SOUTHERN FOREST EXPERIMENT STATION

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1973 MISSISSIPPI RIVER FLOOD'S IMPACT ON NATURAL HARDWOOD FORESTS AND PLANTATIONS

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SOUTHERN FOREST EXPERIMENT STATION

Through October, the 1973 Mississippi River flood had not caused extensive damage to natural hardwood forests or plantations that were 1 year or older and had been flooded only during the first 2 months of the growing season. New plantings of cottonwood were virtually destroyed, however, and 1-year-old sweetgum, flooded about 3 months, was killed. All yellow-poplar observed was killed. Siltation up to 5 feet deep has not caused appreciable damage, but trapped water has caused some mortality.

Additional keywords: Backwater, planting, siltation, water temperature.

A major flood occurred on the Mississippi River during the spring and early summer of 1973. Along the Mississippi and a number of smaller rivers, about 8 million acres were flooded —nearly 3 million acres were in the State of Mississippi. This report summarizes the impact, after one growing season, on planted and natural stands within the Mississippi River floodplain from about 30 miles north of Greenville to Port Gibson, Mississippi.

Research plantings of the Southern Hardwoods Laboratory were affected by Mississippi River floodwater and by backwater from the Yazoo and Sunflower Rivers. Normally the Sunflower drains into the Yazoo, a tributary of the Mississippi River near Vicksburg. When the Mississippi reached flood stage, these rivers backed up and flooded land less than 101.5 feet in elevation.

Mississippi River floodwater conditions were monitored by Southern Forest Experiment Station researchers at Stoneville. Observations were made on research and industrial plantings at Huntington and Catfish Points and Archer Island near Greenville, and at Port Gibson. Backwater conditions created by the Yazoo and Sunflower Rivers were monitored at Mahannah Plantation near Vicksburg and the Delta National Forest near Rolling Fork. Data were received on commercial plantings at Fitler and Paw Paw Island, between Greenville and Vicksburg.

Water temperatures were measured with an Atkins thermistor thermometer and oxygen contents determined with a Sargent oxygen analy-

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zer.[2] Water depths were also measured. The general appearance of all species in an area was recorded at each visit.

FLOOD STAGE REACHED

The Mississippi River reached floodstage (48 feet) at the Greenville Bridge on March 24, 1973. Probably the beginning of the flood was in mid-October 1972. At that time a 7- to 8-inch rain fell over most of Mississippi, causing widespread flooding in low-lying areas. For the next 7 months, more than 46 inches of rainfall was recorded at Stoneville. Average annual rainfall is about 50 inches.

The initial visit to Huntington Point was on March 29, at which time about 1 foot of water covered the research plots. Most of the trees, except sweet pecan and green ash, had begun to leaf out. Maximum water depths at Huntington and Catfish Points were 6 to 7 feet. Water receded about June 1. Five more trips were made to Huntington Point, three to Mahannah, two to Archer Island, and one each to Catfish Point, Port Gibson, and the Delta National Forest, during and after the flood.

Floodwater at Huntington Point reached a maximum 6.5 feet on May 15. Water temperatures reached a high of 69°F on May 25, but oxygen contents were adequate to supply tree requirements. Data on water depths, temperatures, and oxygen contents are given in table 1. Broadfoot has concluded that lower oxygen contents in shallow-water impoundments than reported here are adequate to sustain tree growth.[3] Water conditions at Catfish Point, Port Gibson, and Archer Island, were probably the same as at Huntington Point.

[2] Mention of trade names is for information only and does not constitute endorsement by the Forest Service.

Table 1.—*Water depths, temperatures, and oxygen contents of flood- and backwater*

Date (1973)	River stage		Water depth	Water temperature	Oxygen content
	Greenville Bridge	Vicksburg			
	Feet	*Feet*	*Feet*	*°F*	*P/m*
			HUNTINGTON POINT		
4/4	54.0		2.5	55	7.1
4/12	54.7		3.5	54	8.4
4/27	56.0		4.5	60	7.6
5/15	57.7		6.5	65	6.0
5/25	54.9		2.0	69	5.8
			MAHANNAH		
5/3		51.8	8.5	69	6.7
5/22		52.2	10.5	76	6.1
6/7		45.4	6.0	81	4.8

Backwater at Mahannah did not reach the research plots until April 9, because the area is protected by a private levee. After the backwater went over the levee, it rose to a depth of 6 feet within 3 days. Temperatures were higher and oxygen contents lower than at Huntington Point. Maximum depths at Mahannah were about 11 feet. Water left the area between June 20 and July 1. Conditions on the Delta National Forest were about the same as Mahannah except that depths were lower.

