MICHIGAN STATE UNIVERSITY | Extension

# Propagating Fruit Trees

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Propagation times

- Winter bench grafting
- Spring top graft
- Summer budding
- Spring budding

# First thing……legal issues

Federal and international plant patent laws grant the right to a plant patent holder to control propagation of their variety for the life of the patent (in the US it is 20 years, internationally it is 18 years).

This means that it is against the law to propagate (bud or graft) a patented variety without permission from the patent holder.

Variety owners sometimes trademark the name under which the variety is known in the market (for example Pink Lady).

Thus, even though a grower could legally propagate trees of Pink Lady he could not sell the fruit as Pink Lady apples. He would have to sell them under a different name such as Cripps Pink which is not trademarked .

# Plant propagation and the problem of hidden diseases

Once plants are infected with viruses, viroids, and phytoplasms they are infected for life

Fruit trees from reputable nurseries are (generally) initially clean

Over time fruit trees accumulate viruses

# Plant propagation and the problem of hidden diseases

<u>Methods of virus / phytoplasm spread</u>

Infected plant material (rootstock, scion)

Pollen transmitted (prunus necrotic ring spot, prune dwarf virus)

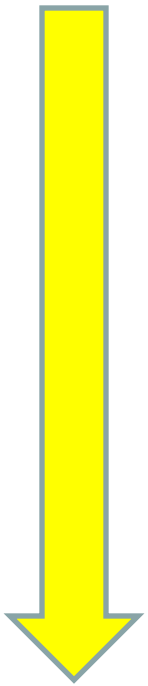
Insect transmitted (plum pox, x-disease)

Nematode transmitted (tomato ring spot)

Spread on contaminated knives, etc

# How serious is virus / phytoplasma contamination?

Depends on the pathogen / host combination



No appreciable effect

Weakens tree

Fruit quality problems

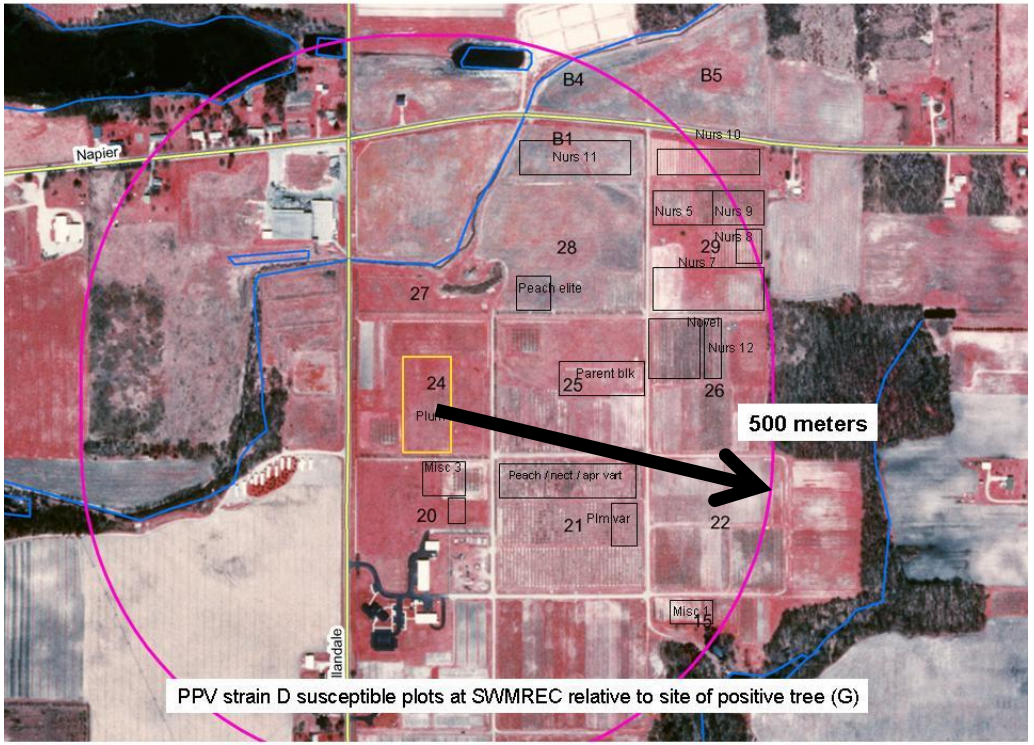
Serious tree decline

Quarantine problem

# How serious is virus contamination?

Worse case scenario

Quarantine pathogen




Plum pox virus – every peach, nectarine, plum, apricot tree within 500 meters of PPV infected tree was removed and burned. Three year quarantine, $600,000 statewide survey.

# Virus diseases types with no vector (topworking viruses)

- Spread by only by clonal propagation, grafting, rootstock bridging
- Examples: apple mosaic virus, apple stem grooving virus, apple stem pitting virus
- Manage these diseases by buying only virus indexed planting material

Pear vein yellows

Apple mosaic virus

Star virus

# “Latent” apple viruses

Some rootstock are hypersensitive to latent viruses.

