McWater's Park Permaculture Gardeners

Permaculture Design Workshop
and Charrette

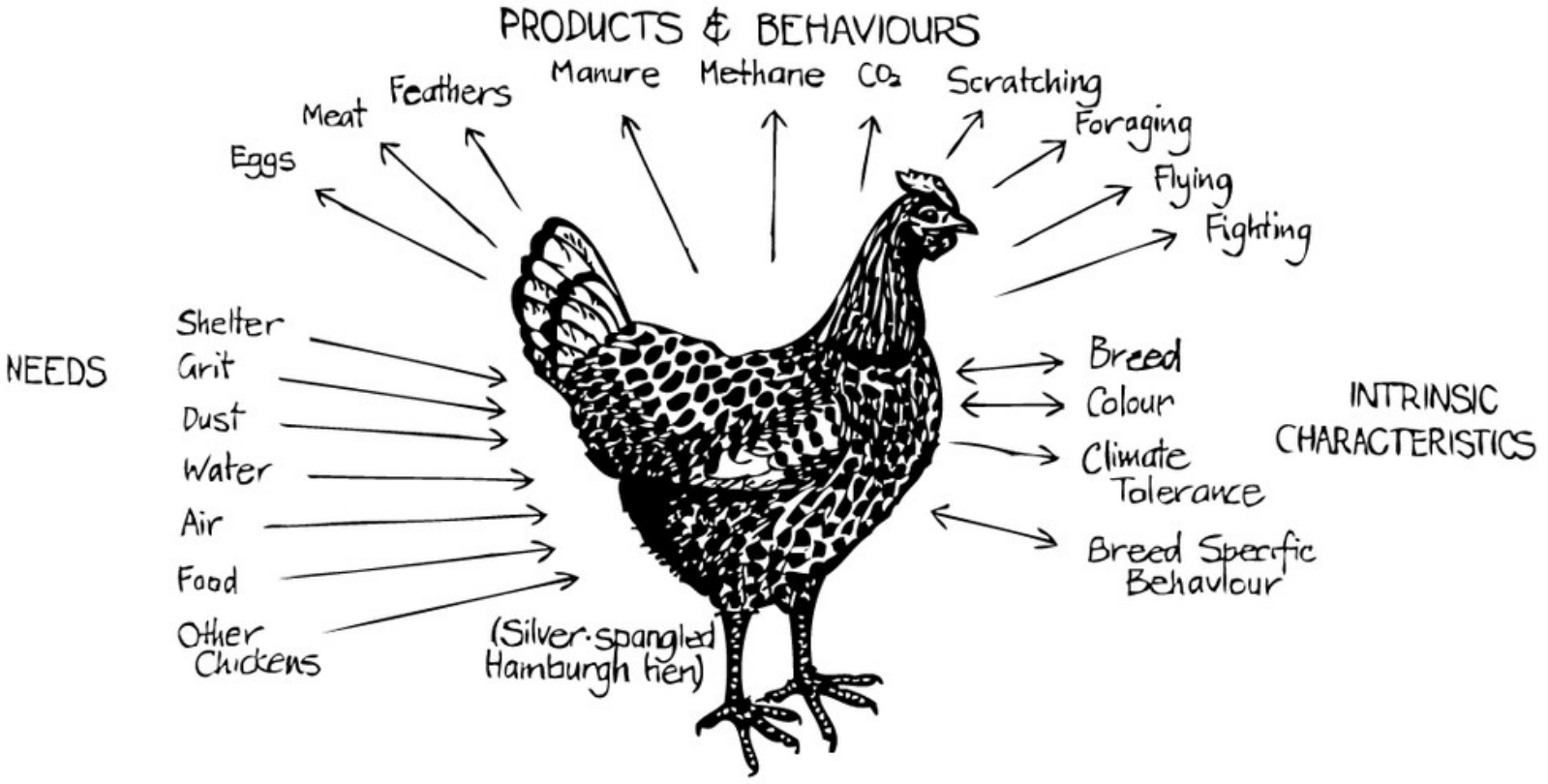
Polyculture Design

Goal Articulation

Clarify your mission
Understand your means
Establish specific actionable goals

Polyculture or Plant Guild Design

How to use garden design to meet the needs of the plants


PRODUCTS & BEHAVIOURS
Manure
Methane
CO_2
Scratching
Foraging
Flying
Fighting
Feathers
Meat
Eggs
NEEDS
Shelter
Grit
Dust
Water
Air
Food
Other Chickens
(Silver-spangled Hamburgh hen)
Breed
Colour
Climate Tolerance
Breed Specific Behaviour
INTRINSIC CHARACTERISTICS

PRODUCTS and BEHAVIORS

gardening: planting, weeding, watering, planning

making things: clothes, tools machines that can make big changes fast

moves things long distances to make things with, moves plants and seeds

waste: trash, sewage erosion, depletion

fighting – killing each other
destroying things

NEEDS

food
(protein
vegetables
berries
calories)

