



Keys to Successful Tree Planting

Tom Ward, Forester

ENTSC

Greensboro, NC

Tree/Shrub Planting for: Reforestation, Windbreaks and Wildlife

CONSERVATION DESIGN SHEET - Forestry Series

612A



Natural Resources Conservation Service

Michigan



Proper site and seedling selection along with good weed control and planting technique make for successful reforestation. Containerized seedlings (as shown above) offer several advantages over bare-root stock.

Species and Soil-site Selection

Trees and shrubs grow best on sites with soils and climate similar to those in which they have become naturally adapted. Review county soil survey maps to determine soil type(s) in area to be planted. Consult section II of Michigan

NRCS Field Office Technical Guide to determine suitability and potential productivity for various species on soil groupings for Forestry, Wildlife and Windbreak purposes.

Tree/Shrub Planting Plan

Land User _____ Date _____

Address _____ Phone # _____

County _____ Purpose(s) of Planting _____

Date of Planting _____ Soil Type _____ (windbreak, wildlife, or forest suitability) Group _____

Planting Method _____ Site Preparation _____

Map Scale: _____ Location: Twp. _____ Range _____ Sec. _____

N



Map Scale: _____



Sketch of Planting Layout

Row	Species	Spacing in Rows	Spacing Between Rows	Row Length	Acres of Planting	Number of Trees Needed

Maintenance _____

Landowner Signature _____ Field Representative Signature _____

Date _____ Date _____

Conservation Job Sheet



Tree/Shrub Establishment Direct Seeding (DS)

Illinois Job Sheet - 612DS **April 2003**



Broadcast seeding with a fertilizer buggy.

Photo courtesy of Bruce Stickers, Champaign County Soil & Water Conservation District



Row Seeding.

Collecting and Caring for Seed
Scout potential collecting sites during mid to late summer to determine the potential seed crop by species. Best collecting sites are areas of mowed grass where mechanical seed harvesters can be used. Make plans for collecting, bagging, floating, sorting and storing seed before seed fall begins (usually in September and early October). All seed should be inspected by performing a cut test or crack test. Collected seed can be inspected during the sorting process; purchased seed should be inspected at the time of delivery. Look for filled, moist, light-colored seed. Acorns should be soaked for 4 to 24 hours to rehydrate the seed immediately after collecting or delivery of purchased seed. Short-term storage can be in any cool, shaded, well ventilated site protected from seed predators. If planting will be delayed for more than 2 weeks, place seed in sealed plastic bags in refrigerated storage at about 40 degrees F. For more information by species see Illinois Direct Seeding Handbook, Chapters 3 and 5.

Site Preparation
Elimination of perennial vegetation (especially sod forming grasses) is critical to seeding establishment. Reed canarygrass, brome, fescue, orchard grass and all warm season grasses must be killed and/or destroyed by tillage. If broadcast seeding the entire site must be treated; if row seeding at least a 2-foot radius circle or 4-foot wide band must be treated, with the planted seed centered in the grass-free area. Depending on the site, it may be necessary to start early in the growing season prior to planned fall planting by spraying regularly with recommended herbicides. Contact your IDNR District Forester or Cooperative Extension Service (CES) representative or see References for specific herbicide recommendations. Use supporting practices, if necessary, to control erosion and/or runoff. For more detailed information refer to the Illinois Direct Seeding Handbook, Chapter 8.

Species	Desired seed/acre	Seed/# ¹	#/acre
1			
2			
3			
4			
5			
6			
7			
8			
TOTALS			

¹ See Illinois Direct Seeding Handbook Chapter 10, page A-7 for Seed per pound table by species.

