Stump Sprouts of Swamp and Water Tupelo Produce Viable Seeds

David S. Priester

ABSTRACT. Stump sprouts of both swamp (Nyssa sylvatica *var.* biflora *(Walt.) Sarg.) and water* (N. aquatica *L.) tupelo can produce seeds two years after sprouting. For both species, seeds of tree origin are heavier and shoots of resulting seedlings are initially taller than those of sprout origin, but after one year seedlings of the two origins are not significantly different in shoot length and total weight. Thus, if seed crops are poor or fail to germinate after harvesting, stump sprouts can provide a suitable seed source within two years.*

Although not previously reported, stump sprouts of swamp and water tupelo have been observed to produce seeds two years after sprouting (Figure 1). Such precocious seeding is not unusual, having been reported by Fowells (1965) on 6-year-old sprouts of flowering dogwood (*Cornus florida* L.) and 10-year-old sprouts of black cherry (*Prunus serotina* Ehrh.), but no other species have been noted to bear seeds at age 2. Stump sprouts might therefore provide a seed source for these two swamp hardwood species if natural regeneration fails after harvest. Accordingly, the present study was conducted to determine if water and swamp tupelo seedlings originating from the seeds of stump sprouts are of the same quality as those originating from the seeds of trees.

Swamp and water tupelo seeds from stump sprouts and mature trees were collected on the Francis Marion National Forest near Charleston, South Carolina. Collections were made from several locations adjacent to the Santee River and a headwater swamp 10 miles southwest of the river. For water tupelo four areas were chosen at the river site; for swamp tupelo three areas were chosen at the swamp site and one at the river site. Sprouts of both species at the river site were two years old. Sprouts of swamp tupelo at the swamp site were 9, 10, and 11 years old, but it had been noted that they had produced seed at age 2.

For both species, 200 seeds were collected per stump sprout or tree. Three stump sprouts and three mature trees at each collection area were selected. On November 8, 1974, all seeds from each stump sprout and tree were depulped and stored individually in plastic bags at 3° C with 5 ml of water added to prevent drying.

Three replications of 10 seeds were randomly chosen from each stump sprout and tree for planting in the greenhouse. Before planting, fresh weights of these seeds were determined. An additional 10 seeds from each tree and sprout were ovendried and weighed to provide estimates of the ovendry weight of the planted seeds.

The seeds were planted on May 1, 1975, in 2-liter pots filled with a 1:1 sterilized mixture of sand and peat. These pots with slit bottoms were placed in trays so that a 6-inch water level could be maintained to ensure saturated soil-moisture conditions. Each week during the course of the study, 100 ml of half-strength Hoagland's solution (Hoagland and Arnon 1950) was added to each pot to ensure proper nutrients for growth.

Four weeks after planting, when germination had occurred and primary leaf development had begun, each pot was thinned to the three seedlings closest to the average shoot length of that pot. Shoot lengths and ovendry weights of the thinned seedlings were compared so that any initial differences between origins could be determined. For both species, there was a high correlation between shoot length of the entire population of seedlings and those remaining after thinning ($r=0.95$ for swamp tupelo and 0.97 for water tupelo), indicating that the remaining seedlings were similar to the original populations.

The remaining three seedlings per pot were allowed to grow until the end of September; shoot lengths were measured biweekly. The seedlings were then removed from the pots for determination of taproot and shoot lengths and ovendry weights. The data were subjected to an analysis of variance and regression and correlation analyses.

RESULTS

Swamp tupelo

Swamp tupelo seeds of sprout origin were significantly lighter in weight than those of tree origin (Table 1). Percentage of germination was higher for seeds of sprout origin, but not significantly so. At four weeks, the seedlings of tree origin were only 5-percent taller than those of sprout origin, but the difference was statistically significant. For the seeds of tree origin, there was a slight ($r^2=0.087$) but significant tendency at four weeks for heavier seeds to produce larger seedlings, but no such tendency was detected for seeds of sprout origin.

At the end of the growing season, swamp tupelo seedlings from the two origins did not differ significantly in length and weight of roots and shoots (Table 2). Nor was there a significant relationship between seed weight and shoot length.

