

SOUTHWEST WISCONSIN TREE CROPS

INTRODUCTION

This book will cover some perennial food plants I have any knowledge on vaguely but will focus primarily on these staples in decreasing order staples of focus:

- American and Asian Persimmon
- Carya (Shagbark hickory, bitternut, and hybrids)
- Juglans (Black Walnut, Butternut and heartnut hybrids)
- Corylus (American and Hybrid Hazelnut)
- Quercus (Burr oak, White Oak, and Red Oak)
- Mulberry, Honey Locust, Seaberry, Apple, Pear, American Groundnut

And non-staples of Pawpaw, Cornelian Cherry, and Goji

THE PEOPLE

First, check out these people, read their referenced work and friend them on Facebook if they are alive:

- **Northern Nut Growers Association (NNGA)**
 - The NNGA archives on the flashdrive with all old letters and writings from members is incredible.
- **Ed Yates (-)**
 - Pecan
 - A lot of his work is at the Pecan Experimental Field
- **John Gordon (-)**
 - Wrote “Nut Growing Ontario Style”
- **Carl Weschcke (-)**
 - Wrote “Growing Nuts in the North”
 - President of the NNGA for longer than anyone
 - Coldest major experimental nut grower and nurseryman
 - Black Walnut, All Hickory, Butternut and Heartnut, Chestnut, Hazelnut
- **J. Russel Smith (1874-1966)**
 - Wrote “Tree Crops: A Permanent Agriculture” (1929) which inspired “permaculture”
- **John Hershey (?-1967)**
 - Nursery started 1921, TVA started in 1934, back to PA 1938
 - Apprenticed under J. F. Jones

- Friends with J. R. Smith who got him the job at the Tennessee Valley Authority where he ran a depression era conservation and agriculture program and ran contests for the best genetics of many native species
- White Oak group, Walnut, Butternut, All Chestnuts, All Hickory, Hybrid Heartnut, Hazelnut, Honey locust, Persimmon, Pawpaw, and Mulberry
- **Fayette Eppers** (-9/1963)
 - Chestnut, All Hickory
- **Bill? Zepp** ()
 - Hickory
- **Parker Coble** (-2020)
- **J. F. Jones** (-)
 - First white person to graft American nut trees. Thought to be impossible prior. Learned from southern sharecroppers grafting pecan.
 - Rush taught Jones.
 - Lancaster, PA
- **Jerry Lehman** (?-2019)
 - Persimmon and Pawpaw
- **James Claypool** (-)
 - Persimmon
- **Don Compton** (-)
- **Archie Sparks** (-)
 - Black Walnut and Hickory
- **Sam Thayer**
 - He wrote the book “Foragers Harvest”
 - Not a breeder but knows wild plants better than anyone in WI.
- **Fred Blankenship**
- **Miekal And**
 - Dreamtime Village
 - Siberian Peach
- **Ken Asmus**
 - OIKOS Tree Crops
 - Hybrid white oaks, groundnut, serviceberry, hybrid butternut walnuts
 - Kalamazoo, MI
- **Phillip Rutter**
 - Badgersett Research Farm

- Chestnut, Hazelnut, and Hickory
- **Mark Shephard**
 - New Forest Farm
 - Hazelnuts, Siberian Stone Pine, and Chestnut
- **Ernie (Ernest) Grimo**
- **Jeff Zastro**
 - Hazelnuts
 - Z's Nutty Ridge
- **Zach Elfers**
 - Keystone Cooperative
 - Nomad seed with a blog very worth reading
 - Hickory and Hybrids
- **Dale Hendricks**
- **Buzz Ferver**
- **Darren Bender-Beauregard**
 - Brambleberry Farm
- **Taylor Malone, Asheville, NC**
 - Nutty-Buddy Collective
- **Clifford England**
- **Alex Tanke**
- **Eliza Greenman**
 - ElizaApples.com
 - A poster child of the Savannah Institute
 - Mulberry and Apple plus other interests
- **Savannah Institute**
- **Lucky Pittman**
 - Great resource and online on FB and the forums often
- **Dax Man**
 - Prolific grafter and online resource on the forums
- **Akiva Silver**
 - Twisted Tree Farm
- **Bill Deeter**
- **SONG (Society of Ontario Nut Growers)**
 - Black, persian, and manchurian walnut, baurtnut, chestnut (jap, chinese, am, and hybrids), hazelnuts, hearnuts, hickories, and pecans

- Complete map of planting in SongNews Jan 2019 (not yet released)
- Website with lots of information: www.songonline.ca
- **Adam Kunsniar**
 - Buzz trusts his understanding of breeding genetics for english and black walnut
- **Andy Thomas**
 - Seems like the go to genetics guy in MO
 - Walnut genetics guy who is an actual contact to missouri agroforestry breeding and he loves elderberry and may be involved in that too
- **Jim (James) R. McKenna**
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- **Ben**
 - Black Walnut Orchard in Centerville, IA
- **Cyril Bish (7/1921-3/2006)**
 - Black Walnuts and Northern Pecans
 - “Cyril Bish Pecan/Walnut Research Orchard” in Lincoln, NE mentioned by NNGA
 - 2 acre planting
 - Hybrid Hazel Planting is adjacent to this planting
 - Evaluated almost all walnut varieties and locations are well documented on the next figures

Location	Cultivar	Month, Day and Year of Observation			
M-15	Bentley	S		MS	MR
M-02	Sparks 228	R		R	R
N-1	Beck	R		R	R
N-2	Hare	MR	R	MR	MR
N-3	Grundy	MS		MR	MR
N-4	Bowser	MR		R	R
N-5	Rowher	R	R	R	R
N-6	Kitty	MS		MS	MR
N-7	Caba Ohio	R		MR	R
N-8	Todd	R	R	MS	R
N-9	Leavenworth	R		R	R
N-10	Pfester #1	R		R	R
N-11	Bentley	MS		MS	MS
N-03	Scrimger	R		R	R
O-1	Sparks 328	R		R	R
O-2	Sparks 228	R		R	R
O-3	Pritchett	R		R	MR
O-5	Wrights	MR	R	R	R
O-6	Pritchett	R		R	R
O-23	Surprise	R			
P-2	Peanut	S	S	MS	MR
P-3	Meyers	R	R	R	R
P-6	Hare	R		R	R
P-7	Sparks 127	R	R	R	R
P-8	Cochrane	MS		S	MS
P-9	Kitty	MS		MS	MR
P-10	Crantz	MS	MS	S	MR
P-01	Tom Roe	R		R	MR
Q-4	Elkhorn	S		S	S
Q-5	Demming Purple	MS		R	MS
Q-6	Card	MR		R	MR
Q-7	Eldora	MR	MR	R	R
Q-8	McGinnis	R	R	R	R
Q-9	Sparks 128	MR		R	R
R-8	Thomas	MR	MR	MR	MR
R-10	Davidson 629	R		R	R
S-9	Sparks MS #2	R		MR	R

Location	Cultivar	Month, Day and Year of Observation			
		10/8/94	10/5/95	9/18/96	10/4/97
G-19	Pammel Park #20	MR		MS	MS
H-18	Wisconsin #1	S		S	S
I-18	Hare	MR		MS	MS
I-19	Lee Lowder	R		MS	MS
J-16	Vandersloot	R		MR	MR
J-17	George	R		MR	MR
J-18	Welch Rope	MS		MS	MR
K-9	Throp	MR		MR	R
K-10	S-127	MR	R	R	MR
K-11	Thatcher	MR	MR	MR	MR
K-22	Pamel Park #14	MR		S	MS
K-23	Pamel Park #20	MR		MS	
K-01	Sparks 328	R		R	R
K-02	Football 1	MS		MS	MR
K-03	Surprise	R		R	R
K-04	John Thordutti 1	R		R	R
K-05	Farm Thomas	R		MR	R
K-06	Sauber #1	R		R	R
K-07	M18	R		R	R
K-08	Burd	MR		MS	MS
KK14	Pammel Park #20	MR		MS	MS
KK15	Lee Lowder	MS		MS	MR
KK17	Mullinix	S		MS	MS
L-1	Sparks 127	R	R	R	MR
L-2	Farrington	MR	MR	MR	MR
L-3	Sparks 127	MR		R	MR
L-6	Krause	R	R	R	R
L-7	Burson	S		S	S
L-8	Stabler	MR	MR	MR	MR
L-9	S147	MR	MR	MR	MR
L-11	Ohio	R	R	R	R
L-12	George	R			MR
L-22	Pamel Park #14	MR		S	MS
L-05	Sparks MXS #4	R		R	R
L-06	Football	MR		MR	R
M-1	Sparrow	R	R	R	R
M-2	Hay	R	R	R	R
M-3	Ogden	R	R	MR	R
M-6	Davidson 629	R	R	R	R
M-7	Sparks 147	MR	MR	R	R
M-9	Crantz	MR	MR	MR	MR
M-9	Rock	MR	MR	MR	MR
M-10	Spilchal	MR		MR	MR
M-12	Thielenhaus	S		MS	MS
M-13	Davis #2	S			

TERMS

- Bark – The outer layer of stems in woody plants that serves only as protection but is no longer used to transport nutrients
- Active Bud – A typical, protruding bud from the stem of a plant. These push from dormant and grafted plants better and sooner than dormant buds.
- Dormant Bud – A bud that is not visible but will push growth if too few active buds are available. When one coppices a tree these will grow from the trunk where no buds would be expected. Hickory are good at pushing dormant buds from scion when grafting.
- Dormant – Buds have not yet broken and the plant is not leafed out
- Germination – When the seed breaks its coating or shell and sends out a root radical.
- Cold-moist Stratify – This is the most common form of stratification where the seed requires, most typically 90-120 days, of cold temps and moist surroundings to germinate
- Scarify – To damage the seed coat/shell in some way that better allows for germination. Honey Locust strongly benefit from acid or hot water scarification



Callus forming around a cut branch from the branch collar

Cull – To kill the plants that are not suitable.

Callus – The tissue that grows from the cambium to cover wounds which is undifferentiated and more dynamic in its potential (like a stem cell) and often is where roots will form in cuttings

Vascular Bundles – These carry nutrients

Monocot – Plants with one embryonic leaf, usually grasses. These have multiple bundles of xylem and phloem.

Dicot – Almost all non-grasses. These have one cambium ring per cross-section making them graftable.

Pith – The soft spongy material in the center of young growth; this transports and stores nutrients and water.