Storage requirements, if necessary: _____

Planting dates: _____ Site Preparation _____

How will potential seed predation and/or wildlife damage be addressed? (see Illinois Direct Seeding Handbook, Chapter 8, pg. 8-8)

Post-Planting Weed Control

Year 1:

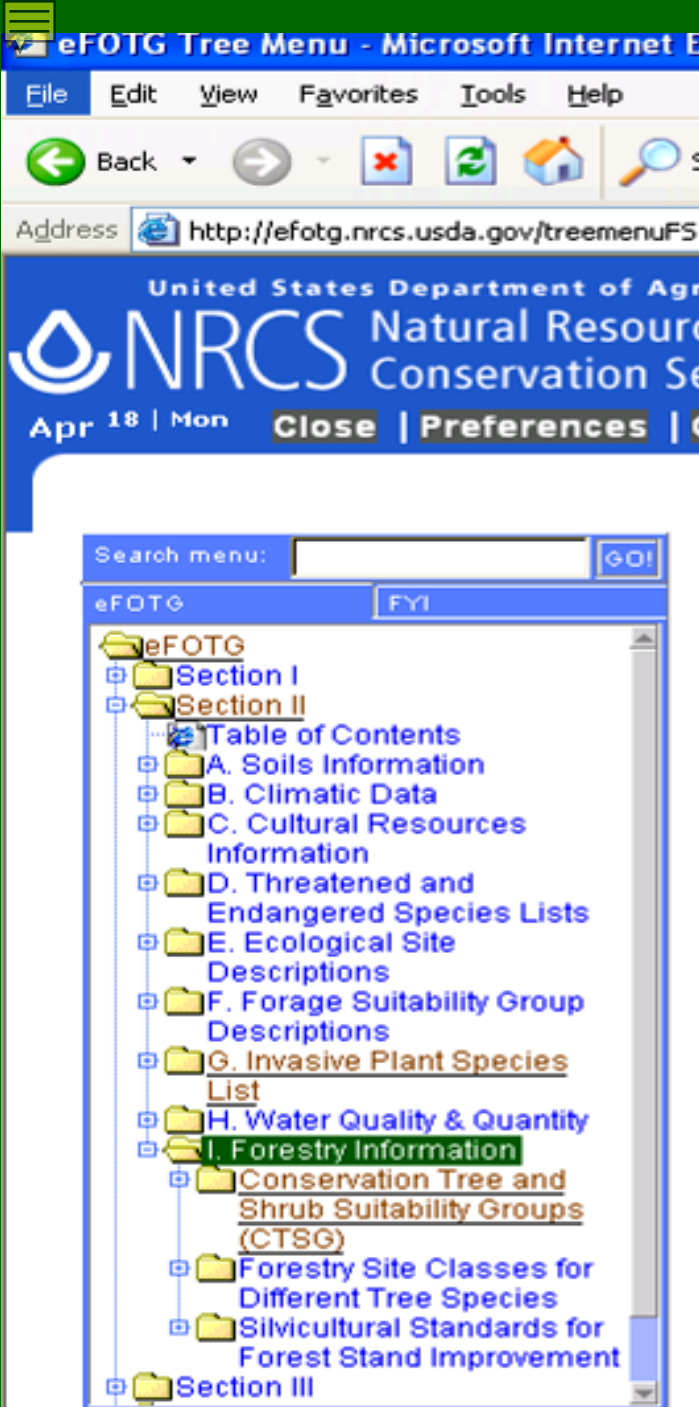
Year 2

Year 3

Post-Plant Seedling Survival (stems/ac. And % of stems planted)

Year 1:	Year 2	Year 3
----------------	---------------	---------------

Method of estimating seedling survival:



Match tree species to soils

CONSERVATION
TREE/SHRUB
SUITABILITY GROUPS,

or similar species selection table,
usually in FOTG, Section II.