Water tupelo

Water tupelo seeds of sprout origin were significantly lighter than those of tree origin (Table 1). Germination was significantly greater for seeds of tree origin. At four weeks, seedlings of tree origin were significantly taller than those of sprout origin. In contrast with swamp tupelo, the heavier seeds of water tupelo from sprout origin showed a fairly strong tendency ($r^2=0.494$) to produce larger seedlings, but no such tendency was detected for seeds of tree origin.

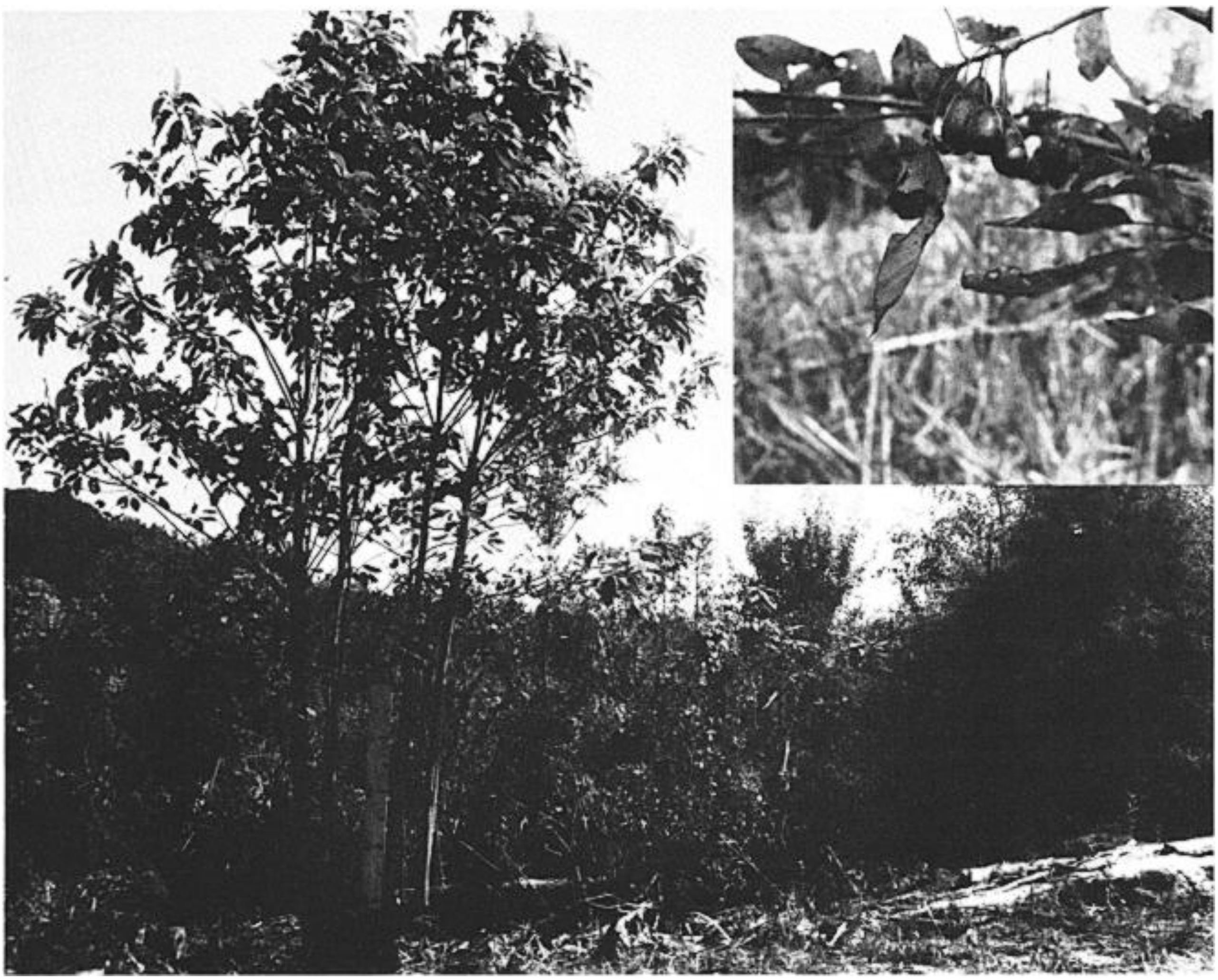

Figure 1. Four-year-old stump sprouts of water tupelo bearing seeds (inset) are located on the Santee River Swamp of the Francis Marion National Forest, South Carolina. Sprouts as young as two years can produce seeds and provide an alternative seed source if initial regeneration fails after harvest.

