Tree and Shrub Planting Along Constructed Stream Channels in North Carolina

John P. Edwards, *Soil Conservation Service, 310 New Bern Avenue, Raleigh, NC 27601*

Abstract: Riparian vegetation has numerous, well recognized values to the stream ecosystem. In small watershed projects in North Carolina, the problem of maintaining and managing this riparian vegetation both during and after channel improvement is an important planning consideration. To date, efforts have largely concentrated on leaving existing trees along the channel bank during construction. Several problems have been encountered with this practice and alternative methods of managing riparian vegetation are being evaluated. This study was conducted to determine the feasibility of planting trees along constructed stream channels. Four shrub and 6 tree species were evaluated for the following parameters: establishment methods, plant survival, and species performance. Three replicate plantings were made. Observations on the effects of mulching and competition from native vegetation were also recorded.

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North Carolina has hundreds of miles of excavated channels. Most were designed for drainage and/or flood control for agricultural land. Design criteria include features for removal of certain quantities of water within a given time frame. A major problem in these channels is aquatic weeds especially in sluggish water flows. These aquatics flourish in channels during the months of April to September, often clogging the channel and greatly impeding water flows. Clogged channels fill with sediment and debris, and over a period of years lose significant design capacity. The result of this process is a "dip out" or re-digging of the channel, which is expensive and environmentally undesirable.

Several methods of control of the aquatics have been tried over the last several years. Initially it was thought that herbicides could be used successfully. Several factors made chemical control impractical, however, including expense, environmental restrictions, and restriction on use of potable water.

Various mechanical methods have been utilized to control these aquatics. Mowing and dragging the channel bottom periodically have been utilized

experimentally, but problems with equipment movement along the channels, and high equipment costs make mechanical control impractical for widespread usage.

Other methods have been used experimentally. Water control and water level fluctuation, natural re-vegetation, and the management of existing vegetation are techniques that have been tried most frequently, and each have been successful to varying degrees. Water control structures, however, are expensive, and considerable time is required to manipulate water levels during the spring growth period.

The management of existing vegetation to control aquatics has proven to be a successful technique, but several problems have been encountered. Natural re-vegetation along excavated channels often results in trees growing within the channel proper, in undesirable species becoming dominant, and in "gaps" or reaches where no tree cover becomes established. This study was conducted to determine the feasibility of planting trees to provide shade along constructed stream channels. This alternative, if successful, could provide vegetation that has wildlife food and cover benefits and be more compatible with farming operations than natural riparian vegetation. Specific study objectives were to determine species performance, establishment methods, and plant survival.

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Methods

The following species of vegetation were evaluated: 4 species of shrubs, Autumn olive (*Elaeagnus umbellata*), Waxmyrtle (*Myrica cerifers*), Oval-leaf willow (*Salix oxica*) and Halberd willow (*S. hastata*) and 6 species of trees: Sawtooth oak (*Quercus acutissima*), River birch (*Betula nigra*), Red maple (*Acer rubrum*), Sweetgum (*Liquidambar styraciflua*), Sycamore (*Platanus occidentalis*), Loblolly pine (*Pinus taeda*). Selection was based on several factors such as rate of growth, canopy development, height, site adaptability, and wildlife food and/or cover values.

In replica 1 on the Evans farm, plantings were made on the crop side of the channel with crop rows parallel to the plantings. In replicas 2 and 3, plantings were made on both sides of the channel adjacent to farm roads. Crop row patterns generally were perpendicular to the travel way and plantings at this site.

All planting stock, with the exception of oval-leaf and halberd willows were obtained from commercial sources. All plants were 0.5 m to 1.0 m (2 to 3 feet) tall at planting. The willows were obtained through the Soil Conservation Service plant materials program. The smaller plants, such as the willows and loblolly pines, were planted using a dibble tree planting bar. Larger trees, such as the sawtooth oak and sycamore, were planted using post hole diggers. The locations of all plants were marked with stakes and flags to facilitate evaluations.

A 28 gram (1-ounce) packet of slow release fertilizer was placed in the hole with each plant. "Easy Grow," Rootcontact Packet TM was used in this trial.[1] The packet was placed in the bottom of the hole and for species planted with the post hole digger, a layer of dirt was placed between it and the plant roots. For species planted with the dibble bar, the packet was placed in the hole directly adjacent to the plant and as near to the bottom of the hole as possible. Two mulch treatments (peanut shells and tar paper) and an unmulch control were used to evaluate the effects of mulching on plant establishment and survival.

The initial plantings were made in April 1977. Two replications were established at this time to evaluate the 10 plant species. Weather conditions during this month were cold and windy. Subsequent weather conditions during the first growing season were very poor, with rainfall below normal and temperatures above normal. These 2 factors combined to produce a very poor growing season during the first year of planting and conditions for plant establishment and survival were poor. As a result, a third replica was established during March 1978. This replica did not include the willows and wax myrtle because neither survived in the 1977 plantings.

Results and Discussion

The study period for evaluating survival of the 10 plant species was terminated in October 1979. Evaluations on plant performance, competition effects, and associated factors were continued through November 1981. Long term observations on performance of the sawtooth oak will continue.

Loblolly pine and sawtooth oak had the highest survival with 44% and 42% respectively (Table 1). Red maple and sycamore had only fair survival, and sweetgum and river birch were considered failures. In the follow-up evaluations through 1981, it became apparent that only sawtooth oak and sycamore could compete successfully with native vegetation. The loblolly pine and red maple that survived initially were eventually overtopped and totally dominated by the native vines, shrubs, and trees. Sawtooth oak had the ability to compete successfully with the native vegetation and clearly demonstrated the

[1] Trade name used solely for information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture, nor does it imply an endorsement by the Department over comparable products that are not named.