Also see Tree/Shrub
Establishment (612) standard

Conservation Tree/Shrub Suitability Groups

	A	B	C	D	E	F	G	H	I
1	Soil Name	CTSG Group							
2	ABBAYE	6							
3	ABSCOTA	7W							
4	ADAMS	7							
5	ADRIAN	2H							
6	ALCONA	5S							
7	ALGANSEE	1							
8	ALGONQUIN	1							
9	ALLENDALE	1							
10	ALLOUEZ	10GA							
11	ALPENA	10S							
12	ALSTAD	1							
13	ALTMAR	1							
14	ALVIN	5							
15	AMADON	10D							
16	AMASA	5GS							
17	AMNICON	4							
18	ANGELICA	2							
19	ANNALAKE	5							
20	ANNINIAS	1							
21	ARCADIAN	10D							
22	ARKONA	1							
23	ARKPORT	5							
24	ARNHEIM	2							
25	ASHKUM	2C							
26	ASSININS	1D							
27	AUBARQUE	1K							
28	AUBBEENAUBBEE	1							

Group 1

Soils in CTSG-1 are somewhat poorly drained to moderately well drained, moderately deep to deep, and have a low to high available water capacity. The depth to a water table during the growing season is between 0.5 feet and 1.5 feet. Some soils have a restrictive layer at 20 inches to greater than 40 inches in depth, such as a fragipan or bedrock. Some soils are subject to frequent or occasionally flooding for brief to less than brief durations.

Group 2

Soils in CTSG-2 are somewhat or very poorly drained, moderately deep to deep, and have low to high available water capacities. The depth to a water table during the growing season is between 0.0 and greater than 0.5 feet from the surface. Some soils have a restrictive layer at 20 inches to greater than 40 inches in depth. Some soils may have fragipan, ortstein, or bedrock at 20 inches to 40 inches below the surface. Some of these soils may be subject to frequent or occasional flooding for long to less than long durations. This group also includes those soils that are somewhat poorly drained to well drained with long durations of flooding.

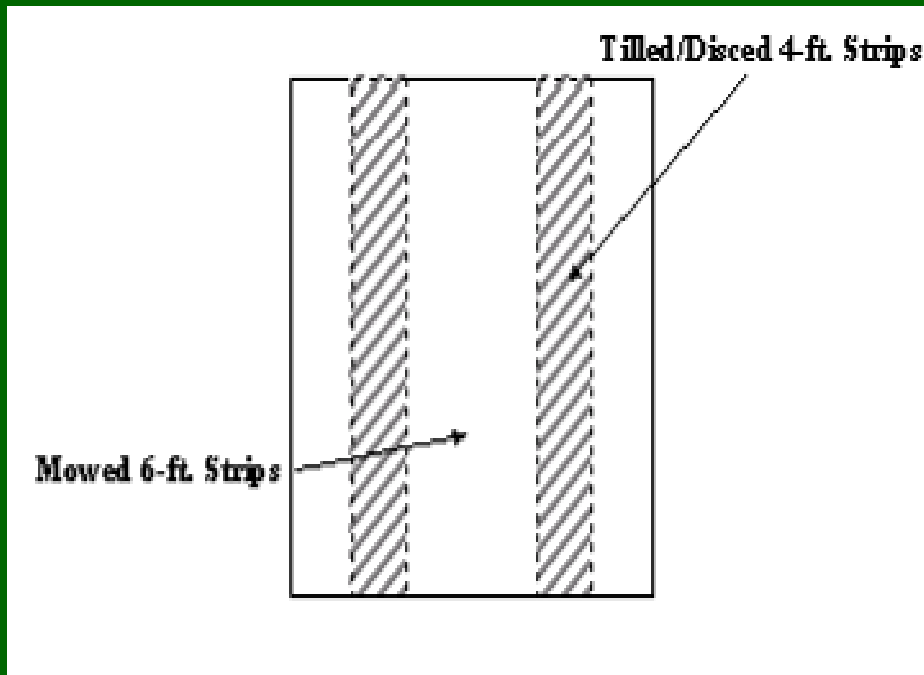
Group 3

Soils in CTSG-3 are deep loamy, moderately well drained soils with a high available water capacity. The depth to a water table during the growing season is greater than 1.5 feet. Some soils in