Table 1. Seed weight, germination, and shoot length of swamp and water tupelo by seed origin at the beginning of the study.

Variable	Tupelo species	Seed origin: Sprouts	Seed origin: Trees	Difference: significance level
		Mg		*Percent*
Seed weight	Swamp	112.4	124.9	1
	Water	460.2	584.4	1
		Percent		
Germination	Swamp	67.50	60.83	NS
	Water	68.33	83.33	2
		Cm		
Shoot length	Swamp	10.29	10.86	3
	Water	16.21	18.98	1

At the end of the growing season, water tupelo seedlings from the two origins did not differ significantly except in length of taproots, which were larger in seedlings of sprout origin (Table 2). The correlation between length and weight of taproots was significant, although only 3 percent of the variability in root weight was associated with root length. There was no significant relationship between seed weight and shoot lengths for either origin after one growing season.

DISCUSSION

Both swamp and water tupelo seeds of tree origin were heavier and the resulting seedlings taller at four weeks than those of sprout origin. Early growth is mainly dependent on stored food reserves of the seed embryos, which are probably larger in the bigger seeds. Water tupelo seeds of tree origin had better germination and thus an advantage over those originating from stump sprouts. However, germination of seeds from stump sprouts was 68 percent for both species, well within the range (51 to 97 percent) previously recorded for both water and swamp tupelo seeds of tree origin (USDA Forest Service 1974, DeBell and Naylor 1972). Thus, germination of seeds from sprout origin does not seem to be a serious limitation on either species.

Table 2. Length and weight of taproots and shoots of swamp and water tupelo seedlings by seed origin after one growing season.

Variable	Tupelo species	Seed origin: Sprouts	Seed origin: Trees
		Cm	
Shoot length	Swamp	89.70	91.02
	Water	90.55	94.65
		Cm	
Root length	Swamp	22.84	22.37
	Water	33.29[1]	28.73[1]
		g	
Shoot weight	Swamp	3.80	3.83
	Water	3.95	4.29
		g	
Root weight	Swamp	1.80	1.78
	Water	2.94	2.55
		g	
Total weight	Swamp	5.60	5.61
	Water	6.89	6.84

[1] *Significantly different at the 1-percent level. All others not significantly different.*

In both species, the initial height differences related to seed size had disappeared after one growing season. The only difference attributable to seed origin was that taproots of water tupelo seedlings originating from sprouts were longer than those of seedlings originating from trees. But from the standpoint of shoot length, shoot weight, and root weight, there were no significant differences between seedlings originating from stump sprouts or mature trees of either species.

The discovery that two-year-old stump sprouts of water and swamp tupelo can produce viable seeds and normal seedlings adds a new dimension in planning future regeneration of these species. Although no quantitative measure has been made of seed production by sprouts, it has been observed that this production depends largely on the number and size of stump sprouts from female seed-producing trees. In one instance, as many as 300 seeds were collected from a two-year-old sprout. Even if the sprout produces no seeds, however, it serves as a most suitable form of regeneration via asexual reproduction.

One of the negative aspects of seed production by stump sprouts is that it could result in overstocking. On the other hand, seeds from sprouts can serve to ensure natural regeneration. For example, if the seed crop prior to cutting is poor, if the seed crop fails to germinate because of prolonged flooding after cutting, or if new seedlings are destroyed by flooding, then in two years stump sprouts can provide an alternative seed source.

Literature Cited

DeBell, D. S. and A. W. Naylor. 1972. Some factors affecting germination of swamp tupelo seeds. Ecology 53: 504–506.

Fowells, H. A. (ed.) 1965. Silvics of forest trees of the United States. USDA For. Serv., Agric. Handb. 271. 762 p. Washington, D.C.

Hoagland, D. R. and D. I. Arnon. 1950. The water culture method of growing plants without soil. Cal. Agric. Exp. Stn. Circ. 349, 39 p.

U.S. Department of Agriculture, Forest Service. 1974. Seeds of woody plants in the United States. USDA Agric. Handb. 450. 883 p.

David S. Priester is assistant biologist, Forestry Sciences Laboratory, Southeastern Forest Experiment Station, USDA Forest Service, Charleston, South Carolina.