Fifth Year Results of Direct Seeding Yellow-Poplar on Tennessee's Eastern Highland Rim

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Yellow-poplar seeds sown in the fall in prepared spots or rows produced well-stocked stands. Spring seeding was much riskier, especially for row seeding. Broadcast seeding of yellow-poplar failed to produce adequate seedlings for regenerating cutover areas. Burning seedbeds before sowing had little effect on performance.

Past logging practices have virtually eliminated yellow-poplar *(Liriodendron tulipifera L.)* from many suitable sites in central Tennessee. Studies have shown that yellow-poplar can be established on these areas by planting (*2*). Direct seeding can also be a regeneration alternative when planting is not practical. At present, most planters do not consider direct seeding as a viable option because of past failures. On the other hand, a few land managers each year attempt seeding under conditions where regeneration cannot succeed. The 5-year results of the direct seeding study reported here describe several successful seeding methods, as well as methods that have consistently failed.

The study compares spot seeding, row seeding, and broadcast seeding on burned and unburned seedbeds and on fall and spring sowing dates. Each treatment combination is replicated four times. The study area is a medium-quality site (site index 90) on Baxter-Dickson soil on gently rolling land near Tullahoma. Before initiation of the study, the area supported a well-stocked, but low-quality, stand of hardwoods. Trees larger than 1 inch at ground level were injected with herbicide. The yellow-poplar seeds were collected in October and stored in dry cold until December. All seeds were treated with 5-percent Arasan, using a 10-percent latex sticker. Seeds were lightly dusted with aluminum powder to prevent clumping and sticking. The yellow-poplar seeds were very good as germination tests indicated 20-percent viability.

Treatments

Methods of sowing. Sowing rates were adjusted so that 20,000 viable seeds per acre were applied in each sowing method.

For broadcast seeding, seeds were mixed with sawdust and carefully distributed over the plot by hand. Fifteen mechanically spaced milacre subplots were marked in each plot for seedling counts and measurements.

For new seeding, furrows were made with a one-person, motor-driven flail trencher. This operation was intended to simulate the effects that could be obtained with a tractor-mounted flail trencher equipped with a seed-dropping mechanism and a packing wheel. Rows were about 7 feet apart. Seeds were sown in a furrow at a rate of 20 viable seeds per 6.6 feet of furrow and were pressed firmly into the soil by foot.

For spot seeding, spots were located to provide 1,000 spots per acre. Before sowing, each spot was raked to remove litter and to loosen surface soil. Enough seeds were sown to provide 20 viable seeds per spot. Seeds were planted about 1 inch apart and about ¼ inch deep.

Seedbed preparation. Twenty-four of the 48 plots were burned in November. The burn removed most of the new leaf fall and some of the accumulated litter. There were some patches of exposed mineral soil. The other 24 plots received no seedbed treatment.

Season of sowing. Fall sowing was performed December 8 with seeds taken directly from the dry cold storage to the sowing area. Spring sowing was performed April 18 with seeds stratified from December 9 until April 18. Stratification consisted of soaking the seeds for several hours, draining, and storing in a plastic bag in a cooler.

Monitoring Animal Use

Previous studies have shown that animal depredation of seeds could be a major factor in direct seeding of yellow-poplar (*1*). In December, 50 seeds were clustered, fully exposed, around the center of each of the fall-sown plots. By April, seeds in each of the 24 plots had been gnawed, and 13 plots had heavy damage. A similar procedure was followed for the spring-sown plots. Considerable damage to the exposed seeds was noted on most plots the following

day; and by June 8, moderate to heavy damage had occurred on all exposed seed spots.

Results

Germination. Total accumulated germination of seedlings at the end of the first growing season ranged from 5,500 per acre for seeds planted in spots in the fall on burned seedbeds to none for seeds broadcast in the spring on burned seedbeds or broadcast in the fall on unburned seedbeds (table 1). In general, fall-sown plots, with some plots approaching 35-percent germination rates, had substantially better germination than spring-sown plots. Seeds sown in spots had higher total germination than those sown in rows, but both spot and row seeding were far superior to broadcast seeding.

Survival. First-year survival followed essentially the same pattern as total germination. However, substantial mortality occurred between the end of the first and the second growing seasons (table 2). Only a few seedlings died between the second and fifth growing seasons. Enough seedlings to produce a new stand survived except for the broadcast treatments and spring-sown row seeding.