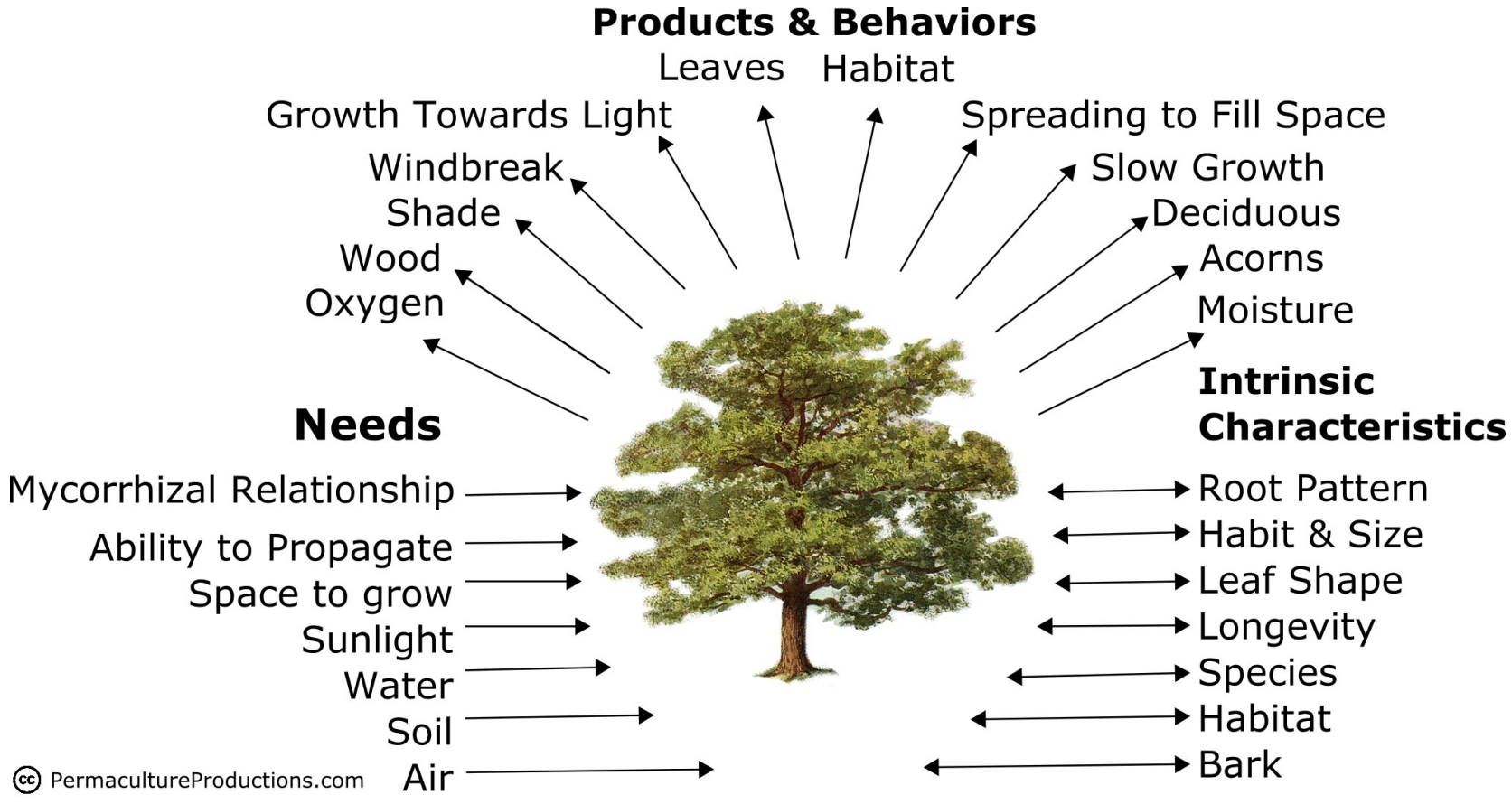
family
community
rest
safety

shelter
cloths
tools

work
meaning
stuff - limitless

INTRINSIC CHARACTERISTICS

social
curious, inventive
powerful
out of balance, unrestrained
long phase of immaturity
culture, specialization
capacity for empathy,
capacity for forethought

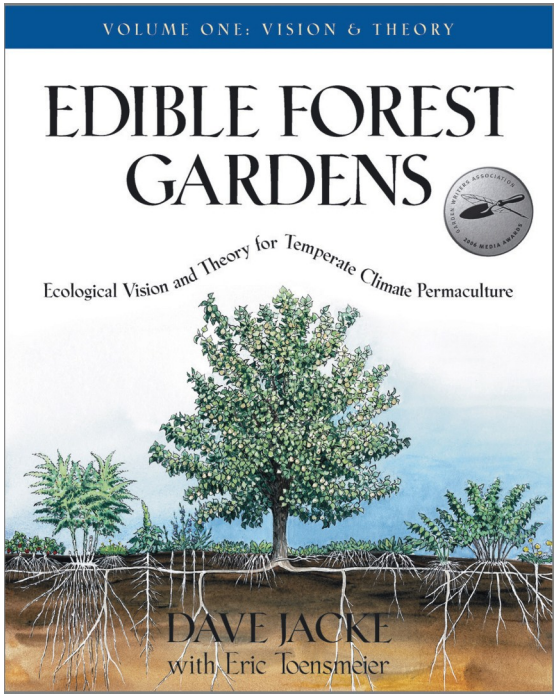

Products & Behaviors
Leaves
Habitat
Growth Towards Light
Spreading to Fill Space
Windbreak
Slow Growth
Shade
Deciduous
Wood
Acorns
Oxygen
Moisture
Needs
Intrinsic Characteristics
Mycorrhizal Relationship
Root Pattern
Ability to Propagate
Habit & Size
Space to grow
Leaf Shape
Sunlight
Longevity
Water
Species
Soil
Habitat
Air
Bark
PermacultureProductions.com

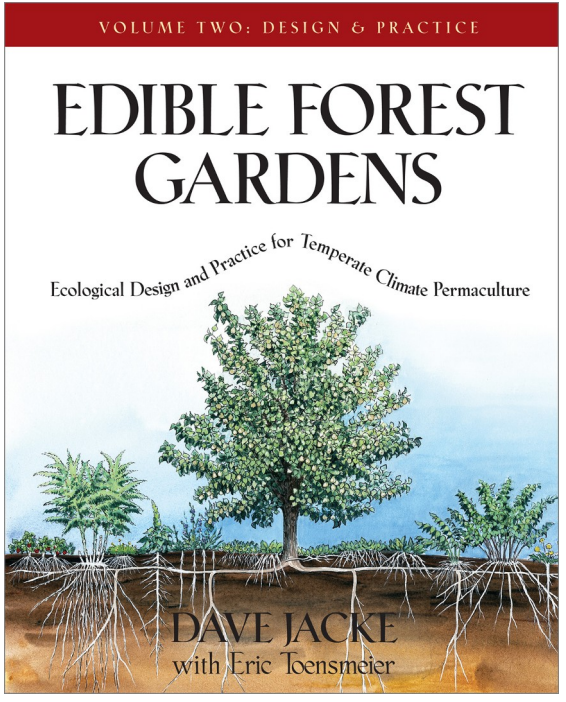
Pick the right plant for the right location:

Climate
Sun/Shade
Soil type
Soil pH
Soil moisture
Soil toxins

Our site assessment informs this step.
Plant tables can help us select plants.

