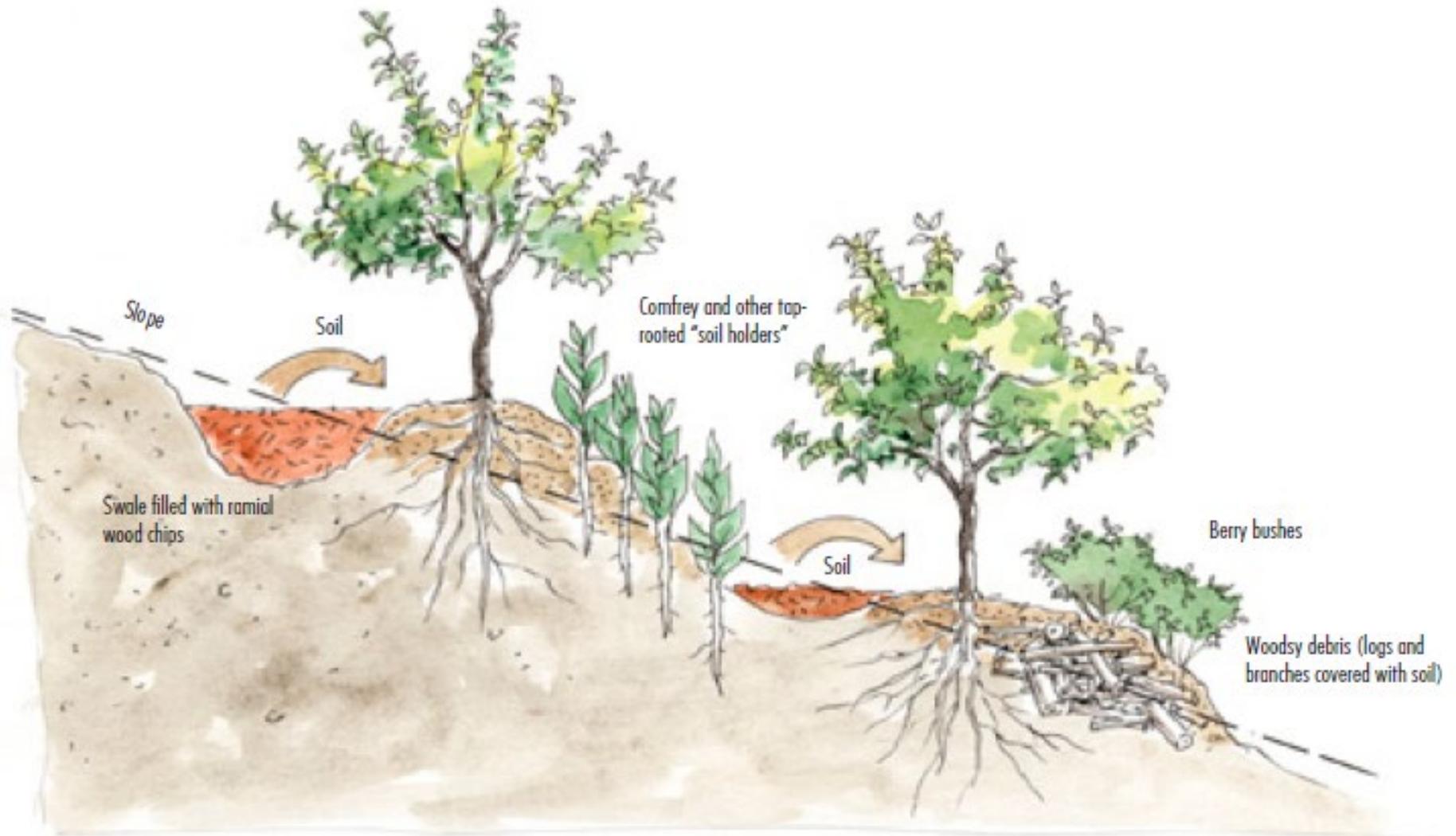
Traditional means for building an underground economy around fungal connection simply emulate how our planet creates long-term fertility.

Wood-Based Fertility



Hugelkultur involves an assortment of biological riffs, all based upon burying woody debris.

Creating Biological Terraces



Fungal Banking \$\$\$

The porous carbon spaces found on the surface of **biochar** are a long-term fertility boon for mycorrhizae.





biochar particle

EHT= 7.00 kV

WD= 16 mm

Mag= 105 X

100µm



Photo No.=7943

Detector= SE1



Understory Fertility Loop

More than the
compost, more
than amendments,
more than the
woody mulch ...
it's the plant
cycling of nutrients
in the understory of
trees that delivers
“in-house” fertility

Dynamic Accumulators

The deep taprooted plants bring minerals up from the subsoil which in turn (upon that plant's decomposition) are made available to the soil food web and thus the tree.



Comfrey

- Living mulch
- Room in the humus
- Bumblebee happiness
- Foliar calcium
- Beneficial insect haven
- Winter chickens



Incorporate plants into the orchard polyculture that provide nitrogen for young fruit trees. When goumi and other nitrogen fixers are cut down, their roots respond by releasing a plume of N into the surrounding soil.

Nitrogen Fixers







Bridge Trees

The so-called “soft hardwoods” like willow and alder bring ectomycorrhizal advantage to an otherwise endomycorrhizal orchard ecosystem.