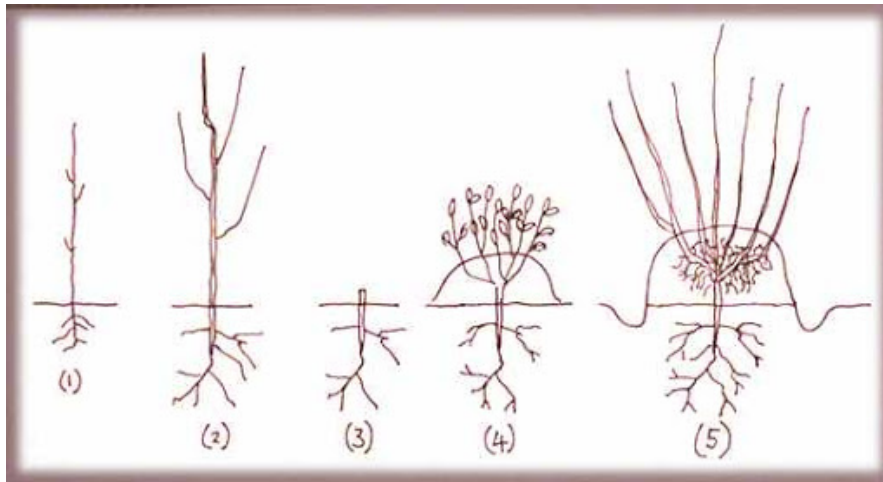
Xylem – Sapwood, inside the cambium.

Phloem – Inner bark, outside of the cambium.

Cambium, Vascular – a layer that is two cells thick, one produces xylem and the other produces phloem. The cambium is the layer on surface between the green inner bark and the wood. It is semi-translucent and somewhat brown/tan in color I repeat, the majority of the green is phloem; the green is mostly inner bark. When the bark is slipping, it slips between the two layers of cambium.

Graft – To connect two different pieces of plant tissue through a type of surgery.

Stool – To pile up a moist media over a part of a plant, often damaging the plant in some way prior, to encourage rooting for the sake of dividing/propagating own-root plants.



Scion – A cutting of a plant that is usually taken dormant, but not always, and used as material to clone as the top of a rootstock

Interstock – When there is some other scion responsible for growing an intermediate part of a tree, typically on the trunk.

Rootstock – A plant that is on its own roots that is usually grafted on top of. Usually rootstock is of seedling sources except for highly commercialized clonal plants like Rosaceae fruit trees

Root Graft – When you graft scion to a piece of root to either get the root to support the scion while it calluses and roots or to have the two heal together and continue growth. This is often much easier than growing out seedlings or stooling for rootstock.

Nurse-Root Graft – When root grafting is for the purpose of supporting the scion while it roots to create an own root plant.

Dead – No green in the inner bark/cambium

Greenwood/softwood – Wood that is not yet yet hard due to it being this year's wood and early in the season.

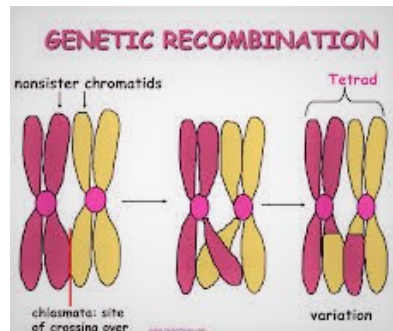
Semi-hardwood – This years growth that, for a subsection of this years growth, is stiffer and starting to form solid wood but not yet fully stiff and ready for dormancy.

Homozygous – In diploids, it means that the two chromosomes code for the same variant of a trait and/or that the chromosomes are both very similar

Heterozygous – In diploids, it means that the two chromosomes code for different variants of a trait and/or the chromosomes are dissimilar.

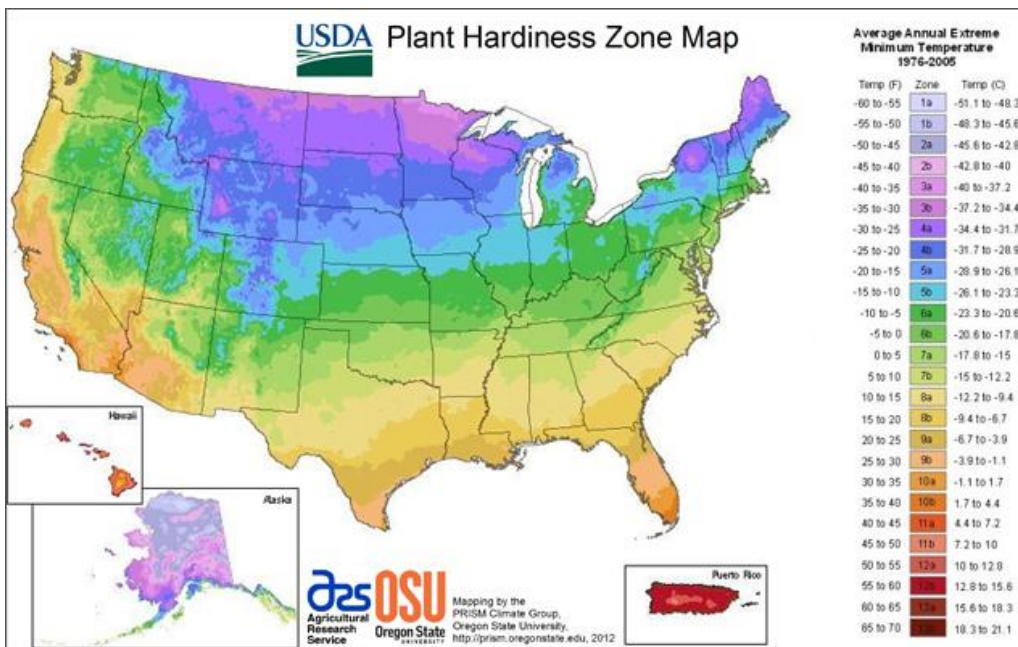
Gamete – A half of its the parents chromosomes which merge with a half from another parent. Pollen, sperm, and eggs are all gametes. Sometimes gametes have all or none of the parents chromosomes, creating near clones (not complete clones due to genetic recombination)

Genetic Recombination – When any creature with chromosomes produces a gamete, they align all similar/pairing chromosomes and swap sections of each chromosome at different spots every time. For example a parent with A1A2 chromosomes could create 2 pairing gametes, one with 90% of A1 and 10% of A2 and the other would be the inverse. This is a way of creating genetic diversity. Sex chromosomes (XX and XY in humans) are designed to not to recombine, at minimum over part of the chromosome to keep sex in two categories.

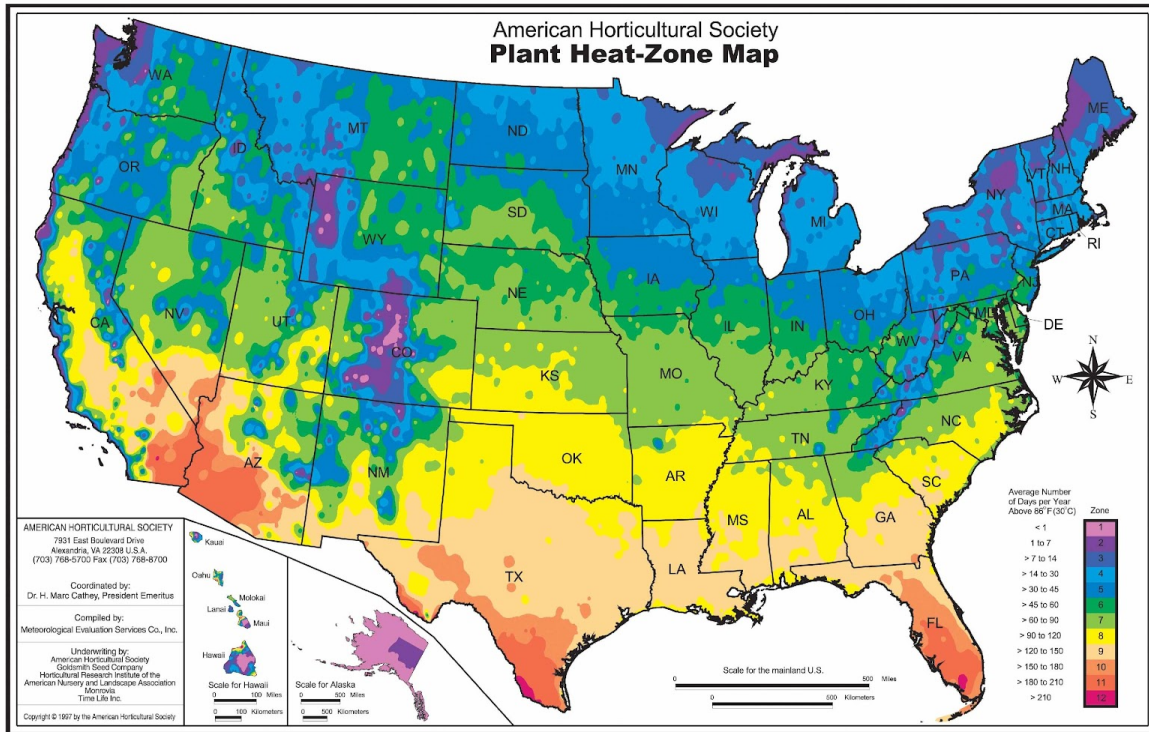


Staple Food – A food that provides significant calories and nutrition and stores or produces well for a large part of the year in the climate of interest

Hardiness Zone – A zone of the world defined by how cold the temperature gets in winter