Edible Forest Gardens
Eric Toensmeier and Dave Jacke



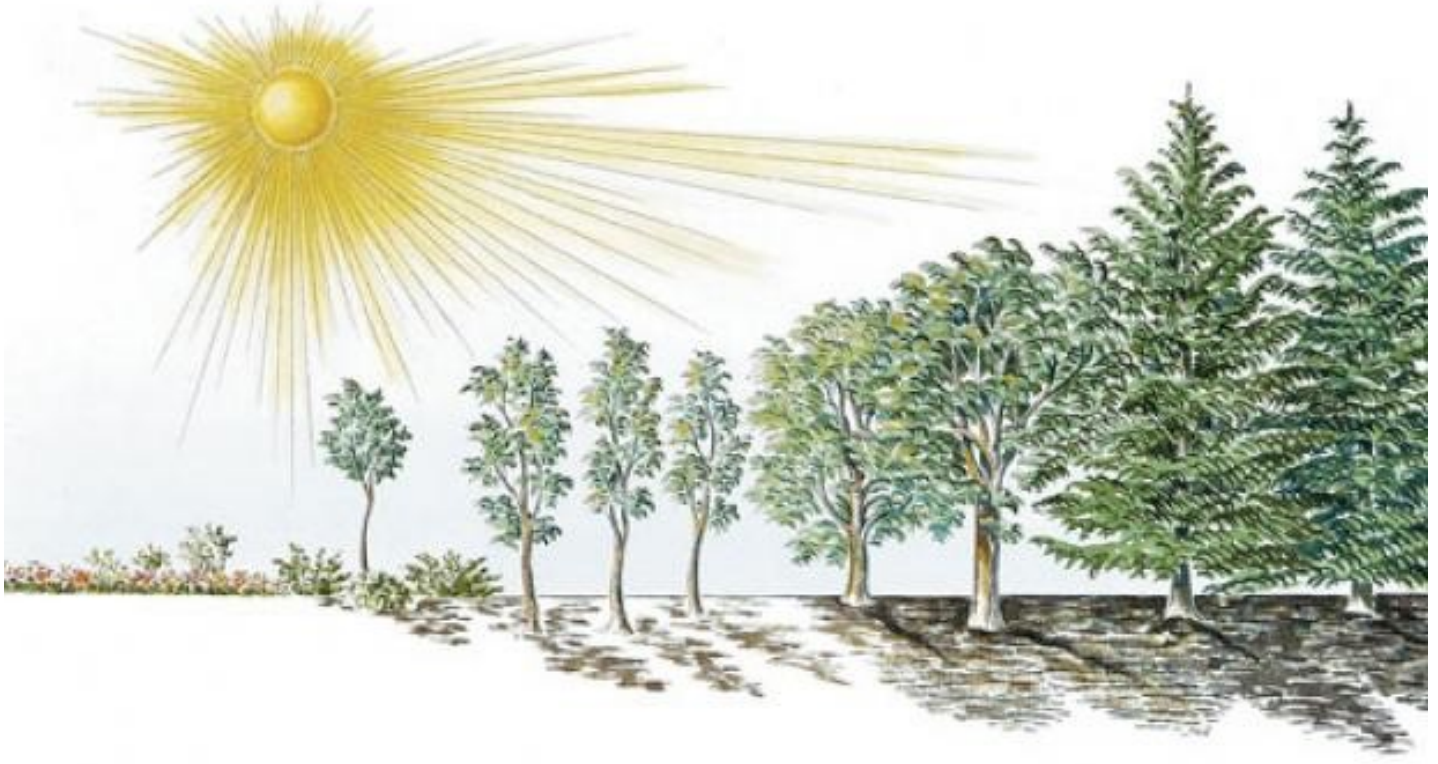


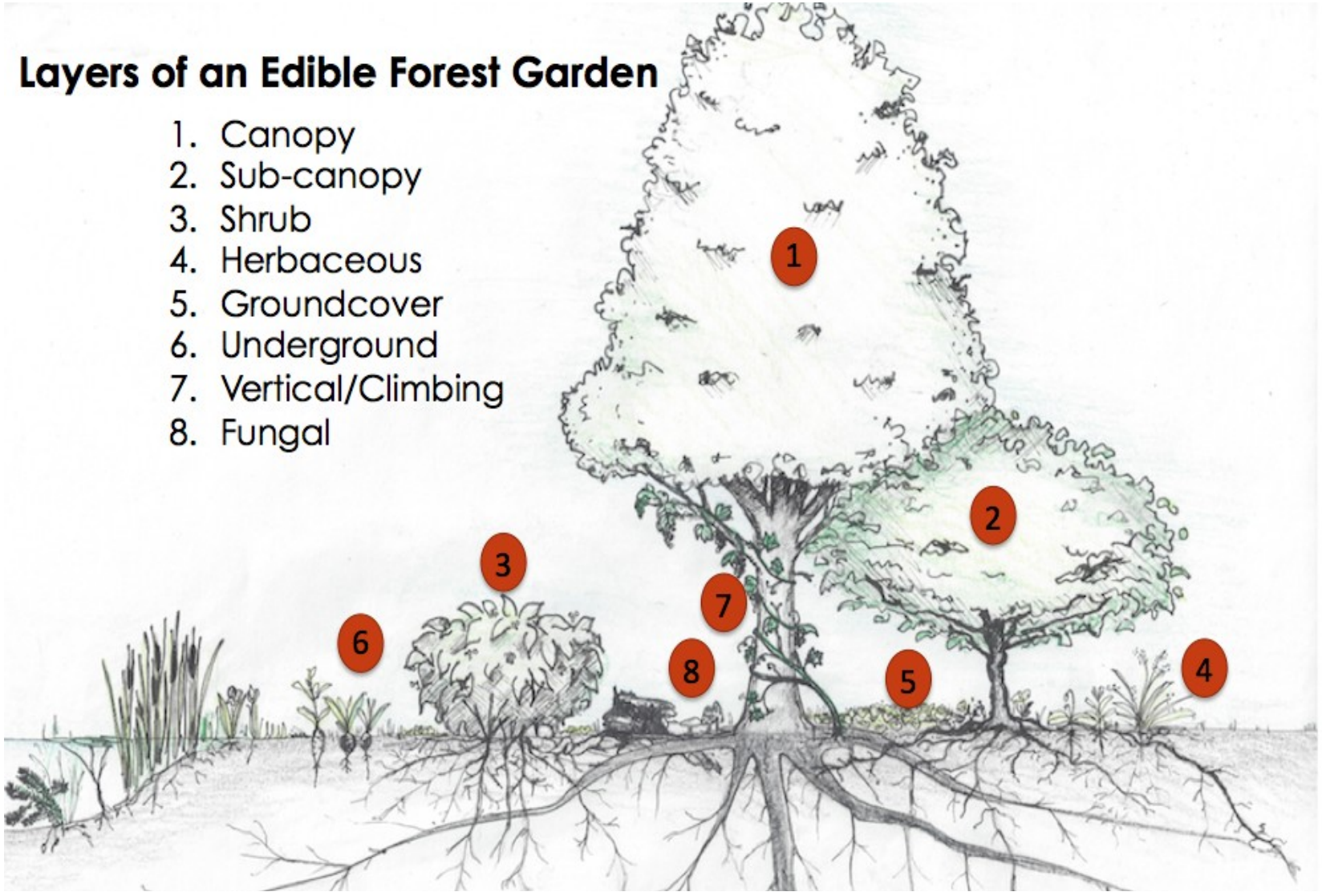
Taxonomy				Tolerances							Architecture		
							Soil pH						
Genus	Species	Common Name	Family	Hardiness Zones	Light	Moisture	Strongly Acid	Acid	Garden	Alkaline	Form	Habit	Root Pattern
Juglans	*regia*	English walnut	Juglandaceae	7-9	○	◑			■■	■	vl Tree	std	
Juglans	*x bixbyi*	buartnut	Juglandaceae	4	○	◑			■■	■	l Tree	std	
Lactuca	*perennis*	perennial lettuce	Asteraceae	5	○◑	◑			■■		m Herb	clmp	
Laportaea	*canadensis*	wood nettle	Urticaceae	3-8	◑●	◑			■	■■	s-m Herb	run	
Lathyrus	*japonicus maritima*	beach pea	Fabaceae	3b-7	○	◔◑			■■		l Vine	r v/skr	R
Lathyrus	*latifolius*	everlasting pea	Fabaceae	4-9	○◑	◔◑			■	■■	l Vine	r v/skr	R
Lathyrus	*linifolius* var. *montanus*	bitter vetch	Fabaceae	6b	○◑	◔◑			■■	■■	l Vine	r vine	
Lathyrus	*tuberosus*	earth-nut pea	Fabaceae	6b	○◑	◑			■	■■	l Vine	r v/skr	Tu
Lespedeza	*bicolor*	bush clover	Fabaceae	4-7	○	◔◑			■■	■■	l Shrub	ms	
Lespedeza	*capitata*	round-headed bush clover	Fabaceae	4-8	○◑	◔◑			■■		m-l Herb	clmp	
Levisticum	*officinale*	lovage	Apiaceae	4	○◑	◑			■	■■	l-vl Herb	clmp	R
Ligusticum	*canadense*	Canada ligusticum	Apiaceae	6	◑●	◑					l Herb	clmp	
Ligusticum	*canbyi*	osha	Apiaceae	3	◑●	◑					l Herb	clmp	T
Ligusticum	*scoticum*	Scotch lovage	Apiaceae	4	○	◔◑			■■	■■	m Herb	clmp	T
Lilium	*brownii*	Hong Kong lily	Liliaceae	7	○◑	◑			■■		l Herb	clmp	B