Conservation Tree/Shrub Suitability Groups

1	Symbol	Form	20 yr Height (ft) Range*	Scientific Name	Common Name	Region*	Conservation Tree/Shrub Soil Group**															
2	ALINR	SH	9/16	<i>Alnus rugosa</i>	speckled alder	ALL	1	2A	3A	4A	5A											10
3	ARME	SH	3/8	<i>Aronia melanocarpa</i>	black chokeberry	ALL	1	2A														10
4	ARAR	SH	3/8	<i>Aronia arbutifolia</i>	red chokeberry	ALL	1	2A	3A	4A	5A											10
5	ASTR	SH	9/16	<i>Asimina triloba</i>	pawpaw	SLP	1			3	4	5										
6	BPU4	SH	3/8	<i>Betula pumila</i>	dwarf or bog birch	ALL	1	2														10
7	CETE	SH	9/16	<i>Celtis tenuifolia</i>	dwarf hackberry	SLP	1		3K	4K	5K	6K	7									10
8	CEOC2	SH	3/8	<i>Cephalanthus occidentalis</i>	buttonbush	LP	1	2														10
9	CHCA2	SH	1/3	<i>Chamaedaphne calyculata</i>	leatherleaf	ALL	1	2														10
10	COPE80	SH	1/3	<i>Comptonia peregrina</i>	sweet-fern	UP,NLP	1					6SG	6A	7								10
11	CODR	SH	9/16	<i>Cornus drummondii</i>	roughleaf dogwood	SLP	1		3	4	5	6	7									
12	COAM2	SH	3/8	<i>Cornus amomum</i>	silky dogwood	ALL	1	2	3	4	5											
13	COFO	SH	3/8	<i>Cornus taemina</i>	gray dogwood	ALL	1		3	4	5	6	7									
14	COSE16	SH	3/8	<i>Cornus stolonifera</i>	red-osier dogwood	ALL	1	2	3	4												
15	COAM3	SH	9/16	<i>Corylus americana</i>	American hazelnut	LP	1		3	4	5G	6GS	7									
16	COCOC2	SH	9/16	<i>Corylus cornuta</i>	beaked hazelnut	UP,NLP	1		3	4	5G	6GS	7									10
17	CRPH	SH	9/16	<i>Crataegus phaenopyrum</i>	Washington hawthorn	All	1		3	4	5G	6GS	7									
18	CRATA	SH	9/16	<i>Crataegus spp.</i>	common hawthorn	ALL	1		3	4	5G	6GS	7									10
19	DIPA	SH	3/8	<i>Dirca palustris</i>	leatherwood	ALL	1		3	4	5	6	7									
20	ELUM	SH~	9/16	<i>Eleagnus umbellata</i>	autumn olive	ALL	1		3	4	5	6	7									
21	HAVI4	SH	3/8	<i>Hamamelis virginiana</i>	American witchhazel	ALL	1			4	5	6	7									
22	ILVE	SH	9/16	<i>Ilex verticillata</i>	winterberry/Michigan Holly	ALL	1	2														
23	JUCO6	SH	3/8	<i>Juniperus communis</i>	ground juniper	ALL	1			4D	5G	6GS	7									
24	JUHO2	SH	1/3	<i>Juniperus horizontalis</i>	creeping juniper	NLP, UP	1			4D	5G	6GS	7									
25	LIBE3	SH	9/16	<i>Lindera benzoin</i>	spicebush	LP	1	2H	3	4												
26	LOCA7	SH	3/8	<i>Lonicera canadensis</i>	fly honeysuckle	ALL	1	2	3	4	5	6	7									
27	MYGA	SH	3/8	<i>Myrica gale</i>	sweet gale	UP, NLP	1	2AK														10AK
28	PAQU2	VI	9/16	<i>Parthenocissus quinquefolia</i>	Virginia creeper	LP	1	2	3	4	5	6	7									
29	PHOP	SH	3/8	<i>Physocarpus opulifolius</i>	ninebark	ALL	1		3K	4K	5K	6K										
30	PRPU3	SH	1,	<i>Prunus pumila</i>	sand cherry	ALL	1				5S	6GS	7									10S

Site Preparation



- Till and/or spray a minimum 2-foot radius circle or 4-foot wide band with trees or seed centered in the grass free area.
- Grass species, esp. sod-forming, are death to trees.