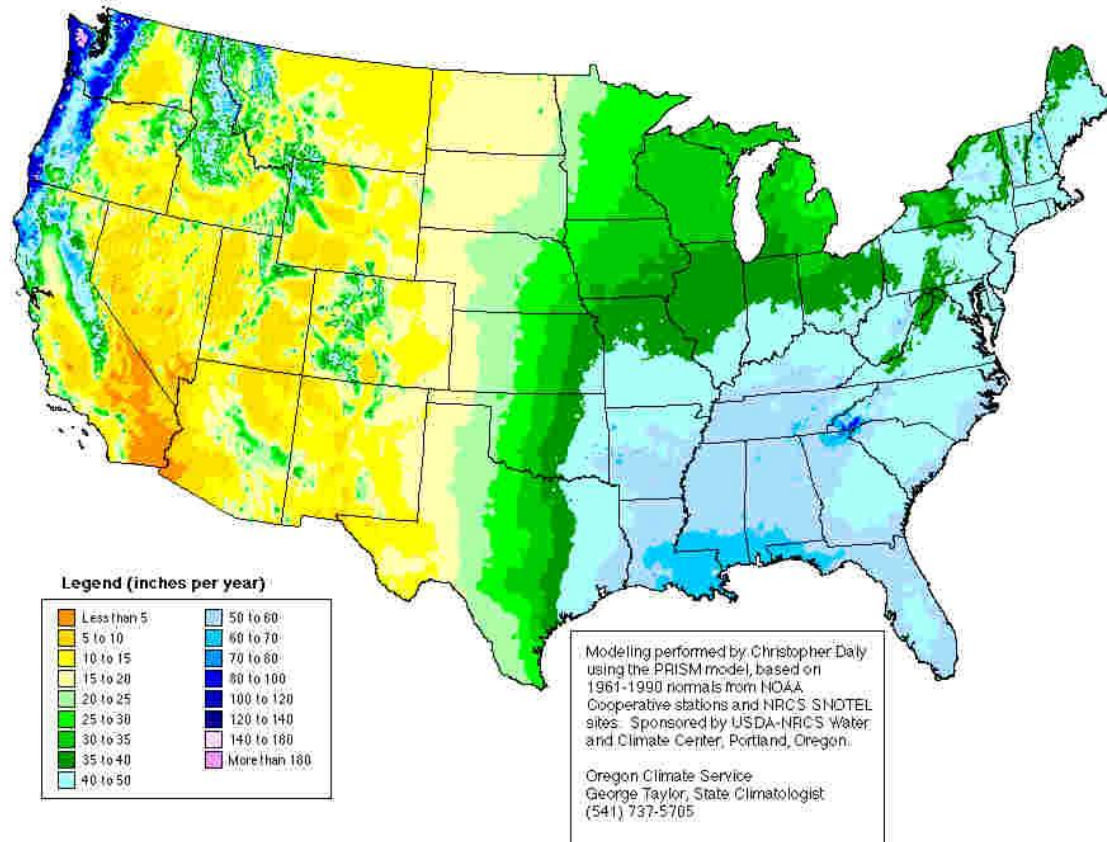


Heat Zone – A zone of the world defined by how many days over a specific temperature the area receives.



Annual Precipitation – The amount of melted water an area is gifted from the sky.

Annual Precipitation, United States, 1961-1990



Aspect – The direction of the slope that the land has. This strongly influences what species grow best on a site.

Ploidy – For all chromosomed creatures, they have at least two copies of each chromosome that code for similar things. Humans have 23 chromosomes that code for different stuff and carry 46 chromosomes in each cell so they have a ploidy of 2. We are diploids. Potatoes are tetraploid (recombination is very messy as they all cluster together), wheat is diploid (2x), tetraploid (4x), or hexaploid (6x), apples are di, tri, and quad, cultivated banana are triploid, American groundnut is diploid and triploid, and persimmon is tetra (60c) or hexa (90c). The higher the ploidy, typically, the larger germ, the more secondary metaboloids, the greater the ability to code for traits so they higher complexity the plant can be, the larger the cells and nucleus, the greater the hybrid vigor can be, and the greater heterozygosity can be. Odd numbers of poidy makes the plant sterile and unable to create seeds.

Inbreeding – Crossing a plant with the same pool of genetics for many generations; this tends to produce homozygous offspring.

Inbreeding depression – Weakness of offspring due to excessive homozygosity and not enough coding for traits or traits lost via inbreeding.

Backcrossing – Crossing offspring back to one parent. This is used to bring a dominant trait from one parent into the type of the parent that is backcrossed to.

Outcrossing – Crossing between genetic pools; this can bring in hybrid vigor

Line Breeding – A lesser version of inbreeding with the goal of making a set of traits stable while not inbreeding enough to produce inbreeding depression.

Open pollinated (OP) – When seed is fertilized by wind or insects without bagging for 100% isolation. It is still possible to be pretty sure the pollen parent from OP seed if you are specially isolated.

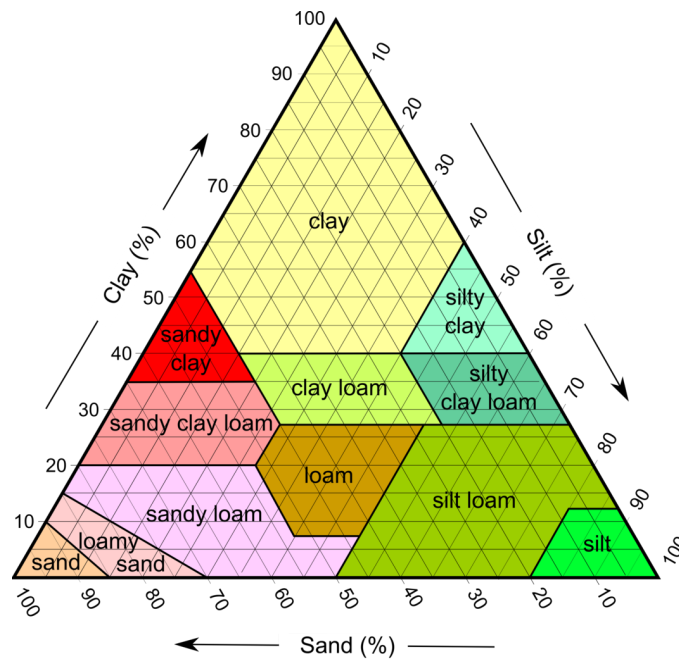
Tissue Culture – A laboratory technique of cloning a plant in a sterile environment from a small piece of a parent. Minimum orders are usually in the 1,000s. This is very cheap per plant, all things considered.

Remial wood – Wood from sticks and twigs with lots of bark and buds. This is much higher in nutrients than logs are

Girdle – To cut a ring around a tree completely damaging the phloem, making the tree unable to send nutrients to the roots but continuing to allow nutrients to flow from the roots to the leaves. This is done by mice sometimes. Partial girdling can induce fruiting. Full girdling is a very fast way to kill a tree.

Lake Effect – Large bodies of water have an effect of stabilizing temperatures and increasing precipitation especially on the downwind side of the BOW.

Soil Type – Clay, Slit, Sand, or Loam are defined by soil size and the soil triangle. You can also have organic soils, built not from rock, but from carbon-based materials/organic matter.



IDENTIFICATION

Persimmons

- Orange fuzz on non-vigorous branches. They have the fuzz on vigorous branches but you have to look closely because it is spread out.

REFERENCE OBSERVATION CALENDAR FOR MADISON, WI

March

- 1st

April

- 1st

May

- 1st
- PFC May 16th notes: Leaf out timing at Perfect Circle Farm, VT: Apples and plums are mostly leafed out and have been blooming for a week WHEN peaches are starting to bloom WHEN Black Walnuts are 1-2" and unfurling WHEN Persimmon buds start swelling WHEN hazels are flat leafed for a week WHEN Red oaks are 1" leaves WHEN Currants and seaberry are fully leafed out WHEN currants are almost done blooming WHEN seaberry have been blooming for a while WHEN it is 4 weeks after currants and elder broke bud WHEN Mulberry buds are swelling WHEN nanking is peaking with flowers but has been blooming for weeks WHEN pawpaw leaves are 0.5" WHEN Peach is blooming WHEN apricot grafted to peach is blooming WHEN Lilac flowers are white but not blooming and closed WHEN hummingbirds just arrived here

June

- 1st

July

- 1st

August

- 1st

September

- 1st

October

- 1st

November

- 1st

PLANTS RELATION TO SITING

It can be good to site plants for breeding at extremes to get information about the plants genetic without waiting for extreme weather. That said, no growing in one location will tell you everything you could want to know about how the plant will respond to another location.

Here are some wacky ways in which plants are non-linear when changing siting: the earliest persimmon in IN is not necessarily the earliest in Ontario, a walnut can still mature a crop even when the number of days needed to mature in the crop in the South is unmet

Rainfall & Water -

Humidity -

Nearby Large Bodies of Water – Receives the lake effect of reducing hot or cold temperatures, delaying the start of the growing season and delaying the end of the growing season. Increases humidity.

Aspect – The direction of the slope that the land has. This strongly influences what species grow best on a site. For example:

- North facing - fruit trees tend to bear more consistently on north slopes due to late waking from dormancy which reduces risk of flower killing frost or growth killing. Biomass forms more quickly due to lower temps and higher soil moisture from low

evaporation. Good for: mushrooms, heartnut, apple, pear, plum, cherry, honeyberry, red oak

- NE Slope – The wettest and coldest of the slopes.
- East facing - warm for the whole day but not hot or dry because they warm up in the morning and have low intensity afternoon sun. Can be protected from the prevailing wind, holding heat in place. Reduces fungal diseases due to evaporation of water on leaves early in the morning, reducing time that dew is on leaves. Good for: apple, pear, honeyberry, butternut, hazelnut, seaberry, white oak, black walnut, mulberry, cornellian cherry, goji
- SE slope – This is the best location for marginally hardy, moderately warm season plants that can grow and ripen fruits in moderate temperatures
- South facing - burr oaks and shagbark hickories in WI, tend to grow here. The plants that grow well here typically leaf out very late. This aspect makes them break dormancy earlier. Slight south slope is best for warm season crops. Good for: persimmon, burr oak, shagbark hickory, Pawpaw.
- SW Slopes – The driest and the hottest of the hot because the sun is strongest during the hottest part of the day. This high heat allows for crops that only grow in high heat to extend their season into the spring and fall when you only get mid afternoon temps high enough to ripen crops. This area may be the most useful for warm season crops that only marginally ripen in your area like persimmon. This may also encourage problems such as SW injury due to strong temperature extremes which peach non-native nuts may suffer from.
- West slopes - drier and very hot due to strong afternoon sun. Higher wind pulls away moisture and causes winter desiccation issues. Good for: grapes, honey locust, and drought tolerant south facing plant

Wind Protection -

Hardiness Zone -

Heat Zone -

Soil Thickness -

Nutrient Availability -

Cold air pocket -

AGRICULTURAL COOPERATIVES

Working with Others

The hardest part of starting a radical cooperative or project will probably be working and communicating with people, if you are anything like me. Here are some things that I am learning about working with people with sub-bullets of ideas on how to make it better:

- The boss-man is domineering and workers don't feel like they have flexibility in the way they do things or what they do with their time. They don't feel empowered to be more than a robot
 - Have the boss-man take a long vacation
 - Have the boss-man define clear boundaries on the limits of what can be done in the space
 - Open up conversation on what it will take to change this

- Ask what spaces they do feel empowered to start a conversation
- Someone feels like they are working too much
 - Work life balance needs to be worked on; maybe work less; maybe integrate life into work
 - They may have a complaint about the work quality so see other bullets.
- Someone feeling like they are doing only menial labor
 - They need to have control over space and tasks; maybe they should initiate a project of their idea
 - Do better at investing in the learning and development of the people doing menial labor; have discover sessions, learning time, ect
 - Get coworkers that make the time more fun
 - Change activities more often
 - Take breaks to do less menial work or something of their own
- Someone is frustrated about coworkers not doing their part
 - More formalities need to be put into place so that there is a limit to expectations
 - More formalities around benefits need to be put into place so nobody can be frustrated about exploitation

Business Options

Ag Coops are all about group sales, marketing, and/or processing. Some good examples are Keystone Cooperative and Midwest Elderberry Cooperative. All I really pay attention to are processing aspects of coops. Midwest Elderberry offers destemming and sanitizing equipment, receives destemmed frozen berries, and processes into juices and resells to large customers. Keystone Cooperative receives nuts, shells, mills, and oil presses nuts for sale.