E.g.  Geneva 16 apple rootstock is hypersensitive to at least one common latent virus.  If contaminated scion wood is used, the trees will decline within a few years

Infected tree shank region of trunk has pitted, disorganized wood

# Old and new apple rootstock characteristics

| Rootstock | Vigor rel. to seedling | Winter hardi-ness | Fire blight / Collar rot resistance | Replant disorder resistance | Precocity / Productivity / Fruit size | Other negatives |
|---|---|---|---|---|---|---|
| Bud 9 | 25% | 5 | 3 / 5 | - | 5 / 5 / 5 | Wooly aphids |
| M.9 nakb | 30% | 4 | 1 / 5 | 3 | 4 / 4 / 5 | Wooly aphids, burrknots |
| G41 | 30% | 4 | 5 / 5 | 3 | 5 / 5 / 5 | Wooly aphids shy rooting |
| G16 | 30% | 4? | 5 / 4 | 3? | 4 / 4 / 5 | Wooly aphids, sus to latent virus |
| M.26 | 45% | 5 | 1 / 3 | 2 | 3 / 4 / 5 | Wooly aphids, burrknots |
| G11 | 45% | - | 3 / 3 | - | 3 / 5 / 5 | Wooly aphids, |
| CG5935 | 50% | 5 | 5 / - | - | 5 / 5 / 5 | Wooly aphids |
| CG30 | 50% | 5 | 5 / - | 5 | 4 / 4 / 4 | Brittle graft union |
| M.7 | 50% | 3 | 3 / 3 | 3 | 2 / 3 / 4 | suckers |

*Range: 1 (poor) to 5 (excellent), - = unknown*

# Apple Union Necrosis and Decline (Tomato Ringspot Virus)

Impact of TomRSV depends on variety & rootstock combination


Break at graft union

<u>Tolerant Rootstock</u>
MM.106
M.26
M.9
Mark
Bud 9

necrosis →

<u>Resistant Variety</u>
Red Delicious
Jerseymac
Jonathan

no necrosis →

<u>Tolerant Variety</u>
Golden Delicious
Empire
York

<u>Resistant Rootstock</u>
M.7, M.9, Mark

no necrosis regardless of the variety

# Pollen-transmitted viruses

*Source: www.nps.ars.usda.gov.*

Prune dwarf and prunus necrotic leaf spot viruses are transmitted by pollen and seed, as well as budding & grafting.

# Prunus necrotic ring spot virus

“shock” symptoms
on tart cherry leaf

Irregular margin
(leaf on right)

# Prune dwarf virus

Infected sweet and tart cherry trees develop excessive flowers on terminal and lateral shoots, resulting in blind wood.

Sour cherry yellows

Mottled appearance on sweet cherry

# Synergistic effects of Prune dwarf virus and prunus necrotic ring spot on peach

- Rapid decline of young peach tree seen within a year of inoculation with both viruses


*Credit: Simon Scott, Clemson University*

# Virus problems are difficult to diagnosis

Plum

Tart cherry

Peach

# Is your orchard contaminated with virus problems?

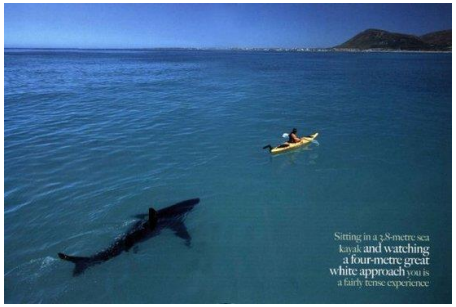
<u>considerations</u>:

- Site history:  many years with susceptible host

- Broadleaf weeds common

- Close to other orchards that may have virus problem

- Nursery stock may not have been clean



Survey for prune dwarf virus (PDV) and prunus necrotic ring spot virus (PNRSV) pathogens in tree fruit leaves, Berrien County orchards, June 3, 2009.

*W. Shane, SW Mich Res & Ext Center, MSU*

*Composite sample of 5 leaves per tree, tested by ELISA, AgDia*

| Orchard | Type | PDV | PNRSV |
|---|---|---|---|
| **1** | Peach | 0* | 1* |
| **2** | Peach | 3 | 0 |
| **3** | Peach | 0 | 0 |
| **4** | Peach | 0 | 0 |
| **5** | Tart cherry | 1 | 4 |
| **6** | Tart cherry | 0 | 2 |
| **7** | Tart cherry | 0 | 1 |
| **8** | Tart cherry | 0 | 5 |
| **9** | Tart cherry | 0 | 0 |
| **10** | Tart cherry | 0 | 6 |
| **11** | Tart cherry | 2 | 3 |
| **12** | Sweet cherry | 4 | 1 |
| **13** | Plum | 0 | 0 |
| **14** | Plum | 0 | 0 |
| **15** | Plum | 0 | 0 |
| **16** | Plum | 0 | 0 |
| *Total positive for all 160 trees* | | 10 | 23 |

**trees positive per 10 trees sampled*

# Michigan Tomato ring spot virus survey in early 1990s

"Our survey of 21 plum orchards in Michigan showed that all 21 plum orchards had trees infected with tomato ring spot virus."