Lilium	*canadense*	Canada lily	Liliaceae	3-7	○◑	◑			■■		l-vl Herb	clmp	B, St
Lilium	*lancifolium*	tiger lily	Liliaceae	5	○◑	◑			■■	■	l Herb	clmp	B
Lilium	*longiflorum*	white trumpet lily	Liliaceae	7	○◑	◑			■■		m Herb	clmp	B
Lilium	*philadelphicum*	wood lily	Liliaceae	4-7	○◑	◑	■■	■■			s-m Herb	clmp	B, St
Lilium	*superbum*	Turk's-cap lily	Liliaceae	4-8	○◑	◔◑		■■	■		l-vl Herb	clmp	B, St
Lindera	*benzoin*	spicebush	Lauraceae	5-8	○●	◔◑	■	■■	■		l Shrub	ms	H
Linnaea	*borealis*	twinflower	Caprifoliaceae	3-7	◑	◑	■■				p Shrub	E Rmat	Fb, Sk
Lobelia	*cardinalis*	cardinal flower	Lobeliaceae	4-10	○◑	◔◑	■■	■■	■■		m Herb	clmp	Fb
Lomatium	*cous*	biscuit root	Apiaceae	5	○	◔◑			■■	■■	m-l Herb	clmp	T
Lomatium	*dissectum*	fern-leaved biscuit root	Apiaceae	5	○	◔◑			■	■	m-l Herb	clmp	T
Lomatium	*macrocarpum*	large-fruited biscuit root	Apiaceae	5	○	◔◑			■■	■■	m-l Herb	clmp	T
Lomatium	*nudicaule*	biscuit root	Apiaceae	5	○	◔◑					m-l Herb	clmp	T
Lonicera	*caerulea* var. *edulis*	edible honeysuckle	Caprifoliaceae	3	○	◑		■■	■■		m Shrub	Cthk	
Lonicera	*kamschatica*	honeyberry honeysuckle	Caprifoliaceae	3-8	○◑	◑			■■	■	m Shrub	ms	
Lonicera	*sempervirens*	trumpet honeysuckle	Caprifoliaceae	4	○◑	◑			■■		l-h Vine	w vine	
Lonicera	*villosa*	northern fly honeysuckle	Caprifoliaceae	3	○	◔◑		■■	■■	■	s Shrub	ms	
Lotus	*corniculatus* cv.	prostrate bird's-foot trefoil 'Plena'	Fabaceae	5	○◑	◔◑		■■	■■	■■	p Herb	Cmat	