Stocking. Stocking percentages based on one seedling per row segment, spot, or milacre stabilized after the second growing season (table 3). After 5 years, stocking percentages are high in fall-sown row and spot seedings, acceptable in spring-sown spots, and very low in spring-sown rows and all broadcast treatments. Burning of the seedbeds before sowing did not affect stocking.

Height. Seedling height growth on all treatments has been acceptable, but not outstanding. Small height advantages achieved by some treatment combinations at the end of the first growing season have been maintained through the fifth growing season (table 4). Heights are somewhat greater on the unburned seedbeds, and fall-sown seedlings are taller than spring-sown seedlings.

Table 1.—*Seeds germinated per air*[1]

Plot, subplot, and seedbed	Season and method of seeding					
	Fall			Spring		
	Broadcast	Row	Spot	Broadcast	Row	Spot
Burned	216	3,300	5,556	0	566	2,430
Unburned	0	3,016	4,916	34	489	1,278
Both seedbeds	108	3,158	5,236	17	533	1,854

[1] Twenty thousand viable seeds per acre were supplied to each treatment.

Table 2.—*Seedling survival per acre*

	Fall			Spring		
	Broadcast	Row	Spot	Broadcast	Row	Spot
			First growing season			
Burned	216	3,134	5,180	0	550	2,403
Unburned	0	2,667	3,764	34	489	1,125
			Second growing season			
Burned	183	2,667	2,597	0	467	1,792
Unburned	0	2,083	2,958	34	400	1,000
			Fifth growing season			
Burned	150	2,150	2,389	0	334	1,584
Unburned	0	1,850	2,667	34	335	972

Table 3.—*Stocking based on surviving seedlings*[1]

	Fall			Spring		
	Broadcast	Row	Spot	Broadcast	Row	Spot
	Percent					
	First growing season					
Burned	22	93	94	0	45	80
Unburned	0	95	86	2	25	58
	Second growing season					
Burned	18	88	70	0	37	68
Unburned	0	82	78	2	22	53
	Fifth growing season					
Burned	15	84	70	0	26	65
Unburned	0	80	76	2	18	51

[1]A spot, row segment, or milacre is considered stocked If It contains at least one established seedling.

Table 4.—*Average height of tallest seedling in each spot, row, or milacre*

	Fall			Spring		
	Broadcast	Row	Spot	Broadcast	Row	Spot
	Feet					
	First growing season					
Burned	0.5	0.6	0.7	—[1]	0.4	0.6
Unburned	—	1.0	1.1	0.7	0.6	0.6
	Second growing season					
Burned	2.3	2.2	2.2	—	1.8	2.0
Unburned	—	3.3	3.0	3.6	2.0	2.4
	Fifth growing season					
Burned	8.0	8.4	7.9	—	6.8	7.8
Unburned	—	9.8	9.5	14.3	8.0	8.1

[1]– = not available, zero germination. (See table 1.)

Discussion

Considerable success can be expected when yellow-poplar is seeded in prepared spots or rows. These procedures can be very useful when traditional planting methods are not practical. This study shows that broadcast seeding, which is less expensive than other methods, will not produce a new stand of seedlings. The spot and row seeding did well because the raking and trenching allowed the seeds to come into full contact with mineral soil and reduced early competition. Fireweed, ironweed, goldenrod, and other forbs proliferated around the spots and rows, but not in them, enabling the yellow-poplar to become established. Later, blackberry entered the area and eventually covered the site, but many yellow-poplar seedlings in spots and rows maintained freedom to grow.

In this study, fall sowing was more effective than spring sowing, because animal activity was at its peak in the spring. Rainfall was adequate and well distributed following the sowings, and there were no adverse climatic conditions.

In some cases, fire may be useful site preparation for direct seeding. In this study, however, no consistent benefits were observed. The herbicide injection of all woody stems before sowing was very effective, as woody vegetation is not a major factor on any of the plots.

Literature Cited

1. Russell, T. E. Animal depredations on spot-seeded yellow-poplar in central Tennessee. Res. Note SO-148. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1973. 4 p.
2. Russell, T. E. Planting yellow-poplar—where we stand today. Gen. Tech. Rep. SO-17. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1977.8 p.