"The percent of infected trees ranged from 4 to 82%.

*In: "Research on stone fruit at Michigan State University" "Stone Fruit Tree Decline, Sixth Workshop Proceedings, April 1994.*

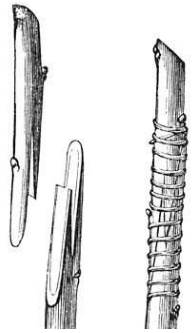
Test of dandelions in stone fruit orchards for tomato ring spot virus in Berrien County, MI, September 30, 2010.

| Orchard | Type | Positive samples | # sampled |
|---|---|---|---|
| **1** | Peach | 5 | 5 |
| **2** | Peach | 3 | 5 |
| **3** | Tart cherry | 1 | 5 |
| **4** | Tart cherry | 2 | 5 |
| **5** | Tart cherry | 0 | 5 |
| **6** | Plum | 1 | 2 |
| **7** | Plum | 2 | 2 |
| | **Total** | 14 | 29 |

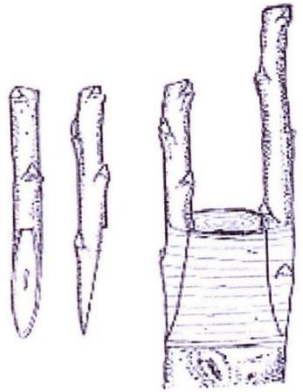
**A sample consisted of 5 leaves, each leaf from a different dandelion plant, each dandelion from a different tree**

*Each five leaf sample was processed and tested using Elisa tests provided by AgDia Corporation of Elkart, IN, with the help of students in the laboratory of Dr. Gretchen Anderson, Indiana University South Bend.*

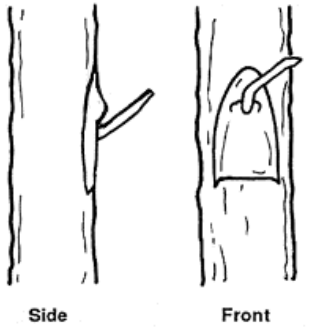
Whip and tongue / Bench graft



Bark / Top graft



Chip budding



# Bench grafting in winter

Liners (Rootstock)

Scion wood of same size

Buddy Tape

Doc Farwells

Knife (Whip graft) or machine

Callusing room

Cold storage

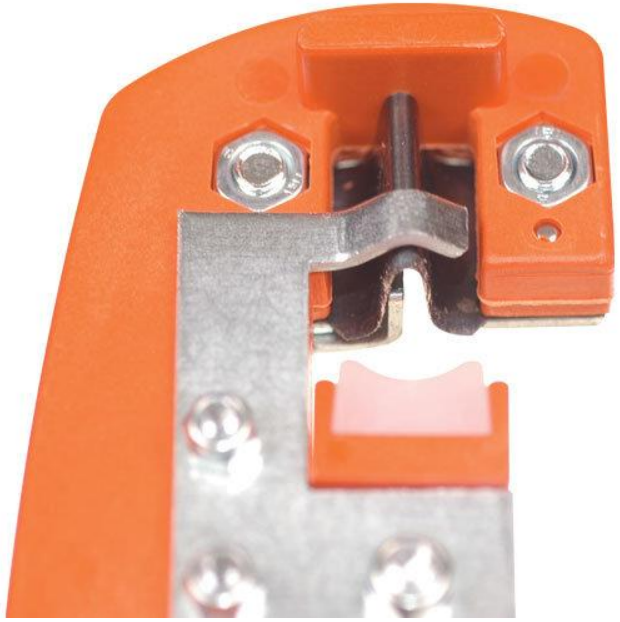
# Budwood for bench grafting or spring budding in the field

For bench grafting, collect dormant  wood must be collected in January or February and stored in an ethylene free storage.

Examine wood for quality, checking buds and the cambium tissue under the bark for winter damage

# Saddle Graft

Scion wood (darker) grafted on rootstock (greener)



Bundles of bench grafted trees – photo credit Jon Clements

The scion and rootstock are joined and tied with a budding rubber or grafting tape and coated with a low temperature wax to seal.

Bench grafted trees should be bundled and stored in moist sawdust and covered with plastic to create a greenhouse type environment. The tree is callused at about 50 degrees for about 4-5 weeks for good callusing, and then stored in a cold room before planting.