Table 1. Survival of 10 species planted on constructed stream channels in North Carolina.

Plant species	Total established all treatments	Total survival October 1979	% survival all treatments
Shrubs			
Autumn olive	239	112	47
Halbert willow	194	0	0
Oval-leaf willow	182	0	0
Wax myrtle	206	0	0
Trees			
Loblolly pine	243	106	44
Sawtooth oak	231	97	42
Red maple	271	45	17
Sycamore	257	41	16
Sweetgum	306	18	6
River birch	298	8	3

ability to become dominant. Individual trees of these species reached heights of 4.9 m (16 feet) and 4.6 m (15 feet) respectively by fall 1981.

Of the shrub species evaluated, only autumn olive (47% survival) proved successful. This was the highest survival of the 10 species evaluated. Wax myrtle, oval-leaf willow, and halberd willow were all failures. In the follow-up evaluations, autumn olive demonstrated a strong ability to compete successfully with native vegetation, with some of the plants producing fruit in 1981.

In general, mulching did not significantly affect plant survival, although loblolly pine appeared to respond favorably to tar paper mulch during the initial establishment period (Table 2). None of the species appeared to receive any long term benefit from either of the mulches through the 1981 evaluation period. Initially, both the peanut shells and tar paper did appear to suppress native vegetation. Over time, however, the native plants grew around the mulch perimeter and overtopped the young plants. In view of the time and monetary inputs involved in the mulching process and the evaluation results, it appears that mulching is not cost effective and is not a major factor or influence in plant establishment along the types of constructed channels found in North Carolina.

The effect of the fertilizer packets on tree performance could not be determined. It was hoped that fertilizer would produce an initial growth surge that would give the planted species an advantage over native plants. This apparently did not happen. The fertilizer may have been utilized effectively by the sawtooth oak, sycamore, and autumn olive, as these species appeared capable of competing successfully with native vegetation but the evidence is inconclusive. Because of the difficulty in initial placement of the fertilizer, time involved in placing the packets in each hole, and questionable results obtained, it appears that the use of fertilizer on this type of planting is questionable at best.

Table 2. Evaluation of mulch effects on plant survival along constructed stream channels in North Carolina, March 1977 to October 1979.

Species	Peanut shell			Tar paper paper			Check		
	Planted	Survival	% survival	Planted	Survived	% survived	Planted	Survived	% survived
Shrubs									
Autumn olive	82	38	46	81	36	44	76	38	50
Halbert willow[a]	65	0	0	65	0	0	64	0	0
Oval-leaf willow[a]	64	0	0	60	0	0	58	0	0
Wax myrtle[a]	71	0	0	66	0	0	69	0	0
Trees									
Loblolly pine	80	26	33	84	54	64	79	26	33
Red maple	87	20	23	92	16	17	92	9	10
River birch	107	0	0	92	0	0	99	8	8
Sawtooth oak	76	28[b]	37	79	36	46	76	33	43
Sweetgum	99	4	4	99	9	9	108	5	5

[a] Evaluation ended in March 1978 because of poor survival and performance.
[b] These plants were mowed on 1 of the trial plots. Percent survival would have been higher had this not occurred.

At the time of planting, stakes were placed beside all trees and flags were used to delineate each treatment reach. The placement of these stakes and flags required a considerable time input. However, over the course of the evaluation period, these proved to be extremely valuable in locating the plants, as native vegetation completely dominated the channel banks. Even with the stakes in place, locating the plants during the first 2 years was difficult. Dead plants would have been impossible to locate without the stakes.

Competition from native vegetation was the primary factor affecting plant establishment and initial performance. Severity of competition by a given species was highly variable among sites, but the following are the most competitive of the native plants: Japanese honeysuckle (*Lonicera japonica*), small cane (*Arundinaria* sp.), raspberry and blackberry (*Rubus* sp.), Virginia creeper (*Parthenocissus quinquefolia*), greenbriar (*Smilax* sp.), sweetgum, black cherry (*Prunus serotina*), and sassafrass (*Sassafras albidum*).

Honeysuckle and greenbriar tended to wrap around and actually kill plants. Cane formed dense thickets, overtopped the planted species, and provided severe competition for moisture. Native sweetgum and black cherry sprouts grew on the channel side slopes. Due to a well-established root system these sprouts exhibited a strong growth surge in the second year and quickly overtopped the plantings. The landowner of one planting became very apprehensive about the native vegetative community that became established during the study period. As discussed in an earlier section, some native trees, shrubs, and vines become well-established and proved to be effective competitors. The landowner had reservations that 1 planted species could effectively control this native vegetation and felt that subsequent control measures required of the project sponsors could be very expensive.

Summary and Conclusions

The results of this study indicate that of the plant species evaluated, sawtooth oak and autumn olive are clearly the best plants. Both had good survival and exhibited a strong ability to compete with native vegetation. These plants can compete successfully and could be used effectively along stream channels. Loblolly pine is acceptable but is severely affected by native vegetation. If this competition were controlled through mowing or other means for 2 or 3 years following planting, then this plant would probably be effective.

Mulching was not effective in increasing plant survival. Neither the tar paper or peanut shells controlled native competition effectively. Mulching is not recommended in future plantings.

Effective methods will have to be developed to prevent the plants from being destroyed by farm equipment. In this study, stakes and flags were used without success. Other methods such as "no mowing" signs and fencing should be evaluated.