Determine the most appropriate planting stock

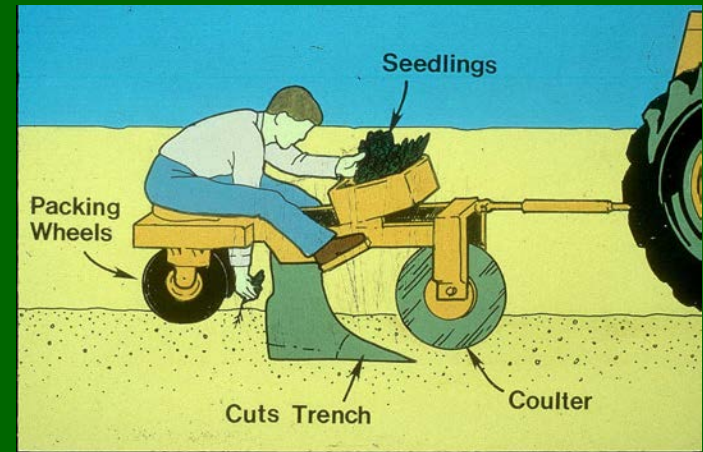
- Bare root seedlings are plentiful, cheap and proven, but...
- For fall planting: seed (hardwoods) or containers (esp. on heavy soil)
- For potential deep water (floodplains): seed or large containers (1-3 gal.)
- For quick results (windbreaks, high visibility sites, etc.): large containers, cuttings

Types of planting stock



Match planting equipment to planting stock

- Will the seedling root mass fit the planting machine shoe or depth limit?
- How deep will the tree planter or seed planter go? Is it deep enough? Too deep (seed planting)?



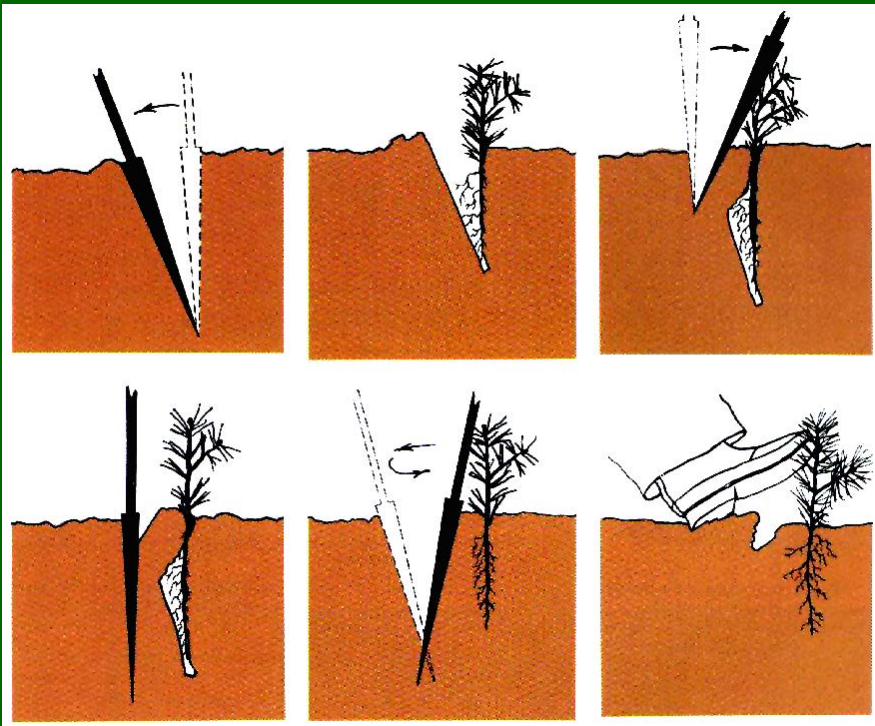
Match planting equipment to planting stock