Critical Cooperative opportunities opened by equipment are from the following tools:

Hammer Mill

- Crushes nuts for pressing

Oil Press

- Kernkraft 40 (\$15,000) - Sam Thayer, Jeff at Z's Nutty Ridge, and Zach Elfers all use this

Condenser Mill

- Separates flour from shell after pressing oil. Kernkraft sells one

Flour Mill

-

Pulper

- Robot Coupe C80 (\$3,200) – Tom Wahl Uses for Persimmon and Pawpaw deseeding
- Useful for de-seeding and de-skinning Persimmon, Pawpaw, Cornelian Cherry, Cherry, Plum, and Peach

Nut Cracker

- Davebilt #43 (\$175) – With a hopper for hazelnuts and Acorns
- Master Nut Cracker (\$70) - One by one for Walnut and Hickory kernels
- Patriot Nut Cracker (\$4000?) - One of the best crackers that works for black walnut
- Masa Grinder - (\$40) - grinds partially cracked shagbark hickory nuts for making milk

Harvesters

- Nut Wizard (\$55)– Acorns only
- No proven harvesters yet. Z's is experimenting with hazel harvesters though

Sieves

- 3/4" hole size - Uncracked walnuts and hickories stay above
- 1/2" hole size - Hickory halves stay above
- 1/4" hole size - Small hickory quarters stay above

Others

- Processing Kitchen and facilities
- Land Access/group farming

HOME PROCESSING AND HARVESTING

General Nut Tips: After dehulling, dry the nuts on a screen for a day or more, then hang nuts in only partially full onion sacks in a well ventilated area until fully dry. Increasing surface area of the nuts in the sack is ideal.

General Oil Processing: Oil yields are ~1 tsp per quart of nutmeats; not worth the time; skimming oil from the surface of tannin rich water is not possible to do well for bitternut and walnut. Shagbark hickories don't expel oil well and are best making milk and skimming meats. Nuts can be encased in the shell and water extraction still works. Black walnuts form the best oil for skimming.

Acorns

- White Oak Group
 - Harvest
 - Harvest quickly as nuts sprout in about a week and will start to hold dirt via roots and tannins may be harder to leach.
 - Natives may have stopped harvesting after the first rain due to color change to black – TBD if this is true.
 - Shaking branches with a hooked stick, burning underneath trees, and laying down tarps before shaking may be helpful in collecting.
 - Larvae infected acorns will fall
 - Acorns may be mature a month before they windfall.
 - Storage
 - Dry quickly in a well ventilated spot immediately as nuts are prone to spoilage
 - Smoking like europeans do with chestnuts may be a good option

- Processing
 - Tannins may become affixed to nutmeats if boiled and then placed in cold water
 - Tannins are stored differently in the White oak group than Red oak so leeching must be done after milling into flour.
 - The shells of this group float in water because there are hairs on them.
 - To leach, shell, then grind to flour, then soak in cold or boiling water until
- Red Oak Group
 - The shells of this group do not float in water because there are no hairs on them.

Pecan

- Hand cracking for raw nut meats is preferred. You may be able to make hickory milk with Pecans as well.

Shagbark and Shellbark Hickory

- Hand cracking for raw nut meats is laborious and only a winter task or high value task
- Hickory Milk (Pawcohiccora in one Native American's language is the name for this)
 1. Crack with Master Nut cracker (and potentially Davebilt) and leave meats and shells mixed
 2. Boil in water for 12-24 hours, refilling water as needed, until the meats float to the top and shells sink to the bottom. It is preferred to have a narrow tall pot and process in large batches for oil skimming
 3. Skim off nut meats from the top with a strainer and toast to dry them for later eating
 4. Pour liquid over a strainer, catching the liquid in another pot or a bowl and use for making tea, coffee, or generally as a milk substitute
 5. Compost the shells caught by the strainer

Bitternut Hickory

- Very high oil content and high tannins encourages oil pressing
- Bring nuts in shell to a oil expeller nearby or, crude crack with nut cracker boil in water as with hickory milk, skimming off the oil and composting all other parts as tannins contaminate all non-oil products.
- You may be able to leach tannins from the nutmeats that rise to the top from bitternut hickory milk by soaking and exchanging water until at low tannin levels

Black Walnut

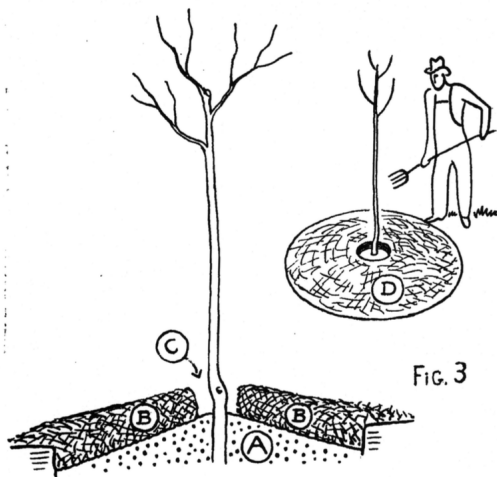
- Hand cracking preferred of easy cracking, large meated trees. Requires a strong nut cracker like the Master nutcracker

Persimmon

- A food mill is good for home pulping to separate the seed and skin from pulp; a colander and a large spoon will do the same
- The seeds and pulp attached to the seeds can be used for fermenting

ORCHARD ESTABLISHMENT AND MANAGEMENT

- Even though peaches goup from wounds, prune anyways but only take very small branches, otherwise unhealable damage occurs.
- When transplanting and the plant is leafed out, strip most of the leaves off to reduce plant stress and encourage root development
- Walnuts transplant very well. Hickories stall out for 2 years if even 2 years old
- When dormant transplanting, top-prune to about half of the top of the plant to balance roots and shoots
- Maximize the amount of roots kept during transplant but only to the extent that you are willing to plant well; if roots will be bunched, squeezed into a hole, or twist, it is better to prune off earlier as they will heal the final root-end sooner
- To transplant, break up soil, place bare-root plant, cover more than needed with dirt, shake the plant from the stem to get dirt in the cracks, heel in, then cover with mulch or loose/uncompressed dirt to conserve water
- Don't water more than once a week during establishment/ever. Too much will flood the roots and kill them. Only do this if there is no rain. Mulch is preferred.
- 1ft of mulch over dirt makes the soil do anaerobic and all plants in the area will die including planted ones.
- Keep mulch away from the stem to prevent rot and rodent damage as seen in John Hershey's planting guide below. I'd keep the mulch even farther away/less sloped or water will wash it in.



In mulching, cover the mound out to the edge of the trench. When cultivating, pull down the mound a little at each hoeing, but not too much as the mound is very valuable in keeping soil moist.

A. Cone shape mound around tree.

B. Four to eight inches of mulch in a circle around the tree, three to five feet in diameter depending on size of the tree. Mulch is listed according to its value, manure, peat moss, straw, hay, weeds. Use the one available to you.

C. Keep mulch two inches away from the trunk of the tree to prevent mice from skinning in cold weather from under the protection of the mulch.

D. Circle of mulch three to five feet around the tree.

-
- Tree hydrology is not as nimble as you may hope. Cutting out shading of a tree even when dormant will cause yellowing leaves and a similarly thin canopy in the summer due to vascular bundles not changing and nodes still being widely spaced. Consistency and gradualness in management of the canopy for plants is always important. For young

seedlings, letting weeds get taller than your plants and cutting them out will heavily stress your plants and in many cases cause leaf loss from desiccation; this is due to sudden high light and wind stress as if taken out of a greenhouse.

NURSERY WORK

Materials (Critical to Optional)

- All steel full length (~5ft) nursery spade with 16" spade
- Bypass pruner
- Mini Diamond sharpener stone (45 or 25 microns)
- 7, 12, and 33 gallon trash liners
- Garden Marker (not sharpie as it washes away)
- Rubbing Alcohol (for cleaning tools of sap and oil after use)
- 9" and 18" twist ties
- Temperature regulators made for brewing that read wide temp ranges and supply heavy current
- Perennial potting soil
 - All approx and questionable quantities 2 CuYd Peat, 2 CuYd finished compost, 2 CuYd remial wood and manure compost, 300lbs ProGrow fertilizer (peanut meal, bone meal, feather meal ect. Very slow release fertilizer), stone sweet (limestone, granite, ect for minerals) ferric sulfate
- Composted Remial wood chips with manure
- Greenhouse/High tunnel
- Stuewe and Sons 3"x10" black pots
- Stuewe and Sons 4"x10" black pots
- Stuewe and Sons 3"x3' black pots
- #7 Stuewe and Sons tray for 15 3"x10" pots
- 600 & 900 tree pots
- 1 Gallon pots

Storing Bare-root Plants

1. Dunk the roots of the plant/bundle in a bucket a few times
2. Place plants in a plastic bag
3. If storing for more than a month, consider putting moist peat moss or potting soil around the roots.
4. Push the air out of the bag, compressing the roots and place a twist tie around the roots, if possible. If the bag is punctured, double bag
5. As high up on the plant as is possible with a very tight seal, wrap the bag over itself around the neck of the bundle, not just making a pony tail but spinning the whole bag from top to bottom around the plant to add layers and tighten up the whole bunch. Twist tie as tightly as possible to reduce ventilation through this stem hole.
6. Refrigerate at 34F ideally at 44F at the very highest.

Storing Potted Plants

- You can keep fully hardy and ready for winter exposure plants by heeling them into mulch, covering part of the stem to ensure the plant is well insulated.
- Temperature sensitive plants should be stored in a root cellar. The cooler the better down to 33F. Top water to drench completely every 1-2 months over winter. Peat without a

wetting agent while bone dry, will not absorb water. If this happens, you will need to soak the pot in a water tub for several minutes at least.