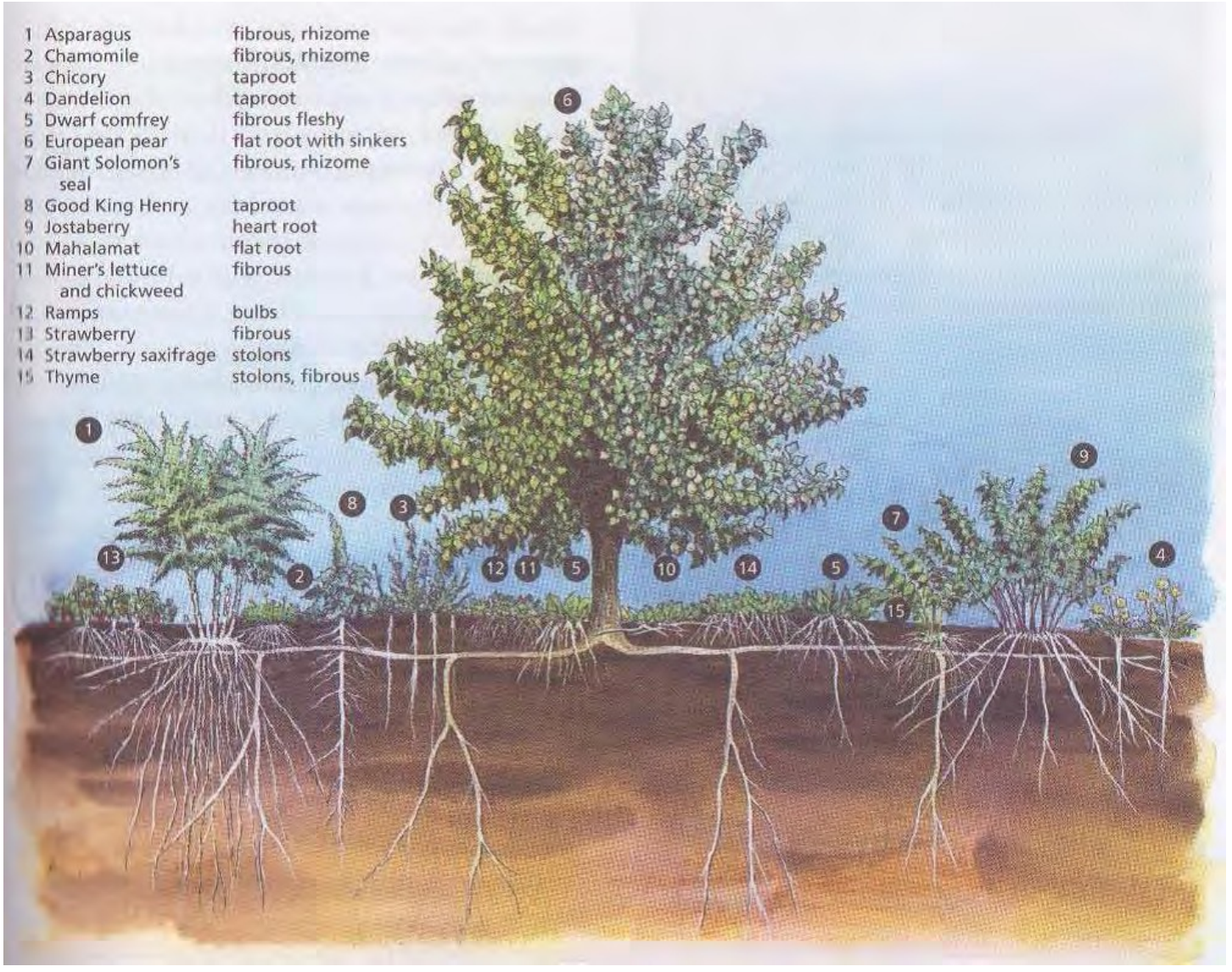
Architecture			Habitats													Uses								Functions						Drawbacks	
Height	Width	Growth Rate	Native Region	Disturbed	Meadows	Prairies	Oldfields	Thickets	Edges	Gaps/Clearings	Open Woods	Forest	Conifer Forest	Other Habitats	Edible Fruit	Edible Nuts/Nast	Edible Greens, Etc.	Edible Roots	Culinary	Tea	Edible Other	Medicinal	N_2 Fixer	Dynamic Accumulator	Wildlife	Invert. Shelter	Nectary	Ground Cover	Other Uses/Functions	Nuisances	Poison
100'+	75-100'	M-F	EURA								✓	✓		✓		E						S		Y			G			
60'	60'	M-F	CULT											✓		E						S		Y			G			
2'	1'	F	EURA	✓										✓			F					E				Y	G		D	
1-3'	1-3'	M	ENA									✓		✓			E			E		F							St	P
1-2'	indef	M	ENA	✓										✓							Y			Y		Y	G	Y			P
6'	indef	F	EUR	✓	✓			✓	✓					✓										Y		Y	G	Y			P
1-2'	1-2'		EUR					✓	✓		✓	✓						G			Y			Y		Y	G				P
3-4'	indef	M-F	EUR		✓				✓					✓				G						Y		Y	G				P
6-9'	6-9'		ASIA		✓	✓		✓	✓	✓	✓	✓					F		Y	Y				Y		Y	G				
2-4'	2-4'		ENA		✓	✓		✓			✓			✓								F		Y		Y	G				
4-8'	4-8'	M-F	EURA	✓	✓				✓					✓			G		G			F				Y	S				
3-6'	3'		ENA									✓		✓												Y	S				
4'	3'		WNA									✓					G	Y	G							Y	S				
2'	2'		ENA											✓			G	Y				F				Y	S				
4'	2'	S	ASIA		✓			✓	✓		✓			✓				G				F			F						
3-8'	3-4'	S	ENA		✓						✓							F				F			F						
6'	2-4'	S	ASIA	✓	✓			✓						✓				G							F						
3'	1'	S	ASIA											✓				G							F						
1-3'	1-3'	S	ENA		✓	✓				✓	✓			✓				F				F			F						
3-8'	4-8'+	S	ENA		✓			✓		✓	✓	✓						F							F						
6-12'	6-12'	S-M	ENA					✓				✓		✓						G	G	G			F						
1-3"	indef	M	ENA					✓				✓	✓	✓								F						Y			
3'	2-3'		ENA									✓		✓								G			F		G				P
18-36"	18-36"		WNA											✓			F	G								Y	S				
18-36"	18-36"		WNA											✓				G								Y	S				
18-36"	18-36"		WNA			✓								✓				G								Y	S				
18-36"	18-36"		WNA								✓			✓			F	G								Y	S				
5'	5'		ASIA				✓								G										F		G		D	P
5'	5'		EURA											✓	G										F		G		D	P
4-15'	4-15'	M-F	ENA					✓	✓																B		G	Y	D	P
1-3'	1-3'		ENA		✓							✓		✓	G										F		G		D	P
1"	1-2'	M	EUR	✓			✓	✓																Y		Y	G	Y			P

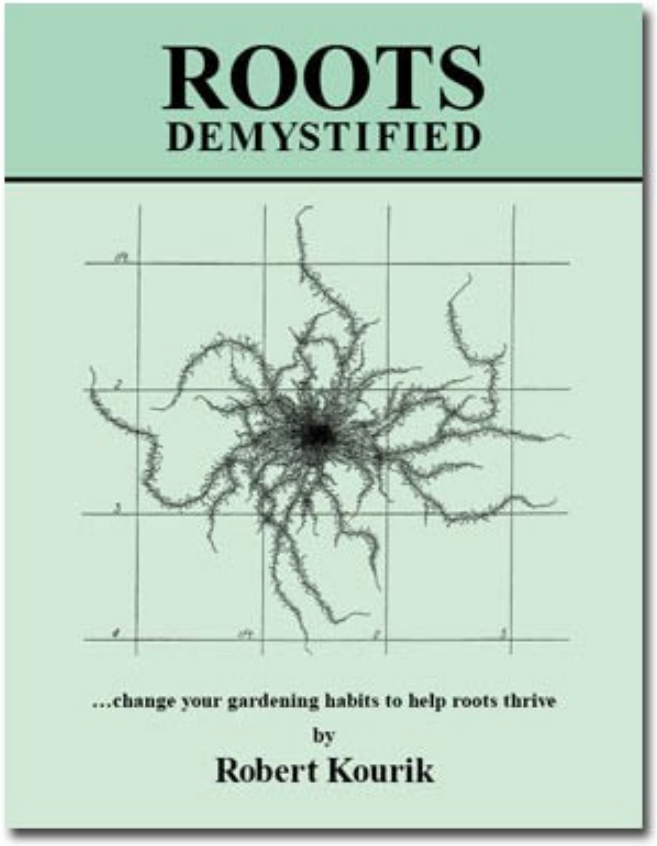
Designing plant configuration and spacing:

Sun/shade
Air space
Soil space




Layers of an Edible Forest Garden
1. Canopy
2. Sub-canopy
3. Shrub
4. Herbaceous
5. Groundcover
6. Underground
7. Vertical/Climbing
8. Fungal
1
2
3
4
5
6
7
8


1 Asparagus fibrous, rhizome
2 Chamomile fibrous, rhizome
3 Chicory taproot
4 Dandelion taproot
5 Dwarf comfrey fibrous fleshy
6 European pear flat root with sinkers
7 Giant Solomon's seal fibrous, rhizome
8 Good King Henry taproot
9 Jostaberry heart root
10 Mahalamat flat root
11 Miner's lettuce and chickweed fibrous
12 Ramps bulbs
13 Strawberry fibrous
14 Strawberry saxifrage stolons
15 Thyme stolons, fibrous



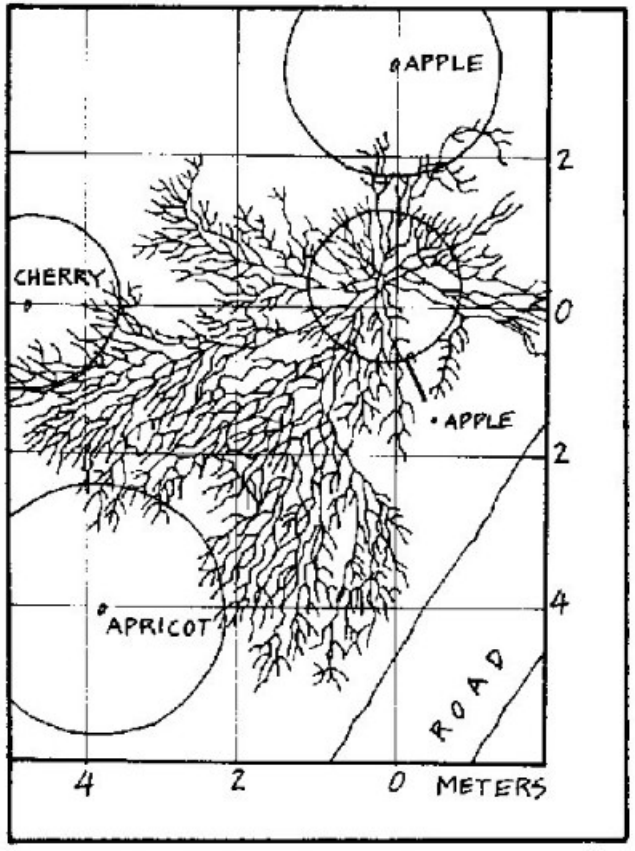


Figure #38: This apple tree's roots extend far beyond the circle representing the canopy of the tree and avoid the compacted soil of the roadway. (Scale is in meters.)

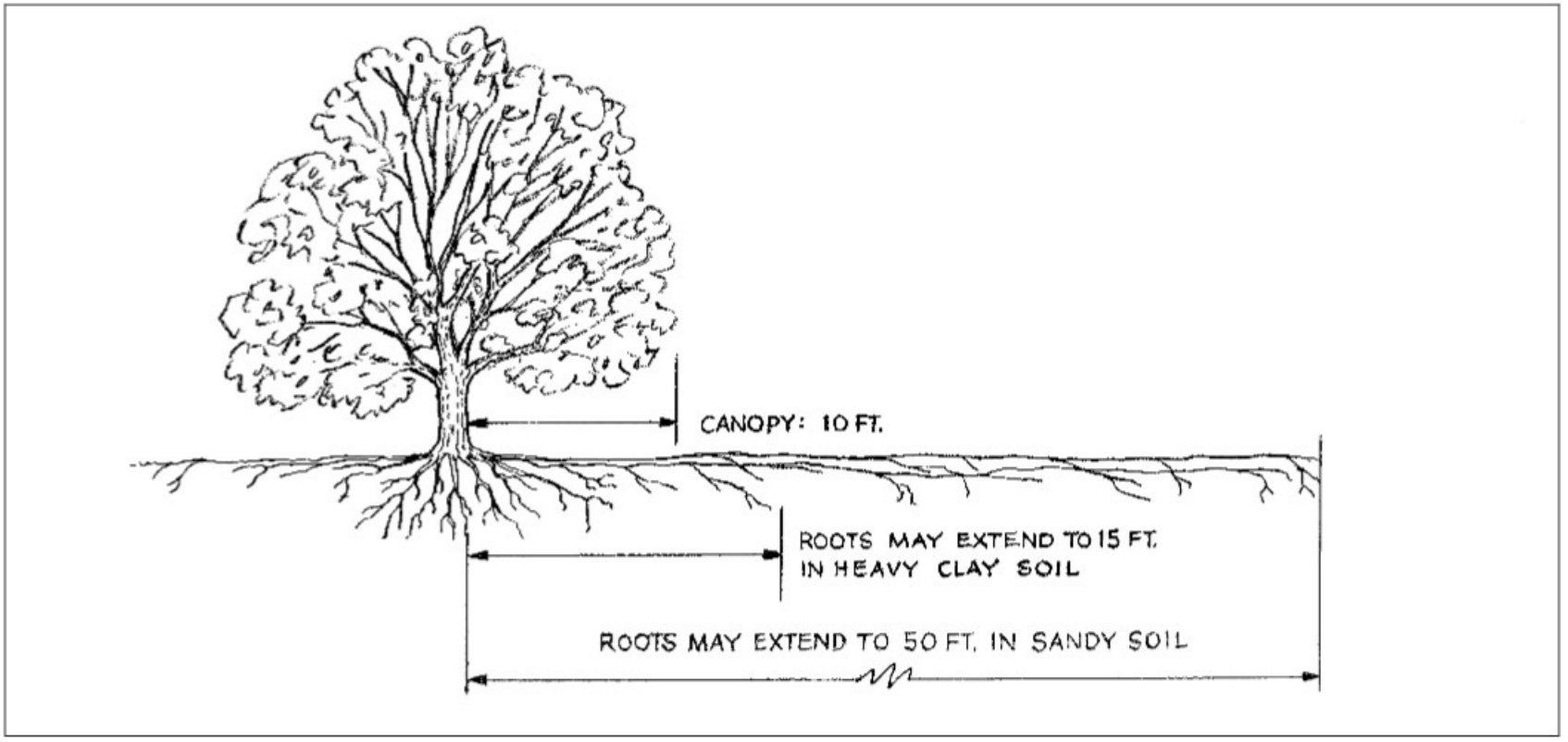


Figure #47: Trees' roots commonly grow one-half wider than the dripline (canopy), and occasionally to as much as three to five times further.