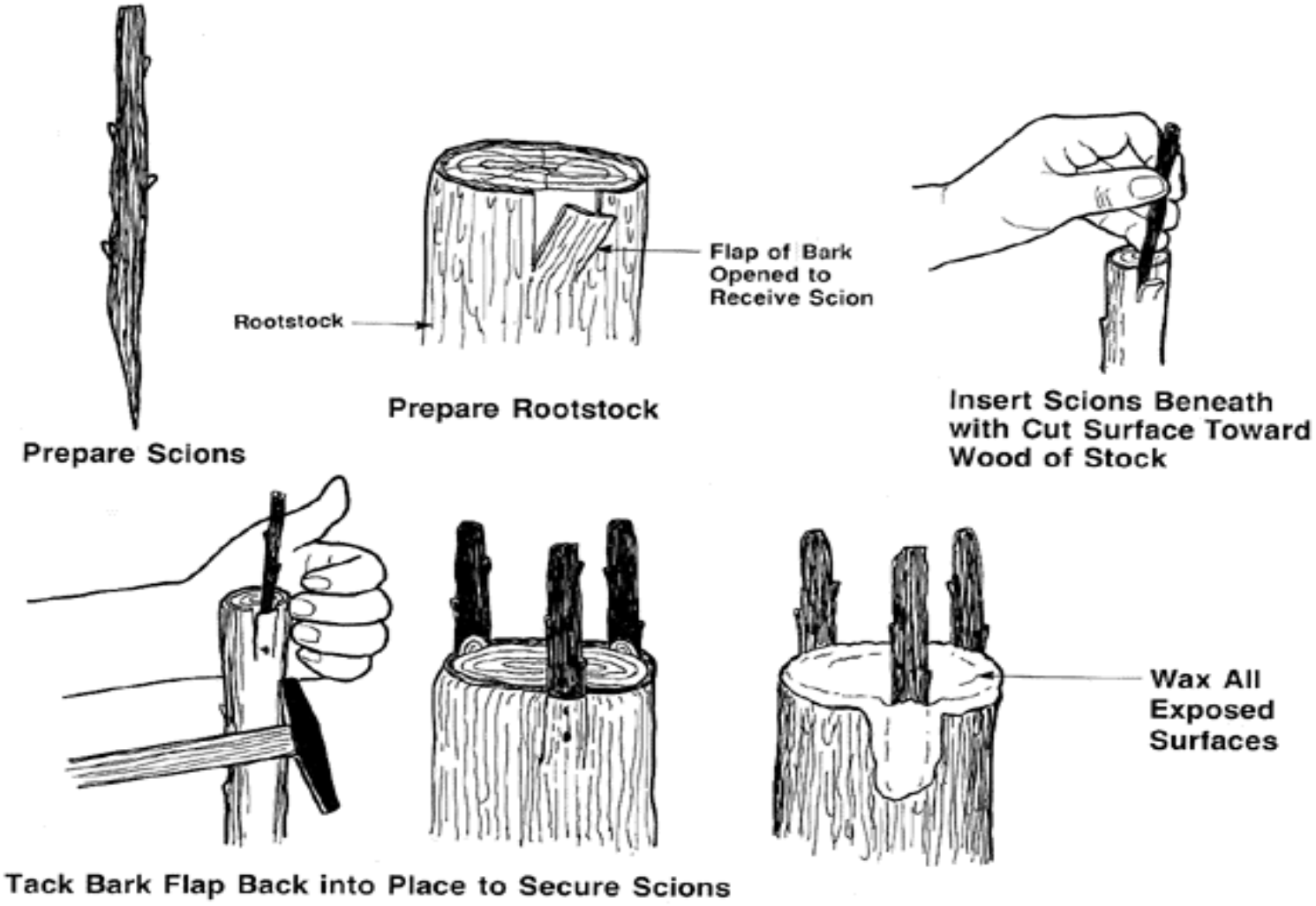
Planting grafted pieces

Grafted trees are carefully planted in nursery when conditions permit planting.

A single bud from the scion is permitted to grow.


Photo credit Win Cowgill

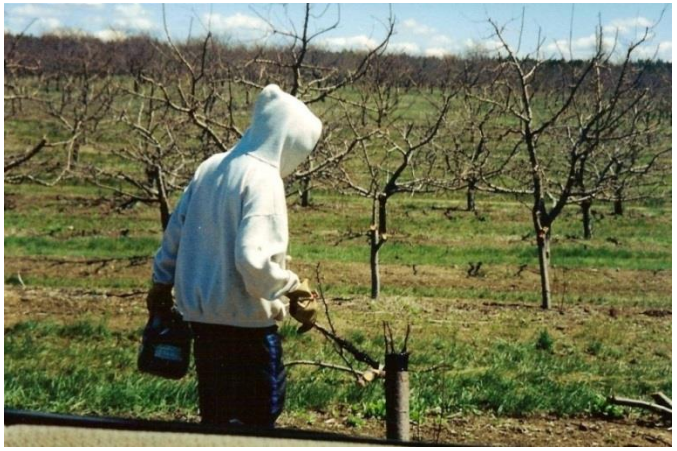
# Topworking - Bark Grafting



# Inserting the scion

# Taping

# Waxing




TREEKOTE
TREE WOUND DRESSING
PRUNING AND GRAFTING COMPOUND
ONE U.S. GALLON (3.79 L)
NET WT. 128 OZ. (8 POUNDS) AVDP.

# Scions

- Scions are grafted into the tree.