Up-potting Potted Plants

- First, fill the pot to the brim with the plant in it, next, slam the pot bottom on a surface to make the soil settle, more is too compact
- The end potting soil level should be 1" below the top of the container to ensure soaking of the soil when watering
- Rub your fingers along the side of the soil from the previous potting to fray the roots and get them to grow outward
- The soil from the previous pot should be just barely covered and made not visible by the soil from the potting up
- When starting with grafted bare-roots, make sure to take off all rootstock buds (disbudding) including sprouts going upward from roots.
- When potting grafting bare-roots, always cut the roots down to the size necessary for the final pot (if that is where they are being planted) so that roots can callus and start growth from appropriate size sooner and no plant energy is wasted.
- If the plant is fully leafed out and you are bare-rooting the plant to up-pot, harden off before leaving without protection

Pruner Sharpening

- Use a blue diamond, quick sharpening small handheld sharpening stone and run it toward the blade edge out to the tip of point of the pruner keeping the sharpener at the same angle or sharper. This can usually be done with the pruners together but you may need to take them apart. Don't sharpen the back, just debur gently keeping diamond sharpener flat to the back surface and running once toward the blade edge to the point of the pruner. Don't sharpen the non-blade side of the pruner.

Weeding

- Use a garden hoe for annuals and shallow rooted plants; only on dry days
- 3-4 prone hoe is good for pulling dirt away from the base of tap-rooted weeds for hand pulling; best on moist days
- Cobra weeding tool is good for hooking under shallow rooted, matting plants for later picking up by hand; this can be done on moist or dry days.

Siting

- The more fertile the soil, the broader the more fibrous the root systems according to Buzz
- Dappled shade from partial tree canopy can drastically reduce water needs and offer leaf mulch

Root Pruning

- Cutting roots to an undamaged area, when kept in moist temperatures, hastens root callusing and therefore new root growth

SEXUAL PROPAGATION – SEEDING

Materials

- Seed stratifier - seed refrigerator, temp regulated freezer, rodent-proof bin in a cellar, or rodent proof, drained buried, sand chamber (40F ideally, 36-45F)
- Growing Bed – rodent protected

Black Walnut	9/15-10/1-10/10	9/5-9/15-10/1	9/25-10/1-10/20	9/20-11/01		9/15-10/1-10/10	9/4-10/18	
Chestnut	9/20-10/10		Tom Wahl – 9/15-10/15					
Mulberry	6/18-8/10							

And here is the frost free day conversion chart:

	Avg Last Frost	Avg First Frost	Frost-Free Days	Days Earlier than Madison	Days Longer Growing Season	First Frost MSN Translation
Madison, WI	5/18	9/25	132			9/25
Canton, MN	5/10	10/1	145	3	10	9/22
Blue Mounds, WI	5/10	9/28	144	8	12	9/17
Kalamazoo, MI	5/4	10/11	162	14	30	9/11
Amherst, NY	5/4	10/10	159	9	24	9/16
Beaver, IA	4/26	10/6	163	20	31	9/24
St. Catherine, ON, CA	5/25	11/5	164	-12	29	10/7
Terra Haute, IN	4/18	10/16	181	25	46	9/1
Downingtown, PA	4/15	10/15	183	28	48	8/28
New Franklin, MO	4/11	10/15	187	32	52	8/24
McKee, KY	5/15?	10/15?				

Note that plants hurry up and ripen a crop when cued by so many factors that I am unaware of so it is impossible to translate when a fruit/nut will crop based off observation and translation.

Process

1. Harvest

- Hazelnuts are ripe when the nut moves in the husk. In American types, when the nut is visible in the husk from the bottom; brown nuts signify ripeness; brown edges of the husk mean they are ripe. Don't dry hazelnuts more than you need to to husk to keep viability high.

2. Process fruit

- Persimmon should be soaked and fermented in water for 3 days until the seeds separate from the pulp, then screen seeds with running water over them
- Cider pressing pear or apple leaves seeds viable still. Planting pulp is fine.
- For Plum, use a paint mixer to mix dirty seed with water, seeds sink and pulp is in water so pour off water and add clean water until clean.

3. Stratify seeds - in your seed stratifier.

- A seed stratifier is better than stratifying in seeding beds because it allows you to transplant trees from the nursery bed and seed in the same year without cover crop, offers better rodent protection, and some seeds are not adapted to cold temperatures caused by harsh weather when soil is snowless
- Chestnut and the white oak group sprout in the fall as these may be easier to plant directly upon collection if well rodent protected. Bury places with moist but mostly dry peat in a sealed bag at a very cold setting; if they are drier, they are less likely to sprout in the bag. Bury doesn't add peat for many if the seed isn't as precious and they are fine and don't tend to sprout.
- No seeds should be dried out, heated, or soaking in water for long periods.
- Wash seed and discard seed that is damaged to reduce molding
- Walnut, butternut, pecan, and hickories (all Juglandaceae) can be stratified in media free bags if never let dry out and surface dry. Adding moistened peat moss or vermiculite to fill in the cracks may be helpful though Bury doesn't.
- Walnut can be stratified and planted in the hull and allowed to freeze and thaw; shell will crack on stratified nuts according to Gordon and easily shear so care must be taken when spring planting.
- Hickory: Storage of nuts has to be cool and airy so that nuts give up water without becoming surface damp and mouldy. Piles of nuts mould unless refrigerated near 1C, packed in dry peat moss in cool storage, bathed in rain, or stratified in cool sandy soil.
- Float test all testable seeds and discard before stratifying; dead seed increases mold risk in other seeds.
- Nut pines don't germ well when stratified in the fridge; they need to freeze solid over the winter.

4. Prep seed for planting if using a seed stratifier

- Juglans: Soak in cool water, replacing water with fresh water daily for 2-7 days depending on shell thickness

- Persimmon and Pawpaw: 99% will likely not survive the winter due to late germ and small size if you seed directly after stratifying without germinating.
- Persimmon and Pawpaw Simple Option: 4-5 weeks before the last frost, place in an extra warm location like on top of a fridge in a warm building until they germinate and there is 1-2" of taproot but no top on most of the seeds. Keep them in a bag with a lot of peat with the top open and kept moist (the Buzz way)
- Persimmon Ideal Option: Mix seed with moistened potting soil, vermiculite, or peat and place in a germ chamber at 80-85F for 1.5 weeks.
- Pawpaw Ideal Option: Mix seed with moistened potting soil, vermiculite, or peat, put mixture in a bag, and place in a germ chamber at 90-95F for 1.5 weeks. 87F for pawpaw and persimmon works too; 1.5 weeks for persimmon and 2 weeks for pawpaw.
- Discard any seed that doesn't pass the float test test or isn't alive before/while planting to properly space rows. Chestnuts should be firm, not too dark colored on shell and mold should not be attached to the shell, juglans and carya should sink, pawpaw and persimmon should be firm
- Honey Locust and Black Locust: get water to 190F, pull off the burner, drop in seeds, then plant in moist soil

5. Plant the seeds –

- Plant in rows so that you can get a hoe (or even just reach your hand in between rows easily even given that sprouts come up a little off line.
- Space tightly to shade out weeds quickly, encourage vertical growth, and increase area yield.
- You can plant any non-heated seed as early as April 1st; the seed will know when to come up and will start rooting long before sprouting.
- Plant germinate Persimmon and Pawpaw May 1st. Mulch with thin wood mulch or leaves keeping the overall depth to seed 1-2x the seed size typically; mulch makes it hard to use a hoe but is very helpful. It may be worth trying growing Mazus or creeping thyme as a ground cover underneath plants during establishment.
- Air pruning beds can be useful for establishing first year plants with a shorter taproot for easy transplanting.
- Space large nuts so that the seeds are almost touching.
- Here is Buzz's spacings in short-season zone 4:
- Buzz uses 9" spacing between all rows.

Species	In-Row (in)	Notes
A. Persimmon	0.5	Y1: 8", Y2: 2' competes, Y3: 4' Buzz grafting stock

Pawpaw	0.5	Y1: 2", Y2: 8", Y3: 1.5' competes
Hickory/Pecan	1	Y1: 3", Y2: 8" fully diggable, Y3: 1.5' competes and roots >16"
Butternut/Hybrid	1	Y1: 2' over-compete
B. Walnut	1	Y1: 1' compete
Oak	1	Y1: 6", Y2: 12" compete
Chestnut	1	Y1: 6", Y2: 12" compete
H. Locust	1	Y1: 1' compete, Y2: 4'
Apple	0.5	
Peach	1	
Graft replants	9 or 18 by size	Y1: Mulched heavily

Here are ideal planting spacings and notes:

Species	Btwn Row (in)	In-Row (in)	Notes
A. Persimmon	9	0.5	Y1&Y2: cull 50+% for desired traits, Y2: dig
Pawpaw	4	1	Y3: dig (top too small to notice otherwise)
Hickory/Pecan	4	1	Y2: dig (root too deep otherwise)
Butternut/Hybrid	9	1	Y1: Dig
B. Walnut	9	1	Y1: Dig
Oak	9	1	Y2: Dig
Chestnut	9	1	Y2: Dig
H. Locust	9	1	Y1: Dig
Apple	9	0.5	
Peach	9	1	
Graft replants	9	9	Y1: Mulched, weedy

ASEXUAL PROPAGATION – GRAFTING, ROOTING, and SToolING

Materials:

- Scion Refrigerator (coldest setting above 32F. 33F is ideal)
- 4"x10" ULINE zipping bags for scion/cuttings

Storing Dormant Scion – Don't store non-dormant scion unless you need to and if you do, do it this way or, for short periods, place in a cup of water; the best place to store scion is on the tree. Store in the scion refrigerator. Place in a labeled, sealable, airtight bag, ideally a 4"x10" ULINE zipping bag. Optionally wax ends with grafting wax if plants are finicky or scion is short and/or stored for long periods. For long periods store scion with only slightly damp-to-the-touch peat moss

Cuttings – The easiest and most scalable way to propagate easy-to-root plants like Currant, Elderberry, Goji, Honeyberry, Grape, Seaberry, and fully hardy peach

Materials

- Waterproof heated pad - Bottom heater
- 0.3% IBA Rooting Hormone

General Tips and Insights

- Energy is held in the stem and this is based off the volume and age of the stem. Current year or one year old dormant wood (generally younger wood) with thick stems hold the most energy and gives the best results.
- Large pith is often present in certain species and overly vigorous wood. Less pith is easier to align, easier to cut, stores more energy in the wood is too thin, too fast grown/pithy wood is less flexible, tends to snap and cause knife slips.
- When sap is held in the cutting, there is more energy held in the stem. Take cuttings when the plant is not in deep dormancy.
- Break the buds off of the part of the cutting that will be below soil level for best results.
- Most plants form roots on callus (elderberry from nodes)
- The wider the internode spacing and more vigorous the wood growth, the more energy in the wood and the fewer bud sprouts than the stem energy needs to support if not already leafed out. Take vigorous cuttings. Note above that pith is not helpful but associated with vigorous shoots.
- When the cutting is not exerting lots of energy in growth, the stem energy will be able to focus on rooting. This varies by plant but leafed out 1 year wood and semi-hardwood are the best for this.
- Softwood is a more nimble grower than hardened off wood and can more easily choose to send out roots. This may not be worth the tradeoff of being in a growth spurt when taken.
- Hardwood is all that can be effectively mailed to others for them to root.
- If needed, rooting hormone applied to the area you would like to root use IBA rooting hormone.
- Collect when the plant is full of moisture (only for active cuttings) at cool, high humidity times like early morning, late afternoon, low-no wind days, and/or rainy days after the plant has been watered and not when in drought.
- Collect cuttings as near to the time of use as possible.
- Cut off dried out ends immediately prior to use starting rooting.
- Flowers use a lot of energy. Pick off flowers from cuttings if possible.
- Some species root from callus. Damage to the cambium, stripping bark, and generally wounding the area you would like to root will form callus and later root.
- Keep humidity high, soil moisture high, lower light levels like dappled shade, wax the top of the cutting, and cut off half or 2/3rds of the leaf that farthest from the stem to reduce transpiration.