Selecting plants that will improve the local conditions:

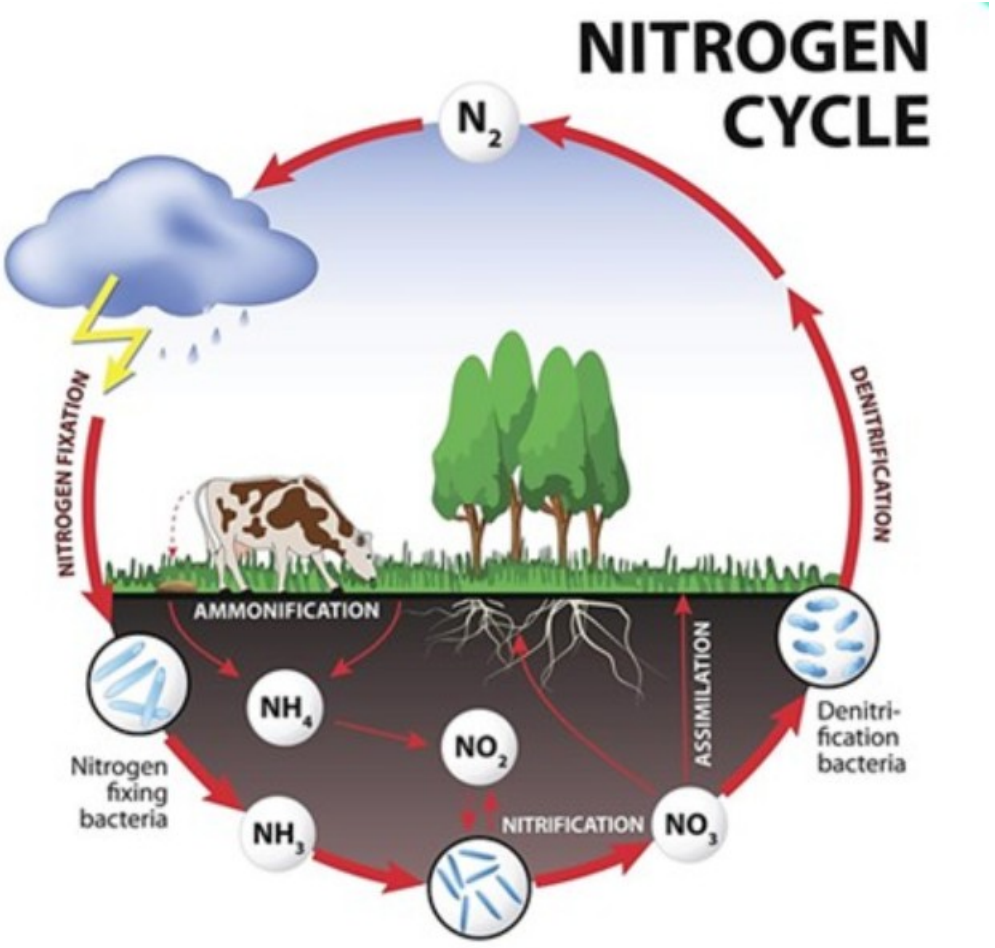
Soil fertility (nitrogen fixers)
Other soil nutrients, K, P, micro nutrients (dynamic accumulators)
Pollination (general and specialist nectories for each season)
Habitat for beneficial species (Tallamy species)
Protection from competition (ground covers, edge protectors, planning for available light)
Aromatic pest distraction

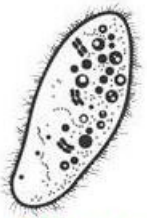
Selecting plants that will improve the local conditions:

Soil fertility = Nitrogen

“Fixing” atmospheric nitrogen with plants so that it is available to be assimilated by other plants

NITROGEN FIXERS

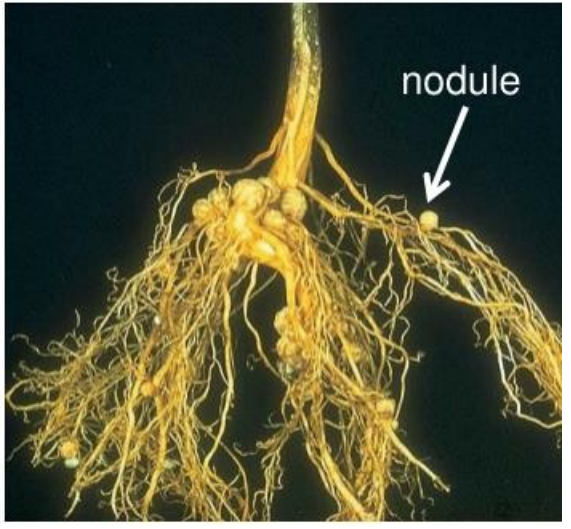

NITROGEN CYCLE
N_2
NITROGEN FIXATION
DENITRIFICATION
AMMONIFICATION
ASSIMILATION
NH_4
NO_2
NO_3
NH_3
NITRIFICATION
Nitrogen fixing bacteria
Denitri-fication bacteria