# Topworking

Scion attached

Rootstock or tree

# Topworking Peach Trees

# Sources of rootstock

Growing from seed

Rootstock liners

Look for CVI = certified virus indexed material

Lawyers Nursery

Rootstock should be stored at about 34 degrees F in moist rotted sawdust or peat moss until needed.

You may be able to use material from the shipping box to store rootstock.

Rootstock liners

## Peach Seed Cleaning and Storage

Pick fruit when mature but before soft rot problems start

Remove pit from fruit. May need to use knife to remove flesh clinging.

Tumble pits in cement mixer with coarse gravel for ~15 minutes to remove flesh

Soak pit for 5 minutes in general fungicide such as captan or thiram (1 teaspoon per 2 quart water)

Put seed on newspaper 1-3 days to dry. If humid, may need help from fan.

Store in mesh bag in refrigerator (34 to 44 F).

# Peach Seed Stratifying

If desired, with large pit such as peach, remove hull with clippers.

Put seed/pit into mesh bag.  Immerse seeds in 10% solution of Chlorox for 5 minutes with occasional agitation

Rinse immediately under running tapwater for 5 minutes, turning bag occasionally.

Soak seed in thiram (or captan) suspension (1 teaspoon per 2 quart water) overnight

Put seed on surface of slightly moistened perlite in tray with loose fitted lid.

Put in in refrigerator (34 to 44 F) for approximately 2 months until root starts to emerge.  Transfer germinated seed to container with potting soil to grow seedling under lights.

# Establish rootstock “liners” in spring for budding in August

Rootstock liners

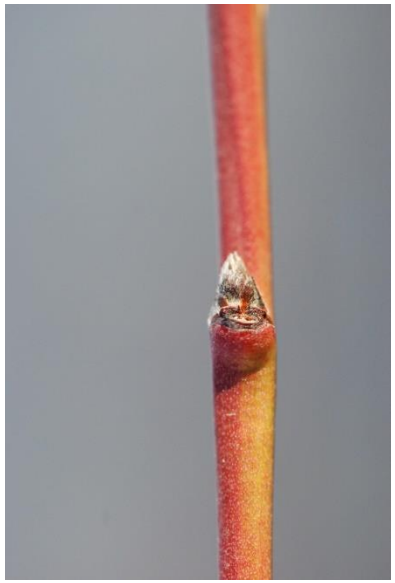
# Mulching for weed management of propagation nursery

- Landscape cloth provides good weed management and helps keep herbicides off the trunks
- Weathered hardwood chips in a 2 foot band will also suppress weeds and reduce need for herbicides but may tie up nitrogen.
- Can use backpack sprayer with glyphosate and keep it off the trunks. This is easy to do because of the mulch

# Budwood selection

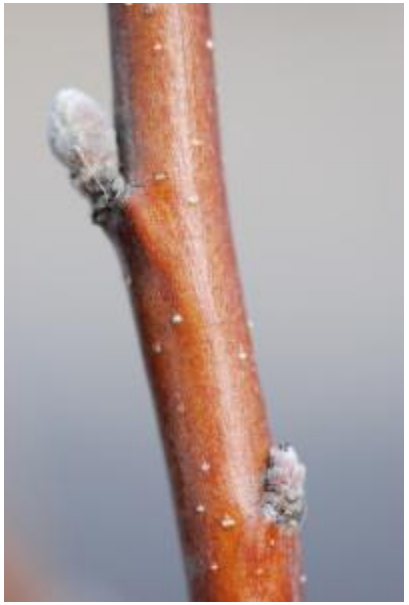
Select from current years growth if late summer budding, or last years if spring budding. Look for upright growth about pencil diameter. Cut off immature buds at tip. Cut off leaves but leave short stub. Wrap in plastic and refrigerate. Best to use wood promptly.

Select branches that have mainly vegetative buds, not fruit buds or spurs.



Single vegetable bud looks pointed

Two flower buds with single vegetable bud



Flower bud on short spur (left) and vegetative bud (right)

Select branches that have mainly vegetative buds, not fruit buds or spurs.

Ethylene damaged peach (left) and apple (right) fruit buds

After collecting wood, bundle, wrap in wet newspaper or burlap, and store in a plastic bag.

Put collected wood in a cooler to keep cold during the collection phase and transfer to an ethylene free refrigerator or cold storage.

