Michigan Technical Note

USDA-Natural Resources Conservation Service

TOPIC: Plant Materials #2

Subject: Direct-Seeding Tree and Shrub Establishment

Date: September, 2008

Background: Direct seeding offers an alternative to establishing new or re-stocking existing stands of hardwood species in Michigan. Direct seeding is alternative to planting hardwood tree seedlings and has proven successful in Illinois, Indiana, Missouri, Ohio, and Wisconsin. However, little information or published research was available on establishing or enhancing hardwood stands by direct seeding in Michigan. Direct seeding of hardwoods is currently a cost-shared component of USDA conservation programs in some states.

Description of Study: A selection of hardwood tree and shrub species were planted in plots by direct seeding in 2003 and 2004. The plots were evaluated for emergence, survival, and plant growth characteristics through 2008.

Procedure: Seeds of heavy-mast and light-mast hardwood tree and shrub species were planted in field studies at the Rose Lake Plant Materials Center. (Species are listed in Tables 1A & 1B.) Planting dates were spring 2003, fall 2003, and spring 2004. Soil was Boyer sandy loam or loamy sand. Treatments were:

1) broadcast on tilled soil, followed by dragging and cultipacking;
2) drill in rows (rows 1.5 ft apart, seeds 8-in spacing within rows) in tilled soil, followed by cultipacking; and
3) drill in rows (rows 1.5 ft apart, seeds 8-in spacing within rows) in non-tilled soil, preceded by glyphosate application and followed by cultipacking.

A rodent control product was placed in several locations. No fertilizer or irrigation was applied. Stands were evaluated in 2003, 2004, 2005, and 2008. Plants were counted in rows in the drilled plots and by a transect method in the broadcast plots.

Field plots were established as two separate experiments using randomized complete block designs, each with three replicates. Statistical analyses were performed on the data.

Results and Discussion

Experiment 1

Sharp differences were observed between emergence of heavy-mast and light-mast species. Therefore, separate statistical analyses were performed on the heavy-mast and light-mast components of Experiment 1.

Heavy-Mast Species: Significant stand differences were observed among the heavy-mast species and in their response to tillage and timing and method of seeding in 2005 (Table 2A) and again in 2008 (Table 2B). Stands of fall-drilled seedlings generally exceeded the grand mean in 2005 and 2008. Stands of spring-drilled and spring-broadcast seedlings were generally less than the grand mean in 2005 and 2008.

Black cherry emergence was ≤ 1% in 2005 in all treatments and no remaining black cherry was observed in 2008.

No remaining broadcast-established seedlings were observed in 2008. Therefore, broadcast-established treatment combinations were excluded from the analysis of 2008 data.

Height differences were observed (Table 2C).

Light-Mast Species: Light-mast emergence averaged 0.2% in 2005 (Table 3). Only 3 of the 7 planted species were observed in the stand count and no broadcast-planted trees were observed. No remaining trees were observed in 2008.

Experiment 2

Results shown in Table 4A corroborated above findings: fall drilling of larger, heavy-mast species fare better than spring plantings. Smaller, light-mast species did not establish during the course of the experiment. Height differences were observed with fall-seeded treatments being taller than spring-seeded (Table 4B).

Discussion: Droughty soil and growing season conditions (summer of 2003) may have reduced the emergence of seedlings which were planted at a shallow, but appropriate depth. Fall planting dates gave seeds the advantage of the earliest possible start to the growing season and an opportunity to extend roots deeper into the soil before summer heat and drought began.

Drilled seeding of heavy-mast species has the advantage of relatively accurate and consistent seed depth. Broadcast seeding produces a more natural plantation but a random seed depth; some will be deeper than ideal depth and some will be on the soil surface and subject to drying and consumption by seed-eating mammals and birds.

Application Summary: Neither broadcast seeding of any species nor direct seeding of light-mast species resulted in acceptable stands. The only acceptable application of direct seeding was with drilled, larger-seeded, hard-mast species.

The trend in forest regeneration is toward increasing rates of trees planted per acre. A comparison with tree seedling planting shows that direct seeding can result in a higher number of seedlings per acre compared to seedling planting.

Although an economic analysis was not included in this study, it would appear that direct seeding may be a favorable alternative to seedling tree planting. Because direct seeding can result in higher numbers of seedlings per acre the cost per established seedling may be much lower than with seedling tree planting.

Table 1A. Species planted in direct seeding tree and shrub study in 2003. Experiment 1. Rose Lake Plant Materials Center.