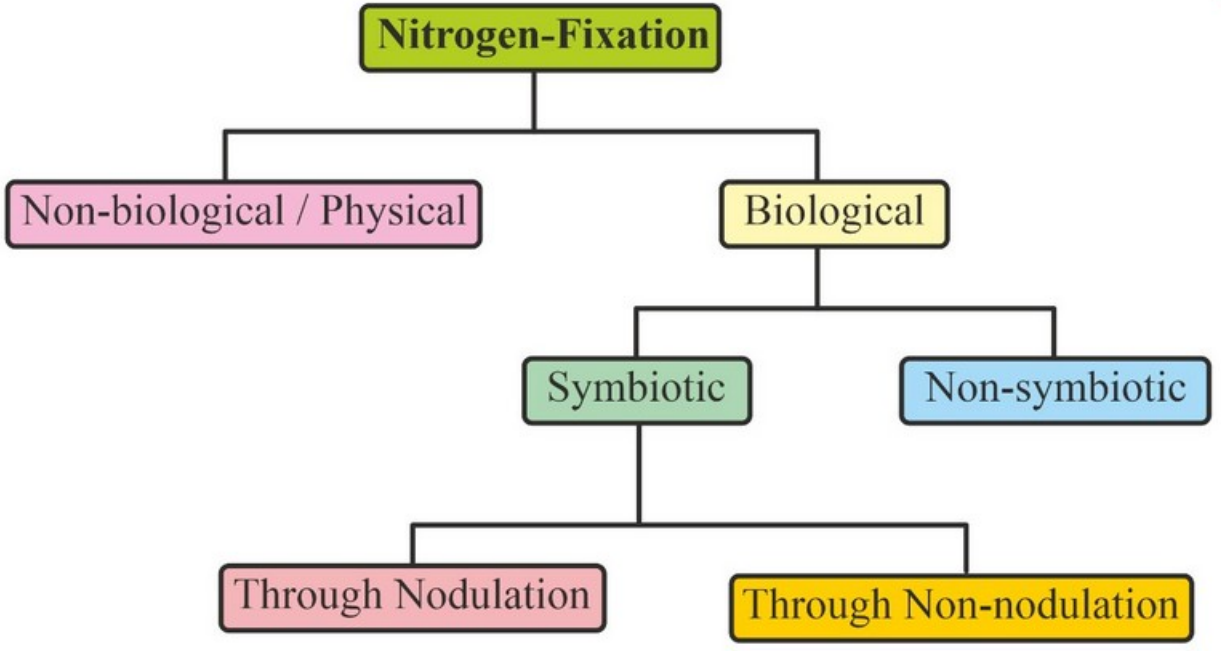


Nitrogen Fixation by Bacteria

Nitrogen Fixing Bacteria:

- found in the soil or on plant roots of legumes (clover, soybean, peas and alfalfa).
- require **high levels of oxygen** to fix nitrogen.
- fix nitrogen more often than lightning.




Nitrogen-Fixation
Non-biological / Physical
Biological
Symbiotic
Non-symbiotic
Through Nodulation
Through Non-nodulation

All Nitrogen Fixers Are Not Created Equal

Written by Eric Toensmeier

Nitrogen fixing species are a cornerstone of food forestry and other permaculture practices. Through a partnership with symbiotic organisms in their roots, these plants can turn atmospheric nitrogen into nitrogen fertilizers useful to themselves but also becoming available to their neighbors over time through root die back, leaf fall, and chop and drop coppice management. While it does not replace the need to bring in phosphorus, calcium, and other nutrients depleted by harvests, this strategy provides a free source of an essential fertilizer.

Martin Crawford's *Creating a Forest Garden* and *Nitrogen Fixing Plants for Temperate Climates* are excellent resources for calculating the percentage of nitrogen fixtures needed in order to supply all required nitrogen just from plants. Martin estimates this at 25 to 40% of plants in full sun or 50 to 80% of plants in partial shade, depending on the nitrogen needs of the crops being grown.

Now I'm going to throw another wrench into your calculations. I've known for some time that the amount of nitrogen fixed varies widely among species, but I recently discovered that the USDA plants database gives information about the amount fixed about many, many species native and naturalized to the United States. Check out their advanced search page to select species for your area. They classify species as **HIGH** (160+ lbs/acre), **MEDIUM** (85-160lbs/acre), and **LOW** (1-85lbs/acre). Note that

False Indigo (*Amorpha fruticosa*)

False Indigo (*Amorpha fruticosa*) is a widely-adapted “medium”nitrogen fixer that is.native to almost the entire country, though it is considered invasive in Connecticut and a noxious weed in Washington. It can be found from flooded riparian areas to extremely dry conditions, though it always wants a good amount of sun. Studies in the Southeast have shown that under their conditions it can be coppiced up to four times a year for alley cropping chop and drop, though permaculturist Jerome Osentowski reports that it does not coppice well in the high desert of Colorado. It is very widely used in China in agroforestry projects due to its fertility benefits and use as a pesticide. I also personally like that it is neither suckering nor thorny. USDA rates this as a “medium” nitrogen fixer.

Selecting plants that will improve the local conditions:

Plants grow best when provided with adequate Potassium, phosphorus and micronutrients

Supplement the soil by growing plants that actively accumulate essential nutrients

Dynamic Accumulators

Dynamic accumulators:

- An underdeveloped field of study
- Many recommendations are not founded in solid data
- Lack of accounting for growing conditions and background concentration of nutrients confounds much of the data we have

New findings further the study of dynamic accumulators

Dynamic Accumulator Database and USDA Analysis

Ben Tyler and Greta Zarro

https://www.permaculturenews.org/2022/01/10/new-findings-further-the-study-of-dynamic-accumulators/

https://docs.google.com/spreadsheets/d/19S3wsjXU6VPzmbklZLVxKt6DCyZIPjCYw6zRrVg7M4Y/edit#gid=662104531

Qualifying Dynamic Accumulators: a Sub-Group of the Hyperaccumulators.

Dynamic Accumulators: Identifying Plants of Interest

Dean Brown

https://www.permaculturenews.org/2015/05/12/qualifying-dynamic-accumulators-a-sub-group-of-the-hyperaccumulators/

https://www.permaculturenews.org/2020/05/18/dynamic-accumulators-part-two/

What we want to accumulate:

- "NPK" Nitrogen, Phosphorus, Potassium
- Sulfur, Calcium
- 6 micro-nutrients: Magnesium, Silicon, Iron, Boron, Copper, and Manganese

    - ➔ Ideally from plants that are vigorous enough to "Chop and Drop" or shed enough leaves gather.
    - ➔ Ideally perennial or readily reseed

Potassium

Comfrey

Lambs Quarters

Purslane

Bay Berry

Phosphorus

Horsetail

Dandelion

Also accumulates sodium which is problematic

Calcuim, Sulpher and Micronutrients

Calcium – Stinging nettle
Sulfur – Stinging nettle, Purslane, White mulberry
Iron – Dandelion, Corn salad, Mullein, Chick weed
Boron - Corn salad, Strawberry
Magnesium – Purslane, Asparagus
Silicon - Comfrey