Beneficial Accumulators



An open swath of buckwheat at the end of a row, sweet cicely by the grape arbor, umbelliferous herbs throughout ...
All these integrations are of great import.

What do Insect Allies Need?

Alternate host/prey

Shelter

Moderated microclimates

In-season refuges

Overwintering sites

Adult Food

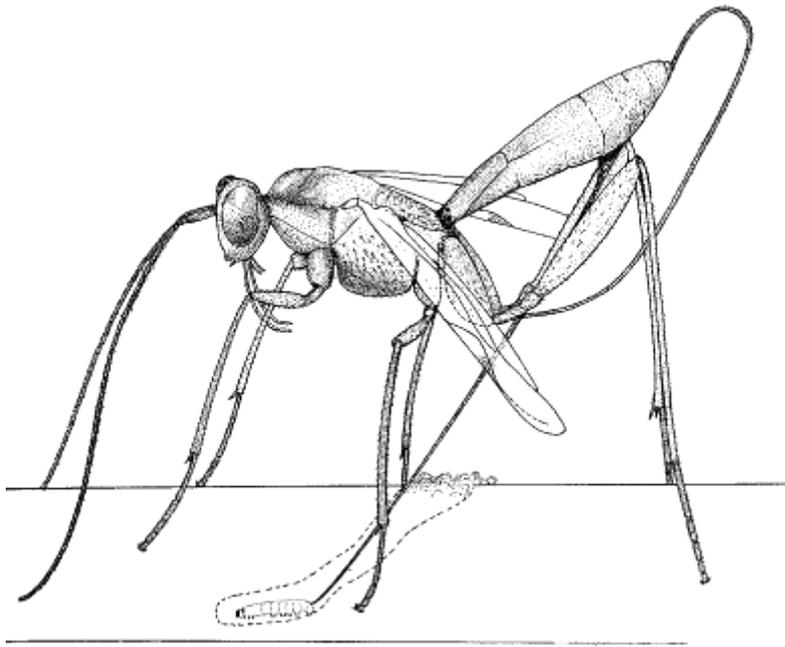
Nectar

Pollen

Sap, honey



Macrocentrus ancylivorus



This braconid wasp is a dedicated parasite of oriental fruit moth larvae and peach twig borer larvae. Parasitism can reach levels of 80 to 90 percent by August and September to help provide long-term control of this pest.

California studies indicate that growing a small plot of **sunflowers** can provide these braconid wasps with an overwintering host (in the sunflower moth) which allow its populations to build more rapidly in the orchard the following season. Similarly, **strawberry** leafroller serves as a food host for *Macrocentrus*. The ragweed borer, which bores in the stems of **ragweed species**, is yet another alternate host. There's a stunning conclusion here: A great diversity of plants left "beyond their time" helps to address pest challenges like OFM and PTB!



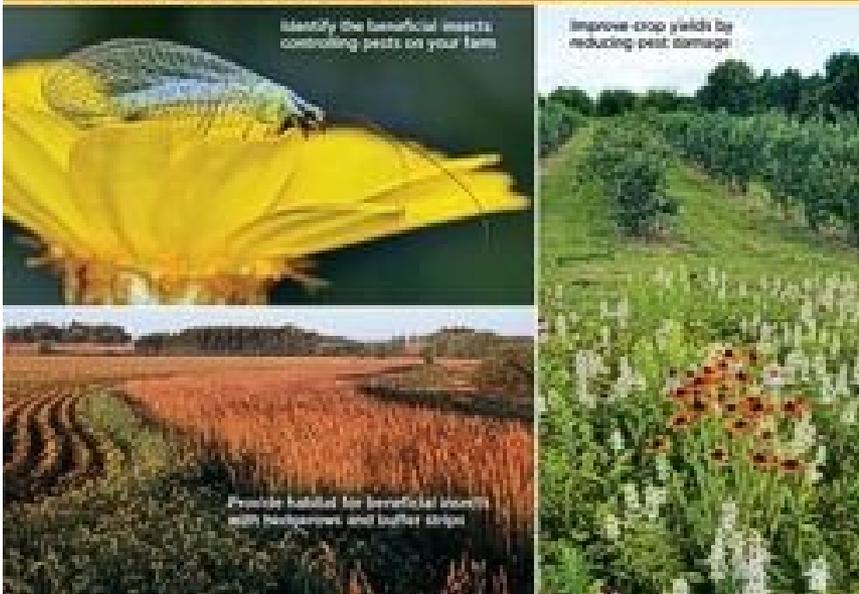
The Case for Winter Debris



THE XERCES SOCIETY GUIDE

Farming *with* Native BENEFICIAL INSECTS

Ecological Pest Control Solutions



Farming with Native Beneficial Insects is a must-have resource for holistic fruit growers.

Steering the Biology

Practices that favor bacterial dominance:

- Herbicides
- Soluble nitrates
- Captan and other conventional fungicides
(check out www.mycorrhizae.com)
- Tillage warfare

Practices that favor fungal dominance:

- Ramial wood chips
- Aged compost
- Fish hydrolysate and humic acids
- Good drainage
- Wood's edge species composition

Mushroom Manifestation

One visible “badge of honor” on the fungal front are mushrooms springing forth on the orchard floor.





Lessons Applied

The ultimate goal in any “orchard system” is to integrate abundant mineralization with fungal duff practices to produce outrageously flavorful fruit.