Cottonwood was observed at Huntington and Catfish Points, and at Mahannah; sycamore at Huntington, Catfish, Archer Island, and Port Gibson; yellow-poplar at Huntington, Catfish, and Delta National Forest; sweetgum at Huntington, Catfish, Archer Island, and Port Gibson; and green ash at Huntington and Archer Island. Additionally, sweet pecan and Shumard, water, cherrybark, and Nuttall oaks were checked at Huntington; Shumard oak, black and Persian walnut, and royal paulownia at Archer; Shumard and cherrybark at Catfish; swamp chestnut oak and loblolly pine at Delta National Forest; and black willow at Mahannah.

Soil type is mostly Commerce silt loam at all locations except Mahannah and Delta National Forest, where it is primarily Sharkey clay.

Cottonwood

The flood virtually destroyed cottonwood cuttings planted from November 1, 1972, to March 15, 1973, for studies and a nursery at Huntington Point. Commercial plantings north of there and north of Vicksburg also suffered. Many cuttings had begun to leaf out when the river reached floodstage. The first several weeks after the water receded, some sprouting occurred. For example, in one study at Huntington Point, 24 percent of 768 cuttings planted had leafed out by the last week of June, although half of these were in very poor condition. The nursery area at Huntington Point was maintained for the summer, but a later sample showed only 18 percent survival for four clones. In several instances

[3] Broadfoot, W. M. **Shallow water impoundment increases soil moisture and growth of hardwoods.** Soil Sci. Soc. Am. Proc. 31: 562-564. 1967.

natural seeding made up for the planting failure.

In March, a 12-acre cottonwood plantation had been established near Vicksburg with seedlings rather than cuttings. Almost immediately the planting was covered with water, and remained so until mid-June. By late summer, most of the trees had evidence of top dieback, but overall survival was about 50 percent.

A previous study found that seedlings survive better than cuttings where flooding occurs prior to the start of height growth.[4] In that report, planting was in January. The site was flooded from mid-March to late May, but tops of some seedlings stayed above high water. Survival was 90 percent for seedlings and 19 percent for cuttings. Also, a publication in 1941 reported that cottonwood seedlings survived better than cuttings on a low site in a wet year.[5]

The same may be said for black willow. Nearly all cuttings planted outside the private levee at Mahannah in March were dead when examined in mid-July. At planting, the soil was soggy since it had been under water just prior to planting. Before the end of the month, the area was covered again and water remained until the end of June.

In contrast, cottonwood that was 1 year or older at Huntington Point survived in good condition. The trees were never completely covered with water (fig. 1). Most had begun to leaf out before flooding, and that part above water formed dark green, fully developed leaves and appeared healthy.

[4] Maisenhelder, L. C., and McKnight, J. S. **Cottonwood seedlings best for sites subject to flooding.** USDA For. Serv. Tree Plant. Notes 19(3) : 15-16. 1968.

[5] Bull, H., and Putnam, J. A. **First-year survival and height growth of cottonwood plantations at Stoneville, Miss.** USDA For. Serv. South. For. Exp. Stn. Occas. Pap. 98, 16 p. 1941.

Figure 1.—*Cottonwood at Huntington Point on May 15, when water depth was 6-1/2 feet, still had vigorous appearance.*

Backwaters reached a maximum depth of 11 feet on a 53-acre, 1-year-old cottonwood plantation at Mahannah on May 22. Some 75 to 80 percent of the trees were inundated (fig. 2). Average heights of the 10 tallest trees per plot ranged from 8.5 to 10.5 feet. Water defoliated the trees, but as it receded they leafed out again and most appeared to do well. Three of the four clones planted in this study averaged from 1 to 7 percentage points less in survival after flooding. However, one clone in a portion of the field next to a soybean planting, had high mortality. Whether floodwater was slow in leaving this area or whether other factors were involved is not known. As an example, the plot nearest the bean planting had 90 percent survival after 1 year, but only 28 percent in September of the second year. The other eight plots had from 3 to 30 percentage points loss.