Common Name	**Scientific Name**
Heavy-Mast Species	
Shagbark Hickory	*Carya ovata*
Black Walnut	*Juglans nigra*
Black Cherry	*Prunus serotina*
White Oak	*Quercus alba*
Scarlet Oak	*Quercus coccinea*
Bur Oak	*Quercus macrocarpa*
Northern Red Oak	*Quercus rubra*
Light-Mast Species	
Red Maple	*Acer rubrum*
Silver Maple	*Acer saccharinum*
White Birch	*Betula papyrifera*
Green Ash	*Fraxinus pennsylvanica*
White Ash	*Fraxinus Americana*
Staghorn Sumac	*Rhus typhina*
Arrowwood	*Viburnum dentatum*
Highbush Cranberry	*Viburnum trilobum*

Table 1B. Species planted in direct seeding tree and shrub study in 2003 and 2004. Experiment 2. Rose Lake Plant Materials Center.	
Common Name	**Scientific Name**
Heavy-Mast Species	
Bitternut Hickory	*Carya cordiformis*
Pignut Hickory	*Carya glabra*
Shellbark Hickory	*Carya lacinitosa*
Light-Mast Species	
Sugar Maple	*Acer saccharum*
Common Winterberry	*Ilex verticillata*

Table 2A. Stand of heavy-mast species. Experiment 1. July 2005.

	Northern Red Oak	White Oak	Scarlet Oak	Bur Oak	Black Walnut	Black Cherry	Shagbark Hickory
	---------- percent of seeds planted----------						
Spring '03 Till, Drill	10	1	6	20	2	0	0
Spring '03 No-till, Drill	6	4	5	20	0	0	1
Fall '03 Till, Drill	37	11	12	22	62	1	57
Fall '03 No-till, Drill	35	6	19	16	47	0	43
Spring '03 Broadcast	9	1	0	9	0	0	0
Fall '03 Broadcast	9	1	0	12	9	1	16

Grand Mean = 12%

$LSD_{0.05}$ = 3% (between or among any entries in table)

Table 2B. Stand of heavy-mast species. Experiment 1. May 2008.							
	Northern Red Oak	White Oak	Scarlet Oak	Bur Oak	Black Walnut	Black Cherry	Shagbark Hickory
	---------- percent of seeds planted ----------						
Spring '03 Till, Drill	7	0	4	17	1	0	0
Spring '03 No-till, Drill	11	1	8	23	0	0	1
Fall '03 Till, Drill	29	3	5	12	66	0	40
Fall '03 No-till, Drill	17	2	5	11	50	0	37
Grand Mean = 13%							
$LSD_{0.05}$ = 12% (between or among any entries in table)							

Table 2C. Plant height of heavy-mast species. Experiment 1. May 2008.							
	Northern Red Oak	White Oak	Scarlet Oak	Bur Oak	Black Walnut	Black Cherry	Shagbark Hickory
	---------- height (inches) ----------						
Spring '03 Till, Drill	10	0	11	14	10	0	0
Spring '03 No-till, Drill	14	5	13	15	0	0	2
Fall '03 Till, Drill	9	6	5	8	19	0	5
Fall '03 No-till, Drill	10	5	4	9	23	0	5
No plants observed							
Grand Mean = 7 inches							
$LSD_{0.05}$ = 8 inches (between or among any entries in table)							

Table 3. Stand of light-mast species. Experiment 1. July 2005.							
	Viburnum spp.	Staghorn Sumac	Green Ash	White Ash	Red Maple	Silver Maple	White Birch
	---------- percent of seeds planted ----------						
Spring '03 Drill, Till	0	0	0	0	0	0	0
Spring '03 Drill, No-till	0.7	0	0.7	0	0	0	0
Fall '03 Drill, Till	0.7	0	0	0	0	3.0	0
Fall '03 Drill, No-till	0.7	0	0	0	0	1.5	0
Spring '03 Broadcast	0	0	0	0	0	0	0
Fall '03 Broadcast	0	0	0	0	0	0	0
Grand Mean = 0.2%							
$LSD_{0.05}$ = 0.3% (between or among any entries in table)							

Table 4A. Stand as evaluated. Experiment 2. May 2008.					
	---------- percent of seeds planted ----------				
	Pignut	Shellbark	Bitternut	Winterberry	Sugar Maple
Fall '03 Till	21	46	25	0	0
Spring '04 Till	5	25	9	0	0
Fall '03 No–till	31	80	23	0	0
Spring '04 No-till	4	43	13	0	0
Grand Mean = 16%					
$LSD_{0.05}$ = 13%(between or among any entries in table)					

Table 4B. Tree height. Experiment 2. May 2008.					
	---------- Height (inches) ----------				
	Pignut	Shellbark	Bitternut	Winterberry	Sugar Maple
Fall '03 Till	6	7	11	0	0
Spring '04 Till	2	6	4	0	0
Fall '03 No–till	6	7	12	0	0
Spring '04 No-till	3	6	4	0	0
No plants observed					
Grand Mean = 4 inches					
$LSD_{0.05}$ = 3 inches (between or among any entries in table)					

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