- A cutting is most accurately determined whether it is hard, semi-hard, or soft by its flexibility rather than color or texture.
- When a cutting loses its leaves, this does not mean it has failed. A cutting will drop its leaves a week or two prior to producing new shoots, signifying adequate root development. From any particular bud, multiple leave/shoots cannot grow so senescence must occur prior to growth; oaks do this with the leaves they hold onto over winter too.

Seaberry – Females are much easier than males typically. Take cuttings between fall dormancy and January 1st; the earlier the better. Stick 50% of length into potting soil. Break off buds below soil level. Apply rooting hormone. Semi-Hardwood cuttings can be taken when wood is beginning to harden off; if the stem falls over and wilts, it is too soft still; these can be rooted well enough to survive the winter outdoors in the ground if taken early as wood is forming.

Grape – Root grows from callus and grapes callus between 80-85F. You can root dormant cuttings directly in rich, well drained soil if soil temps are high in early June if kept moist with hardwood cuttings from winter. The fastest method is to, callus cuttings in vermiculite or pine sawdust (perlite is too porous and gives worse results) using bottom heat for 2-4 weeks. Once the callus is formed, you can root out at lower temperatures by planting outdoors at the same time that outside-grapes have leafed out around May 15th. Take cuttings in late winter (March). No rooting hormone necessary.

Currant and Elderberry – Roots grows from nodes. Take cuttings in spring as the buds are breaking (around April 15th) and root as soon as possible in the cool, moist spring; dormant cuttings will work too but soak in water until leafed out at basement or mostly/completely shaded outdoor area. Keep only a few inches of the cutting above the ground with only 1 or 2 buds above soil level. It is not necessary to break off buds below soil level although it is always. Make the cutting so at least one node is below the ground when rooting or in water while soaking. If you have rich, well drained soil, you can root in soil in the final location or in nursery rows. Otherwise use pots and keep soil moist but not soggy; ideally, keep humidity high. 2 year old wood works okay with currant; one year with elderberry.

Honeyberry – Softwood cuttings in mid June ideal.

Blueberry - Hardwood cuttings at the same time as elderberry while buds are swelling

Prunus – Peach, Plum, Almond, and Apricot – Dormant cuttings have very low success. Cuttings are best with semi-hardwood in August (for Siberian Peach) for Buzz. Bottom heat 75-80F.

Root Cuttings – The easiest and most scalable way to propagate own-root plants that don't root from cuttings like Pawpaw, Persimmon, Honey Locust, Black Locust (plants that naturally sucker but are hard to root from cuttings)

- Dig roots for propagation; for large trees you can just rip the roots with a hook on a tractor and dig suckers caused by this damage. Cut sections 2+” long (the longer the better) and place 1/2-1” below the surface of the soil; keep soil moist by watering or mulching with straw lightly.

Stooling and Layering – The least technical, least intensive, and fastest method of propagating berry plants, own-root fruit trees, hazelnuts onto their own roots. Not as scalable, quick or easy to get started compared to rooting or grafting.

Stooling and layering work on everything you can root cuttings of, everything you can root graft, heartnuts, and maybe persimmon; this is only relevant on own-root plants otherwise you are just stooling rootstock. The goal of stooling is to create many plants from one plant using young shoots from a stump or root-suckers. If there is young growth near the ground as with bushes, just bury the branches young growth and let it grow for a year; this is layering. If the non-intensive versions don't work, try the next assisting. Generally, fruit bushes can be layered, fruit trees can be stooled without hormone or girdling, and nut bushes and trees should be given all the goodies.

To stool, you:

1. Start by encouraging new growth low to the ground by coppicing the plant; coppicing works best when it is done regularly and callus is able to form over small areas rather than large areas so keep this in mind in the way that you coppice; think of it as a very low pollard. Cut just above, near flush with the collar of the sprouts of stools when you take separate them. For nut trees, girdle every other inch around the trunk so half is girdled in early spring 1ft above the ground.
2. Let it grow 6" more than you want the roots to form on via covering. You could try covering this with sawdust/dirt now and see if blanching helps.
3. When outdoor temperatures are good for grafting/callusing of that species, the plant can form callus and is ready for this optional step that is helpful for hard to root plants like hazelnut, persimmon, and heartnut. Girdle the sprout as close to the base as possible, apply rooting hormone to the girdle if needed, and cover the rooting area with potting soil, sawdust, or dirt. A fence to hold up the dirt may be helpful.
4. Water as needed.
5. Prune down to the minimum number of leaves possible and let the cut heal.
6. Cut off when roots are well developed. And pamper in very good soil for a year

General Grafting Methods and Tips

Knife Handling

- Be really really careful and don't cut yourself; there should be no need for finger protection and gloves are too clunky to use.
- Use a very sharp knife that you can shave with
- Left or right handed blade for lefties/righties; Right handed knives have the angled edge on the right side of the blade when looking into the blade edge with the handle beneath the blade.
- Make cuts in a way where the flat side of the blade is touching the wood at the start of the cut
- Pull the knife across the wood to slice and reduce the use of force.
- Start cuts with the base of the knife blade for more control
- Interlock or maintain firm contact between hands via thumbs or fingers on cuts towards you
- Hold the knife handle very close to the blade with a fist unless using the thumb to interlock hands on cuts towards you
- You can rock the knife for cleft cuts and tongue cuts if the wood is too hard and your force is dangerous; on each rocking of the blade, try to only rock as much as you cut on each side, otherwise flaking may occur on the wood

- Cut with pruners so that the blunt edge of the bypass pruners is on the discard side or in spots that will be cut off so that this pressure does not damage wood more than necessary.

Positioning Scion

- Align cambium as closely as possible for as much distance as possible. Read above on what the cambium is because it may be different than what you think.
- Keep the buds close to the graft so that there is less pressure necessary to push through the graft to feed the scion buds.
- Nurse branches are best above the graft because the branches nutrients flow down to the roots and then nutrients flow back up to support tip growth; keep any nurse limbs much lower than graft site to reduce apex competition says some
- John Hershey and his friends grafted much of the time on small side branches rather than the apex according to Buzz

Graft Technique

- Don't change the angle of your knife relative to the plant during any cuts as this will make a bumpy surface and cause poor cambium contact
- Cut off the wood at the end of the scion at an angle (30ish degrees) towards the last bud about ½ of the stem width above the last bud. Cut where the die-down/rot would be if you did not cut off the extra scion (observe die-down on other grafts). The angle allows sap to more easily flow to the last bud and cutting prematurely establishes the highway more quickly to push sap to the last bud.
- Cut the stock at an angle upward towards where the scion (45 degrees is good) is grafted when the stock is larger than the scion; this reduces water/sap holding in the scion, rotting the union, and allows sap to more easily flow in the wood up to the scion.
- If phloem or bark is too thick, just shave it down to increase flexibility and easy of grafting
- Cut off dead-end wood and wood that will die off while making the graft; wood will die if past the cambium of the corresponding area on the scion/stock or if wood is past the first cambium alignment of the wood; the dead wood interferes with callus formation
- Ideally, don't let cambium see the sun as this damages it
- Don't touch cambium as skin oil is toxic to cambium
- Only keep 1-2 buds on the grafted scion so the graft doesn't need to support as much growth
- Smooth off any saw cuts with the grafting knife in the area of grafting
- It is best to graft when the stock's bark is slipping but hot callusing or changing greenhouse temps to proper range works.
- The buds of scion in the middle of the years growth are the highest quality
- Fruits slip whenever watered heavily according to gordon. Typically spring and fall

While-Grafting Care

- Compress the graft so that there is strong cambium contact between stock and scion across the whole length
- Reduce transpiration from the scion and the graft cuts as much as possible.
- Only cover buds with one layer of parafilm, buddy tape, or wax to allow the buds to break through easily. Wax can be used to keep the scion moist but stretched tape also works great over the whole scion. Either wrap spirals or apply vertically after stretched. Wax can be made of beeswax and coconut oil
- Graft will heal best when completely moist but doesn't hold sap or pool water

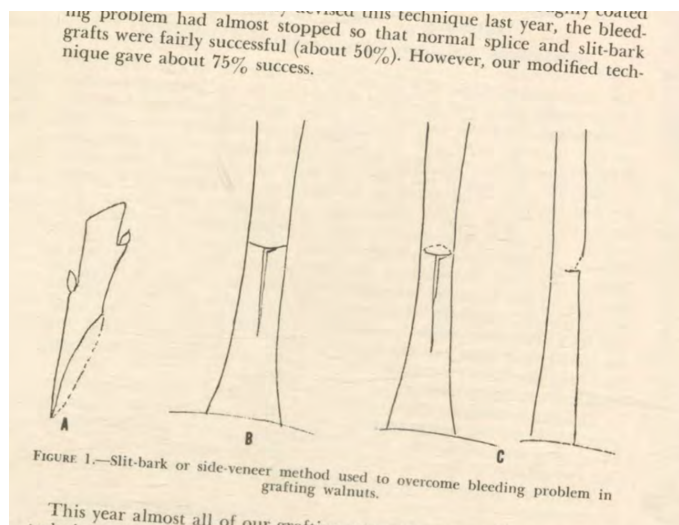
- Consistent temps within callusing range is ideal; plastic bags and aluminum foil both keep temps consistent outdoors; shading can be given with a paper bag, white is ideal, with cut holes for ventilation in the top corners. Shading in the morning and late evening is not necessary and can be permitted by only shading to the South
- Compression prevents bleeding, especially when budding
- Wind desiccates unions so protection with bags/foil is helpful for that
- Add a bird perch reduce the risk of birds landing on the young branch
- Multiple scions in large stumps heals over faster and prevents decay

Stock

- Graft on healthy stocks with strong wood with good past growth.
- Don't wax or tape in a way that interferes with callus growth over gaps and wounds in the graft.
-