Figure 2.—*Water depth at Mahannah was about 11 feet deep on May 22, and a majority of the trees were covered.*

A slightly different situation with cottonwood plantings occurred in nurseries where stems had been cut back. At Mahannah, on Commerce soil, the rootstocks were 2 and 3 years old. Survival was 70 percent where 10-inch stumps were left, but only 20 percent where stumps were even with the ground. Part of the mortality may have resulted from high temperatures, as the water receded to about 1 foot and remained for several days. Water left the nursery about 2 weeks earlier than in the plantation. At Catfish Point, also on Commerce soil, 2-year-old rootstocks had from two-thirds to three-fourths the previous year's survival. In both nurseries, stems had

been cut just prior to flooding. Late dormant season cutting, i.e., in March, may or may not have influenced survival.

Fusarium cankers were observed in several cottonwood plantations starting their second year. A sample survey at Mahannah in August indicated from 6 to 16 percent infection in three clones, while the fourth clone varied from 6 to 60 percent. The latter was next to the plot with the heavy mortality mentioned previously. The flood was not entirely responsible, as many of the cankers indicated infestation during the previous year, probably aided by mechanical damage during cultivation. However, the flood undoubtedly reduced the ability of the trees to resist the canker. If the trees prove vigorous enough, they have a chance of overcoming the infection with rapid growth. That appeared to be the case at Fitler and on Paw Paw Island. The cottonwood trees developed good color and growth, and the cankers seemed to heal. These plantations were disked as soon as the sites were dry enough, and this treatment seemed beneficial.

Yellow-Poplar

In a planting at Huntington Point, wilting of leaves on 1-year-old yellow-poplar was first observed on April 27, about 1 month after flooding began. All trees were dead by May 15. Two other yellow-poplar plantings were killed by the flood. One at Catfish Point was 11 years old, averaged 6.8 inches d.b.h., and was 55 to 60 feet tall. Floodwaters were 6 to 7 feet deep. The other was on the Delta National Forest. These trees were 15 years old and averaged 7.9 inches d.b.h.; the dominants were 72 feet tall. Floodwaters were about 4 feet deep. Water stood on both plantings about 2 months, and trees had leafed out.

Sycamore

One-year-old sycamores at Huntington Point were never completely covered with water. At least half of the trees became infected with anthracnose during the flood and looked sickly by mid-May (fig. 3). But after the water receded, the trees recovered, and were growing vigorously by the end of the season. Planted sycamore (11 years old) at Catfish Point also survived in apparently good condition. Sycamore plantings in 1962 and 1963 on Archer Island were not damaged by the 1973 flood. Many of the trees stood in trapped water at least through August, but were healthy in September.

Figure 3.—*Water was receding at Huntington Point on May 25, but sycamore had sickly appearance.*

Sprouting of coppiced sycamore at Huntington Point did not appear to be reduced by the flood, but there was no unflooded area for comparison. Stems with 3-year root systems, after field planting, were cut in January 1973, and the stumps sprouted well after the water subsided.

Sycamore seedlings planted in January 1973 on Hooker's Ridge, north of Vicksburg, died.

Sweetgum

Sweetgum at Huntington Point had begun to leaf out for their second season. Trees were completely inundated from about April 4 to June 1, but were in good shape at the end of the growing season.

In contrast, 1-year-old planted sweetgum near Port Gibson did not survive the flood. The only apparent difference was that the Port Gibson sweetgum were inundated about a month longer, from mid-March to mid-June.

Sweetgum planted with sycamore on Archer Island in 1962 and 1963 also survived even though they were in trapped water during most of the growing season.

Green Ash

One-year-old green ash at Huntington Point had not leafed out when flooding started. Tops above water leafed out during the flood. The leaves were killed when the trees were covered, but leafed out again when the water receded. The trees grew vigorously during the rest of the year.

Green ash on Archer Island, planted in 1962 and 1963, also stood in trapped water through August. As with sycamore and sweetgum, it apparently did not suffer any appreciable damage.

Other Species

Shumard oak seedlings planted at Huntington Point in January 1973 had 90 percent mortality by the middle of June. Seedlings and cuttings of species observed in this study probably need at least a year's growth in the field to withstand flooding. For example, on Archer Island, 1960-1961 plantings of green ash, sycamore, Nuttall oak, cherrybark oak, willow oak, swamp chestnut oak, sweetgum, yellow-poplar, and royal paulownia died in a 1961 flood.