# Apple rootstock options

| Rootstock | Vigor relative to seedling | Winter hardiness | Fire blight / Collar rot resistance | Replant disorder resistance | Precocity / Productivity / Fruit size | Other negatives |
|---|---|---|---|---|---|---|
| Bud 9 – see note | 25% | 5 | 3 / 5 | 2 | 5 / 5 / 5 | Wooly aphid |
| Weak M.9 clones: Flueren 56 and T337 | 28% | 4 | 1 / 5 | 3 | 4 / 4 / 5 | Wooly aphid, burrknots |
| G41 * | 30% | 4 | 5 / 5 | 5 | 5 / 5 / 5 | Shy rooting, somewhat brittle |
| Strong M.9 clones: Nic29 and Pajam2 | 32% | 4 | 1 / 5 | 3 | 4 / 4 / 5 | Wooly aphid, burrknots |
| G16 * | 32% | 4? | 5 / 4 | 3? | 4 / 4 / ? | Wooly aphid, latent virus susceptible. |
| G11 * | 40% | ? | 3 / 3 | 3 | 3 / 4 / 5 | Moderate wooly aphid |
| G.202 | 45% | 4? | 5 / 5 | 4 | 4 / 4 / 4? | |
| M.26 | 45% | 5 | 1 / 2 | 2 | 3 / 4 / 5 | Wooly aphid, burrknots |
| G.935 * | 50% | 5 | 5 / 5 | 4 | 5 / 5 / 5 | Wooly aphid |
| G.30 * | 50% | 5 | 5 / 4 | 4 | 4 / 5 / 5 | Brittle graft union |
| CG.210 ** | 65% | 4? | 5 / 5 | 5 | | |
| M.7 | 60% | 3 | 3 / 3 | 3 | 2 / 3 / 3 | Suckers, some burrknots |
| MM.106 EMLA | 70% | 4 | 4 / 2 | 3 | 3 / 4 / ? | Burrknots, very susc to TomRSV |
| MM.111 | 75% | 3 | 4 / 3 | | 3 / 3 / ? | Burrknots, mod susceptible to TomRSV |
| Bud118 | 95% | 5 | 3 / 3 | 4? | 3 / 3 / 4 | |

*Need support*

*Free standing*

1 = very poor to 5 = excellent, * limited availability, ** very limited availability.
This is the vigor for the American Bud 9 clone available from U.S. Nurseries. A European clone of Bud 9 has shown more vigor.
TomRSV = tomato ring spot virus, a nematode vectored virus more common in sandy sites
Rootstocks M.7, MM106, MM111 & Bud118 are free standing trees. The rest are lower vigor

# Pear rootstocks

Bartlett seedling – susceptible to fire blight, well anchored, well-adapted to various soils and climates, vigorous rootstock somewhat slower to bear.

Old Home X Farmingdale clones – all highly resistant to fire blight, good winter hardiness

OHxF 87 – more precocious than Bartlett seedling, some dwarfing

OHxF 97 – more precocious than Bartlett, generally same size as Bartlett seedling

Quince – of several types of quince, Quince A is the hardiest but still less than Bartlett & OHxF rootstocks. Quince rootstock provides dwarfing. Not graft compatible with Bosc, Clapp's, Seckel, or standard Bartlett, but compatible with Swiss Bartlett.

Pyrodwarf -- Produces a tree somewhat larger than Quince A, and perhaps 60% of Bartlett seedling tree, precocious, no graft incompatibility problems, more resistant than Bartlett to fire blight but still susceptible.

Pyro 2-33 -- Produces a tree of same size as on Bartlett seedling, precocious, no graft incompatibility problems, more resistant than Bartlett to fire blight but still susceptible.

# Peach rootstocks

Best for Michigan
Bailey, Lovell, Tennessee Natural

Not as desirable
Halford, Guardian

Not recommended
Nemaguard, Krymsk 1

# Plum Rootstock Options

Myrobolan – compatible with most European and Japanese varieties. Stanley infected with tomato ring spot virus becomes incompatible with myrobolan.

Mariana – more vigorous than myrobolan—more suited to Japanese plums. Some strains have rootsuckers. May be slightly less hardy than myrobolan. Has less problems with tomato ring spot virus than myrobolan.

- GF 8-1
- 29C
- 2624
- M40 has less rootsuckers than 2624

St. Julien GF 655-2. -- Dwarfing

Torinel – Compatible with European plum, dwarfing, better for heavier soils

# Apricots

The best rootstock is Manchurian apricot.

Apricot grow rapidly on peach rootstocks but do not generally live as long.

A new Russian rootstock Myrocot is under evaluation.

# Rootstocks for Sweet Cherries

Mazzard - more tolerant than Mahaleb to wet site, can harbor X-disease

Mahaleb - slower to yield than Mazzard

MxM series (Mazzard x Mahaleb)
- Maxma 14 more productive than Mazzard
- M X M 60 is similar to Mazzard in size but more productive

Gisela series
- # 5 results in tree 50% of a Mazzard
- #12 is 60% of Mazzard
- # 6 is 70% of a Mazzard tree

# Budding in the field

Rootstocks should still be growing at the time the budding is done and for the month following budding.

Need to watch watering, nitrogen fertilizing, and insect problems such as mites, aphids, and leaf chewing worms and beetles.

If possible block the prevailing wind and watch out for excess wind speed from sprayers

# Additional tips for a good budding nursery

Rootstocks should still be growing at the time the budding is done and for the month following budding.

To keep the trees going watch watering, nitrogen fertilizing, and insect problems such as mites, aphids, and leaf chewing worms and beetles.

Typically, trees need about 1 acre inch of water per week in the hot part of the summer (June, July, and August) provided by a combination of rainfall and irrigation.  Taper off irrigation starting about 1 month after budding.