After Care

- Support vigorous growth of grafts from birds and wind with stakes and ties for 2 years
- Don't leave anything non-stretchable around the graft long enough to cause girdling
- Pinching off shoot growth tips from rootstock and extra buds on scion when stems are forming allows the leaves to still feed the plant but stops growth from that shoot; this is useful in supporting rootstock during grafts and strengthening a union when there are two buds in the scion while also forcing a single bud to be the leader. Pinch off tip ends of nurse branches to top growth and energy loss from the stock
- Winter tender grafts can be insulated with wool or other insulation; it may be good to protect wool with steel wool.
- Grafting is a large shock to a plant, especially if the stock was cut back heavily. Grafting, then transplanting the year after is very hard on the plant
- Bleeding is reduced when the top is left on. Budding and bark grafting while the top is still on is ideal; you can even slot-bark or bark graft with the top on



- Rapid stock growth while budding can cause breakage of the graft union when budding with the full top on

Growth Notes

- Grafted branches tend to want to grow in the same orientation where they came from. One bud doesn't seem to have as much orientation memory as a branch and grows vigorously vertically
- Scion from mature trees on young stock fruit earlier than the stock would due to maturity of wood.
- Scion from high up in a tree will have the high up characteristics of the original position, even when grafted lower. I.e. thornless tops of honey-locust grafted on a seedling will still be thornless like the top of the tree even if the trunk of the scion source was thorny.
- Neither xylem nor phloem are actually connected when grafting, new vascular bundles are created in undifferentiated callus tissue after wound healing has taken place. When grafts scion has grown for a few days, this seems to be a sign of vascular bundles forming
- For stocks over a few inches, it is an art to keep the stock nourished but push growth of the scion.
- Bleeding is reduced by waiting until later in hickory or walnut growth and grafting can be done on greenwood at this time, leaving a few leaves underneath to support the scion.
- Bleeding is encouraged by rains and strong temp swings between night and day
- Take cuttings on the first week of march or some other time late winter (Buzz does cuttings from zone 5 to zone 7 on this week. Cliff goes late February. Don't cut scions after hard freezing weather and before the tree has fully recuperated from this because the tree is sap flowing to return losses from desiccation during the period that was so cold, that the tree couldn't get water to the branches according to JF Jones. Don't cut scion during syrup season either. The best time is after syruing is done
- Active buds take less energy and to push and flush earlier than dormant buds. On some species like hickory, dormant still works fine though
- Poor scion is usually pithy, has thin bark, and/or is dark in color. Good scion has large buds and well but not excessively spaced buds
- Gordon says Callus flows outward fastest but I don't believe this

Species Notes:

Species	Grafting Temp/Signal	Scion Notes	Stock Notes	Graft Notes
Shagbark	When nights are 70F+, when black locust is blooming by Elfers; ground temp above 50F; when leaves are well developed by Weschcke. When wood is stiffening at the 4 th leaf node above 3 well sized leaves with gelatinous pith by Gordon.	1-3 year wood, blind wood is okay, the best scion is the base of 1 year wood and the top of 2 year wood with the intersection in line with the top of the stock during topworking. The hardest thing is to get a bud to push so make sure there is 1	Not over 3" in diameter. If one third of branches are left on the stock, bleeding is not much of a risk. Bit hybrids take best on bit stock. Pecans and hybrids are easiest stock to graft due to year round growth; others only have a burst of growth in the spring	Weschcke cuts off most of the top several weeks prior to grafting, grafted around May 29 th . Chip as soon as buds swell by gordon. Try chip budding in Spring and then cutting the top the next year.

		active bud available		
Black Walnut	75F-80F, less callus growth above 82F; start bleeding when stock leaves are half size? 80F daytime temps are typical of grafting season. Graft when catkins fall. Prolonged drought inhibits callus in planted stock. Continued daily temps above 90F inhibits callus formation, especially on the south side of the stock.	1-3 year wood, 3/8"-5/8", lower buds best, it is better to cut early spring than late spring, you need to rub catkin buds off before grafting. Place scion on south side of tree because leaves need light to form callus.	Crown should be 1.5" to 1/2" diam. Callus grows from the top of the wound and grows downward. Leaves above the graft union accelerate union formation. Vigorous stocks should be used. Non-vigorous stocks don't have reserves to form callus.	<p>Best in dry weather, do not water potted stock; excessive bleeding is reduced if side-limbs are left on the tree; in top-working, let bleed for a week to 10 days but if new sprouts has formed, it has been too long and graft will fail; bleeding is worst on warm days following cold nights, higher takes occur when stock is 1.5"-3" for bark graft.</p> <p>Davie method says: bud/bark graft early with bark painted black (maybe shield scion if slot-bark graft), cut top to a nurse branch after ~1 week, cut top completely after bud has pushed 1"</p> <p>Chip as soon as buds swell by gordon.</p> <p>All Buzz does different than apple is thick rubber band them, not water,</p>

				and different temps
Butternut			Butternut on Walnut stock delay blooming a few days which can save the crop due to typical species early blooming; weschcke has never seen butternut canker on butternut on black walnut stocks too; heartnut is best on black walnut.	It is the most difficult to graft to heartnut stocks. BW stocks the best even for heart hybrids
White Oak Group				These can be field grafted in June in zone 4 with no winter hardiness issues.
Persimmon		Greenwood grafting works for Tom		
Pawpaw	When leaves are 1-2", Buzz grafts BR in 65-75F greenhouse	Break off flower buds when grafting		
Honey Locust				HL graft union is only hardy to zone 5a or 5b even with a 3 yr aged union from buzz's experience. This may not be true but weschcke reports the same. Some winters, the union survives for Buzz. Root grafting seems essential for the north

Mulberry	65-75F is plenty heat, no bottom heat necessary for root grafts. Can graft when leaves are 2". They are easier a little later than typical signs for apple	Greenwood grafting doesn't work for Tom		Field grafts in zone 4 with no winter issues
Apple	When leaves are 1-2" long; two weeks at 55-75 is enough to callus and push growth that can handle light frosts, can graft as late as may and again in the fall when bark is slipping and buds are fully formed on the tree. This is between July 15 th and August 15 th typically.			
Peach		Apricot and Peach both graft to peach stock		Siberian C is the best. It would be worth importing more siberian peach to diversify Miquel And's single parent breeding program...

Knife Sharpening

- Grafting knife – Victorinox budding knife or razor blade. The beveled side of the blade is opposite with these options.
 - Canvas or suede leather strop and white or green honing compound (0.5 or 1 microns)
 - Smooth leather strop
 - Waterstone or Oilstone at least as wide as your knife in approx 1000 grit (15-25 microns) and 3000 grit (8-15 microns)
1. When your knife is way out of wack (when purchased and annually), use sharpening stones at current angle or sharper until the whole edge is pretty flat as seen by light reflecting along the edge. To use the stone, place the dull side of the knife into the same spot in your thumb as you always use and rub the knife circularly in a different part of the stone every time. Make sure to sharpen both extremes of the blade well and keep the pressure across the blade as uniform over the width as possible.
 2. After every 2 or so hours of grafting, strop the blade. To strop, the blade should be almost flat on the angle side and entirely flat on the flat side; note this is much flatter than when on a stone because the canvas/leather deforms (maybe 5 degrees off horizontal). Place

honing compound on the canvas if needed. Pull the knife across the canvas strop towards the dull side of the blade 7-15 times on the bevel side and once on the flat side. Do the same repetitions on the smooth leather.

Whip and Tongue Graft – Dormant on dormant or slipping. Scion and stock should be firm and sizable. Stock & scion should be of similar or identical size with the stock. Either stock or scion can be larger

1. Find a spot where the scion and rootstock are the same or as similar a diameter as possible. The higher on the stock, the better due to stored stem energy. If the stock is larger everywhere, cut the stock at a 30-45 degree angle towards the mounting side.
2. Cut the scion to where you would like it to start with pruners. The blunt side of the pruners should cut on the discard side of the wood.
3. Make a scion whip cut. Make a ~1.5" cut quarter inch scion, 1" cut for pencil size scion, and 1/2" minimum cut for micro-scion. Cut across your body with the knife in a parallel plane to your chest. The flat edge of the knife starts the cut next to the wood. Start at the very base of the knife and slide across the knife as you cut. Arm follow through can be helpful when the wood is hard. Do not interlock hands or put your dominant thumb on the other side of the scion.
4. Cut the tongue. With hands locked into each other, with the knife on the top side of the scion and the flat edge facing the scion. The scion should be about in-line with your non-dominant arm. Keep the blade at the same angle the whole time or a bump will be produced that generates poor cambium contact. Keep the cut shallow otherwise there will not be good contact; too shallow and the bark peels off which is less health. Cut the tongue approximately 1/3 of the whip down from the point for about 1/3 of the whip.
5. Do the same set of cuts on the stock. Note that if the stock is larger than the scion, on the higher up side of the angle cut in the stock and cut much more shallowly to produce cambium exposure about the same size as the scion cut.
6. Position pieces. Align cambiums. If an easy species you can align to one side if necessary.
7. Optional stock slipping modification. The stock's bark should be slipping so for similar size scion and stock grafts, you can peel the bark back on the stock, use your knife to cut the stock wood at a 45 or more vertical angle towards the stock whip cut when the scion is detached starting about 1/2 of the way up the whip cut back side. Lay the bark back down on the wood. Do not cut the half moon on the part where you do this modification. You should cut excess off but not to the point where you can see cambium.
8. Cut excess thin whip, if there is any. Make a small half moon of xylem exposure on the top and bottom parts of the graft by using the grafting knife to cut off the thin part of the whips while the pieces are connected by pressing the knife into the excess with the other piece to stop the knife from cutting your hand. Pressure will cut and make a click when the piece is cut off. This small piece is past cambium contact, will die, and get in the way of callus. Callus boils up to alive wood if this is cut and heals better.
- 9.

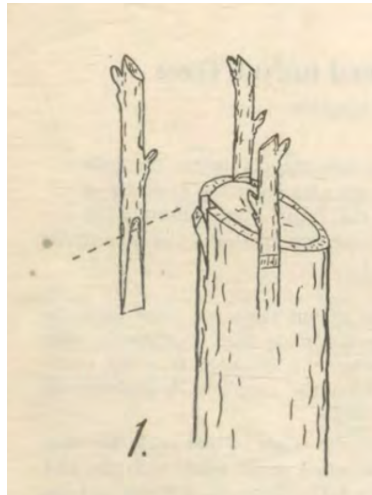
Banana Graft/Four Flap Graft – The highest high cambium contact for same size stock. Slow.

1.

Cleft Graft – Good for small or flimsy scion and/or stock. Not recommended for large stock due to wood cracking. Very fast.