A 14-year-old Shumard oak planting on Archer Island was not damaged by the 1973 flood. Trees averaged 7.5 inches d.b.h. and dominants were about 55 feet tall. During its third growing season this planting had withstood the 1961 flood. The 1973 river stage was about 10 feet greater.

Additional plantings on Archer Island in 1962 and 1963 were made with black walnut, royal paulownia, and Persian walnut. The latter two species were dead at the end of June 1973. The black walnut looked good at that time, but by the end of September all trees that had been in trapped water were dead. Trees on higher ground were in very poor condition and did not look as if they would survive.

Sweet pecan, water oak, Nuttall oak, and cherrybark oak that had gone through one growing season survived although they were inundated for 2 months at Huntington Point. Eleven-year-old Shumard and cherrybark oak at Catfish Point, and 15-year-old swamp chestnut oak and loblolly pine on Delta National Forest, were undamaged by 2 months of flooding.

Nuttall oak acorns had been direct-seeded and green ash cuttings planted horizontally on Tennessee Bar, north of Vicksburg, during winters of 1971-72 and 1972-73. The 1971-72 Nuttall seedlings survived in good condition, and a count of the 1972-73 planting made in late August showed that 65 to 70 percent of the acorns had germinated after floodwaters receded; seedlings appeared healthy and were growing vigorously. Sprouting percentages were low for the 1971-72 green ash planting, but where the cuttings had sprouted they appeared to survive. Green ash cuttings planted in 1972-73 did not sprout after the flood. Floodwaters had been about 25 feet deep in the area.

OTHER EFFECTS

Siltation occurred in nearly all flooded areas. Depths ranged from a trace to 5 feet. Observations 2 to 3 months after the floodwaters receded indicated no apparent damage either to the planted trees or species found in natural riverfront forests. Trees appeared healthy and growing well in September in portions of a 2-year-old cottonwood plantation at Catfish Point with almost pure sand deposits up to 5-foot depths (fig. 4). The only loss was by the amount the main stem was covered.

Figure 4.—*Sand deposits had not affected these 2-year-old cottonwood trees by late September.*

Floodwaters caused heavy damage to deer fences around research plots at Huntington Point. Debris broke the wire away from the posts or pushed the fence over. On commercial cottonwood plantations, where "debris fences" had been built to exclude deer, some trees were broken when the water washed tree tops and branches into the plantations. Where the current received some channeling, water movement alone appeared to have been sufficient to bend, break, or wash over plantation-grown trees. Older plantations, in the 3- to 5- and even up to 10-year age classes, suffered some blowdown in localized areas from the waterlogged soils and gusty winds.

Trapped water in low areas and former stream channels has been a problem. In the cottonwood plantation at Catfish, several such areas have water up to 4 feet deep and trees were beginning to die by August (fig. 5). Natural sycamore, up to 20 feet tall and still standing in water at the

Figure 5.—*Trapped water throughout the growing season had caused some mortality by late September in this 2-year-old cottonwood plantation.*

end of September, did not appear adversely affected. Leaf scorch from anthracnose was present, but so was it on drier sites. In another location where water was 1 to 6 feet deep, small sweetgum (4 inches d.b.h.) and dogwood were dying. Older hackberry, ash, honeylocust, and others showed no apparent damage.

DAMAGE SUMMARIZED

Trees less than 1 year old died in the 1973 flood. However, trees that were 1 year or older survived where flooding occurred in the first 2 months of the growing season—with the exception of yellow-poplar.

Cottonwood plantings established in the winter of 1972-73 were virtually destroyed. Cottonwood seedlings fared better than cuttings. One-year-old sweetgum—flooded about 3 months—was killed. Yellow-poplar, from 1 year to 15 years, was killed.

Species such as sweetgum, sweet pecan, and Nuttall, water, and cherrybark oaks survived 60 to 65 days flooding even though they had gone through only 1 growing season in the field and were only 1 to 2 feet tall. Green ash, cottonwood, and sycamore were also in good condition.

Siltation up to 5 feet deep in plantations and natural stands has not so far caused any appreciable damage.

Trapped water around trees is harmful. Probably low oxygen content and high water temperatures cause the mortality.