Block the prevailing wind (snow fencing, ryegrass strips, and watch out for excess wind speed from sprayers

Table 1. Typical fertilization program for on-farm nursery trees the first year.

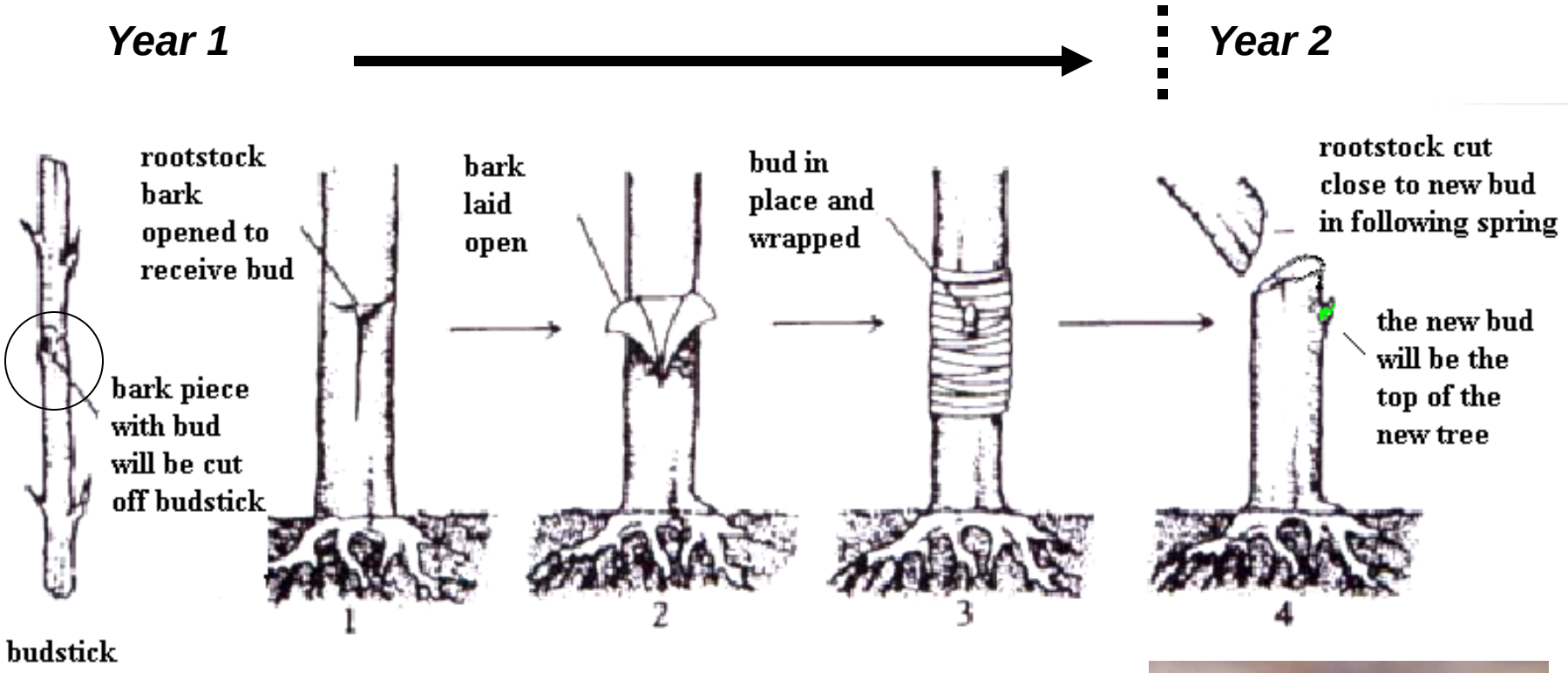
Ground application
• Use 80 to 120 lbs of nitrogen per acre
• Equally split between 3 to 4 applications at every 3 weeks from shortly after planting early August
• Calcium nitrate is preferred

Fertigation method
• Use 20-10-20 with micronutrients at 150 to 200 ppm nitrogen once per week
• Provide 1/2 to 3/4 gallon solution to each tree from mid June to Aug 1

Foliar application • Use 5 lbs Urea/100 gallon • Apply 2-3 applications at 2-week intervals

Mazzei injector

# Tree Propagation by T-budding



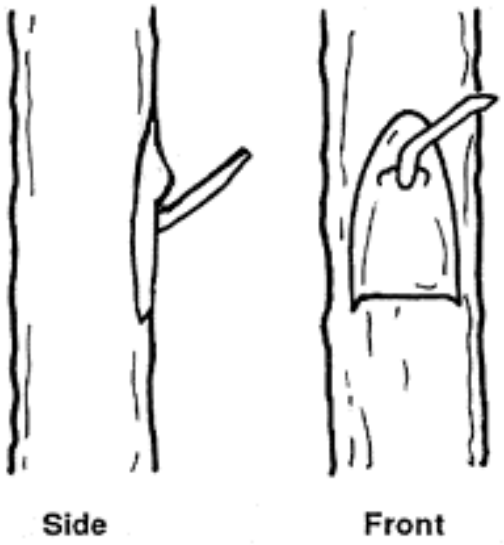

Inserted bud before growth in spring

Inserted bud starts to grow in spring

T bud peach in August

T-budding cherry in June when bark is slipping with current seasons growth budwood.  Photo credit Kim McCann