Slot Bark Graft/Bark Inlay – This to provide the most cambium contact and least detriment to stock for large stock. If the diameter of stock is small and you only use a single slit to make bark flaps, you will need to start the scion cut with a deep angle to scoop into thin wood at the beginning in order to reduce the bark stretching/lifting of the stock. Buzz roughens up the bark next to the exposed cambium lines on the scion because he was taught to do it this way.



Budding – Conserves wood and buds. Bud loses branch growth memory. Very small wound for plant to heal.

- The bud should be allowed to heal in for 2-3 weeks, then the top can be cut when the tree is starting to push spring growth. Don't cover buds with anything but parafilm or buddy tape with one layer; stretch prior to covering to ease bud breaking through; letting the bud stick out is fine too and put tape underneath the bud behind it; long and skinny buds are

likely to break when covering so don't. It is dead if not pushed at 5 weeks after cut to nurse branch.

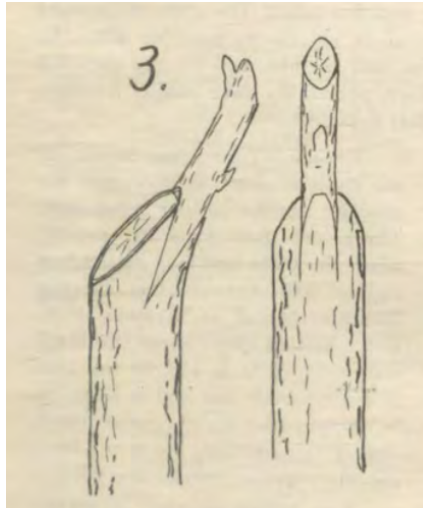
Chip bud - Right when first leaf is visible even for nut trees on south side with dark bark color exposed even with nut trees; early budding, accurate fit, and compression reduce risk of bleeding. After leaves start to grow (2-3 weeks later), cut stock 4" above to push bud. If T-shield, no need to wrap directly over the bud. Cut to just above the bud at an upward slant and seal with glue. Some species are budded, then cut to a nurse branch once healed, others cut to a nurse branch at the same time as budding.

T-Shield bud -

Patch Budding -

Z Graft – Zach's favorite for hickory.

Modified Cleft Graft – This can be done a 1-2" away from the top of the stock which allows the top to be unwaxed and left to bleed. This seems really hard to get a good stock cut.



Wrapping with Buddy tape/Electrical Tape -

- Tape over the graft in such a way that the tape jumps over any gaps in wood where callus will bubble. Having the edge of tape in the middle of a bark gap will make an tape surface that is not smooth over the region of major callus and will interfere with callusing more-so.

Potting Up – In a drained container, put a few bundles of grafted plants into a container so that the roots are not touching the container walls (this is not such a big deal with typical fruit plants), the tops do not lean over the edge of the pot (so pots don't interfere with each other when callusing graft unions), so that all roots are under soil (they can be under a lot of soil for non-sensitive plants like apple and pear), and so the graft is not under soil. Cheap-O tip: you can use remial instead of potting soil on non-sensitive plants with large root systems like typical fruit tree crops.

Root Grafting and Nurse Root Grafting – The easiest and most scalable way to propagate dormant scion of Mulberry, Hazelnuts, Apple, and Pear onto their own roots. This could have potential in being used transitionally to get plants own roots for propagation via root cuttings.

Field Grafting

Materials

- Electrical Tape (needs to be taken off but for pressure and seal) or parafilm (biodegradable and for seal) or freezer tape (biodegradable and for pressure)
- Aluminum foil
- Grafting sealer - Exterior Latex Paint mixed with Wood Glue 50/50 mixed into air tight container the day of (idk how long it keeps. I bet for a week)

Tips

- For high temp nut grafts, a 2L soda bottle may be useful in increasing the temperature. Make sure it doesn't overheat, it may be good to fill with moist pine sawdust, venting and peak sun shading will be essential in some capacity but the best solution is yet unknown. A european leaves the top open and fills the container with moist sawdust on walnut

Bare-root/Potted Grafting

Materials

- Grafting Wax - 50/50 Beeswax and refined Coconut Oil (cheap and doesn't crack, 100% beeswax (expensive), grafting wax (expensive and toxic), or beeswax mixed with paraffin wax (crack prone). Antimicrobial properties of beeswax are helpful.
- Grafting Tape - Buddy tape is the best and the stretchiest, parafilm M (M stands for Medical grade) is next best, Horticultural parafilm is lowest quality, John Gordon used Pipe sealing tape
- 5 gallon buckets with and without 10 1/2" holes on the very bottom of the side/bottom for drainage

Process

1. Get the plant active - For Apple, Pear, Pawpaw, pull out the rootstocks from the cooler and soak them in water in a warm greenhouse until the leaves are visible. Change the water when it gets stinky. For prunus rootstock, you can soak them for 1-4 days but too long can cause damage. You may want to Pot Up plants with sensitive roots to get them going or just start with potted plants. Apple and pawpaw are okay even if in water for 3 weeks.
2. Wait for a cool morning or evening. Ideally, but not necessarily, have low/indirect sun or make a shady spot.
3. Clean the space, fill 5 gal bucket with water to receive plants bare-root plants, sharpen knife as needed, make labels, open pruners, open grafting knife, and place on bench.
4. Place scion on a clean surface like a towel or bag
5. Make your preferred graft
6. Wrap with buddy tape. Rubber band as needed.
7. Wax the whole scion up to the buddy tape.
8. Place bare-roots in water or potted plants in a flat.

GENETICS AND BREEDING

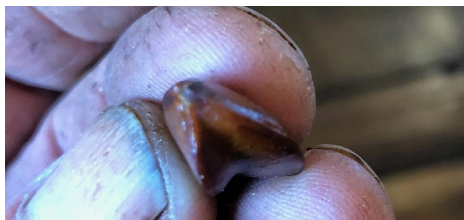
General Tips

- For Walnuts and maybe others: grafting the scion onto a branch of a mature tree backwards will force the scion to fruit that year so that you can tell what nut characteristics young seedlings will have in the future

- Grafting young scion onto a mature tree branch will cause fruiting sooner and will increase generational cycle time.
- Negative branch angle (gravitropism) encourages fruiting: bending branches at a downward will encourage them to fruit. This is not know to work on nut trees but works on fruit trees often, especially apples
- Lateral bearing (spur or side bearing) tends to be a lowland tree characteristic because the plant is more confident to adequate water supply. Lateral bearing can increase yield and positioning of fruit makes the branches better able to support the fruit weight
- Weak, shaded branches consume more energy than they produce so having the plant drop branches when shaded, like in persimmon boosts productivity.
- Trees should be bred in a spot that is slightly more stressed than the commercial orchard and trialed in complementarily stressed locations.
- Structure of trees should be open and branching should be outward with strong limb sockets, not prone to rot or breaking.
- Flowering should be at a time where there is very low probability of cold damage (killing temps vary by species); the later the flowering, the better. Late flowering delays ripening time on a fixed days to maturity which may not offer enough time to ripen a crop every year. Gordon: "Early persimmons flower early."
- Early ripening is linked to annual bearing; early ripening give the plant time to build stores of energy for next years growth and crop, though not critical for annual bearing.

Specific Tips to Compile Later

- Disease, temps, insects can reduce crop and increase plant expended energy. Breed resistance: Anthracnose in black walnuts, bud mites in hazels, early hard frosts with leafed out persimmon, erratic spring and fall frosts for heartnut and hybrids, hickory weevil in nuts, acorn weevil in white oaks, late spring frosts for kiwi
- For Hickories: You should find that nuts which are smooth and flat on the outside, are also the easiest to crack and separate, reflecting a smooth, flat structure on the inside.
- Hickory and Walnut: Flat nut kernels are easier to extract with no ripples
- Hickory and walnuts: stout and wide nuts tend to have easier to extract kernels
- Hickory: about 1 in 80 wild nuts are Large in size in Dane Co, WI. 0 in 300 has been extra large
- Multi-dimensional persimmon seed (seed that is not flat across its surface) may be hermaphroditic according to DEC and is important to the future of persimmon breeding because quality males are hard to evaluate. DEC, "The seed comes from a hermaphroditic flower." DEC, "These seeds are a hermaphroditic cross. It depends on how the cross went. Did the female part out cross with an unrelated male, or the true male of the same tree, or the hermaphroditic male of the same flower. The outcome can end up many ways. One way I think is Szukis."



○

- Blue Wafer Persimmon from Hershey has more hardy seedlings than any other

- To keep ants out of pollen bags, a cotton swab is placed around the branch where the bag is tied
- Collect pollen before bee activity starts at 5:30a-6a
- Persimmon pollen is viable refrigerated for 48 hrs and 60 with reduced viability
- Persimmon female flowers are receptive for 48 hrs after opening; you can remove the bag 48hrs after the last flower has been pollinated
- Orange bags, or small onions sacks are used to catch fruit of controlled crosses; install when fruit starts to change color
- Pawpaw fruit:seed ratio is whole fruit with peel to seed weight because peeling is very hard. Large fruit is almost always less seedy according to Jerry, but there are exceptions...
- Tall, narrow male seaberries are useful because they don't take up horizontal space and spread pollen farther. Buzz selected a few for this.
- Chestnuts: Buzz's favorite NTN chestnuts (he prefers raw flavor and ease of peel) are Guthrieville Rd 530 and 400 and Squirrel Stash (the best at NTN) by the walnut and flat field. Fisher and Route 30 is a good chestnut, Kintzel is great, Irish Valley chestnut is on the way to paragon (idk where it is but it used to have tons of americans that all got wiped out by blight)
- Baurtblack hybrids tend to bear laterally and are very productive from Ken's experience
- Fully adapted Juglanaceae and Quercus plants will dominate spring flush with end bud growth. The fastest largest growth may come from the highest point in the plant with best quality wood between it and the roots. This may be true of many more species. Chestnuts typically have duds as their last 3 or so buds.
- For persimmon's we want pulping persimmons and fresh eating persimmons. Fresh eating need more fiber; annual bearing is encouraged by less heavy bearing and early bearing.
- For persimmon: some males set perfect flowers and some females set male flowers (but not perfect. Early golden carries the gene of females setting male flowers.
- Females have only XX chromosomes and Males have XO. Zsukis produces female pollen with only X Chromosomes. Pollen from female trees produce only female trees. Jerry uses brothers of great persimmons as pollen source
- Persimmon: Earliest by Jerry is: A115 (pulper) drops second week of august and complete early September at Jerry's, Able 33, H120
- Persimmons: more sensitive to excess water than deficiency. Less rainfall will make the fruit smaller and firmer
- Dollywood is a Pulper, Prok (pulper with mild kaki flavor)