- Pines: Do not root prune
- Hardwoods: Determine the depth of planting equipment & root prune only if necessary. Prune taproot only, not laterals.
- Plant as deep as root collar, or slightly deeper

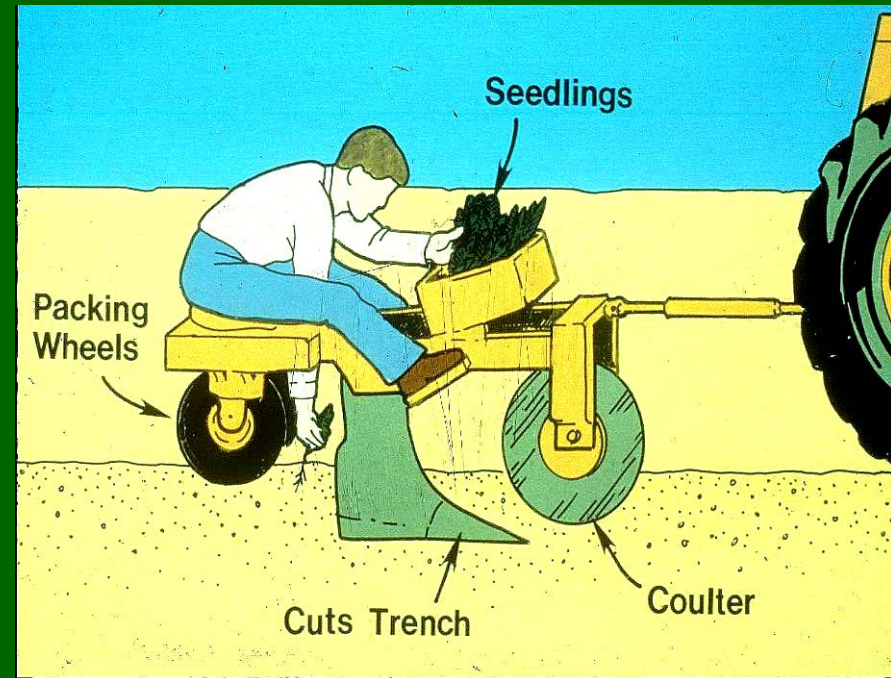


Planting Methods: Bare Root & Plugs

Hand Planting



Machine Planting



Planting Methods: Hardwood Direct Seeding

Row Seeding



Broadcast Seeding



Planting Methods: 1-3 gal. Container

- Shovel planting is an option
- Hole must be at least slightly bigger than container
- If auger planting use at least a 12" bit



Spacing and Arrangement

- Determine between-row spacing based on anticipated maintenance equipment (mower/sprayer width)
- Determine within-row spacing based on desired stocking/ac
- More is better. Numbers that follow are MINIMUMS/acre
- Direct Seeding: row planting, 3,000 hard mast + 4,500 light seeded; broadcast 4,500 hard mast; + 4,500 light seeded
- Bare root, small container, cuttings: 300 (12'x12') to 900 (6'x8') per acre
- Large Container: root pruned, 28 (40' X 40') if light seeded spp. present, otherwise 50 (30' X 30')

Spacing Table

Number of trees per acre at various spacings in feet:

Feet x Feet	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	2723	2178	1815	1556	1361	1210	1089	990	908	838	778	726	681	641	605
5	2178	1742	1452	1245	1089	968	871	792	726	670	622	581	545	512	484
6	1815	1452	1210	1037	908	807	726	660	605	558	519	484	454	427	403
7	1556	1245	1037	889	778	691	622	566	519	479	444	415	389	366	346
8	1361	1089	908	778	681	605	545	495	454	419	389	363	340	320	303
9	1210	968	807	691	605	538	484	440	403	372	346	323	303	285	269
10	1089	871	726	622	545	484	436	396	363	335	311	290	272	256	242
11	990	792	660	566	495	440	396	360	330	305	283	264	248	233	220
12	908	726	605	519	454	403	363	330	303	279	259	242	227	214	202
13	838	670	558	479	419	372	335	305	279	258	239	223	209	197	186
14	778	622	519	444	389	346	311	283	259	239	222	207	194	183	173
15	726	581	484	415	363	323	290	264	242	223	207	194	182	171	161
16	681	545	454	389	340	303	272	248	227	209	194	182	170	160	151
17	641	512	427	366	320	285	256	233	214	197	183	171	160	151	142
18	605	484	403	346	303	269	242	220	202	186	173	161	151	142	134

Use high quality planting stock

- Inspect and cull damaged, diseased, dried up, etc.
- Don't hesitate to question or reject inferior stock
- Bare root seedlings:
Hardwoods: minimum of approximately 3/8" caliper OR 12" top, 8" roots.
Pines: 1/4" caliper, 8-10" top, 6" roots



Use High Quality Seed

- Plant only undamaged, mature, viable seed
- Cut or crack test at least 10 random seeds per bushel
- If non-viable seed is found, increase seeding rate by the same percentage





Container Stock

- “Plug” Containers: minimum 7 cu.in.
- Air root pruned (“RPM”) stock: 1 gallon, 3’ top or 3/8” caliper.



Care of Planting Stock

- Keep out of sun
- Keep moist
- Keep cool, 28 to 40 degrees
- Arrange in advance for refrigeration



Planting Dates

- Plant ASAP after delivery of planting stock. Have equipment, labor, etc. prepared.
- Plant on cool, cloudy, calm days
- Do not plant on hot, windy days
- Direct seeding: Best in fall (Oct-Nov.) but whenever soil has adequate moisture and is not frozen
- Bare root: *South*: Dec.-Feb. *North*: spring, before June 1; fall, after Oct. 1 but not on clay or loam soils if frost heave is possible
- Container: Oct. 1 to June 1, when ground is moist and not frozen

Tips for Successful Planting

- Hire a professional & check their references
- If DIY, get onsite advice from NRCS, CD, or DNR & tree planter training
- Obtain good early weed control, esp. grasses
- Plant only when top 10" has good soil moisture
- Plant ASAP after delivery, keep cool & moist
- Secure cold storage BEFORE delivery
- Don't wash the roots of bare root seedlings

Regeneration Survey

- 1/100 acre plot = 11 foot 9 inch circle
- Seedling count x 100 = seedlings per acre
- Randomly locate one plot per acre; maximum 10 plots
- Select a transect route across soils polygons



Plantation Maintenance

- Maintain weed free area for 2-3 years
- Replant if survival drops below 70% after 1 growing season, counting desirable natural regeneration.





Plantation Maintenance

- Weed control, especially sod-forming grasses, is critical.
- What is the age difference between these 2 rows of black walnut?



Plantation Protection

- Protect from grazing/browsing, fire, etc.
- Mow for rabbits, don't mow for deer, consider tree shelters if both deer and rabbits are abundant.



Bud caps to protect pines



Mowing can limit the development of valuable natural regeneration...



14 yr old MN oak savanna plantation



Direct seeding results

5 year old SWO



6 year old Black Walnut



For more information, contact:

Tom Ward, Forester

**USDA – NRCS, ENTSC
2901 E. Lee St., Suite 2100
Greensboro, NC 27401**

Telephone: 336-370-3351

Email: Thomas.Ward@gnb.usda.gov