# Chip Budding



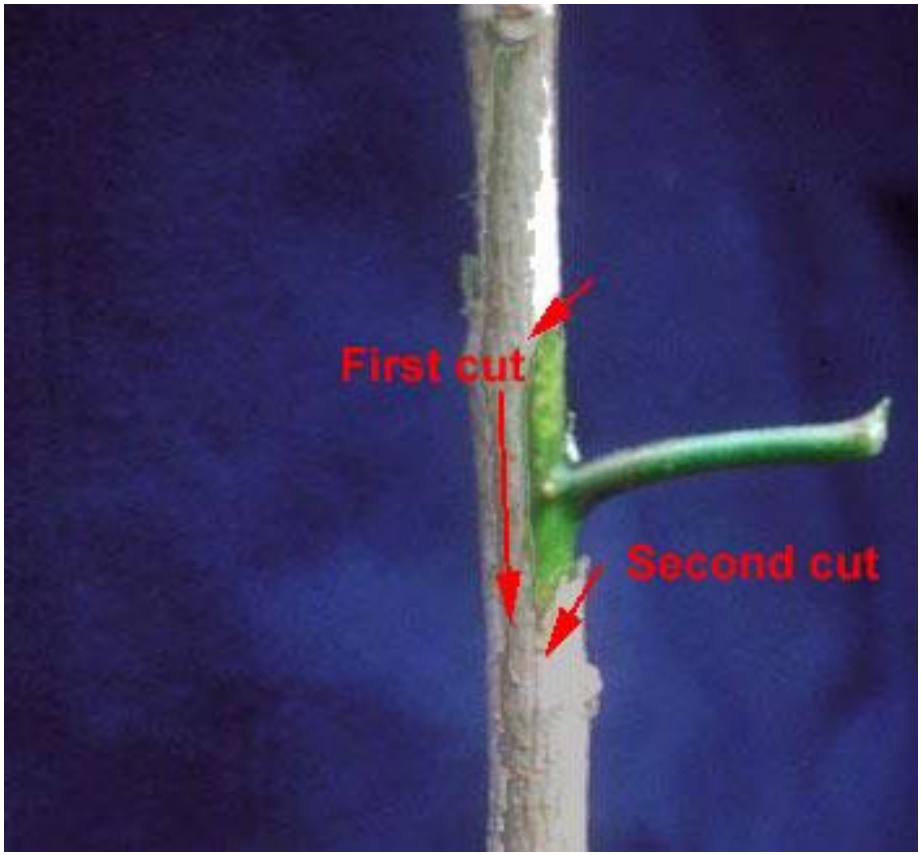

inserted bud

cambium

G 935 rootstock – chip budded.
Photo credit Win Cowgill

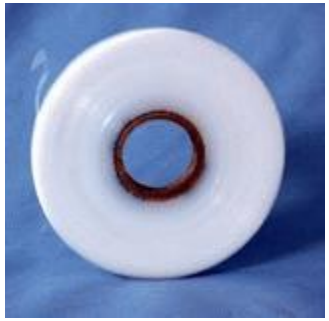
Chip bud

Making cut on rootstock similar to that on budwood stick



Wrapping over the bud or around the bud?

# Wrapping bud



Budded rootstock

Cut off rootstock above budding point in spring


Sleeping eye trees that have budded out – photo credit Jon Clements

As tree grows, removing unwanted sprouts

May need to support tree with bamboo to protect from wind, birds, and to get upright growth. Birds land on the pole rather than the upright sprouts

Cheaper to put ½” conduit cut in 5 ft lengths every 20 ft and anchored by larger posts at the row ends.

As the trees grow, put two strands of twine on either side of the stakes to sandwich the growing trees.  Add more twine as needed.

# Management of Propagation Nursery

- Put the nursery site where you will see it every day.
- Treat the nursery like a garden of annual plants, requiring weekly care, perhaps daily watering during hot spells.

# Weed Management of Propagation Nursery

- Landscape cloth provides good weed management.
- Weathered wood chips will suppress weeds but may tie up nitrogen

# Herbicides for weed management of propagation nursery

Relatively safe soil-active herbicide combination is:

| | |
|---|---|
| Trellis SL | 20 fl oz/treated acre |
| Prowl H20 | 3 qt/treated acre (or Surflan) |

Needs to be rained, sprinkled, or lightly fan raked in within a week to be activated.

Reapplication will be needed approximately 90 days later.

# Rodent management

Stakes mark where tunnels of ground squirrel were found

13 lined ground squirrel

Hibernates October to March

Mouse bait is the only control method that seems to work

# Deer management

Rabbit damage – use 3 foot metal chicken wire fence

Less effective, paint the trunks with a mixture of white latex paint and Thiram.

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