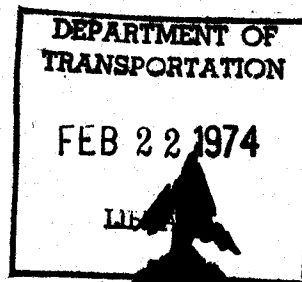


Selection of Woody Plants to be Used for Highway Landscaping and Erosion Control

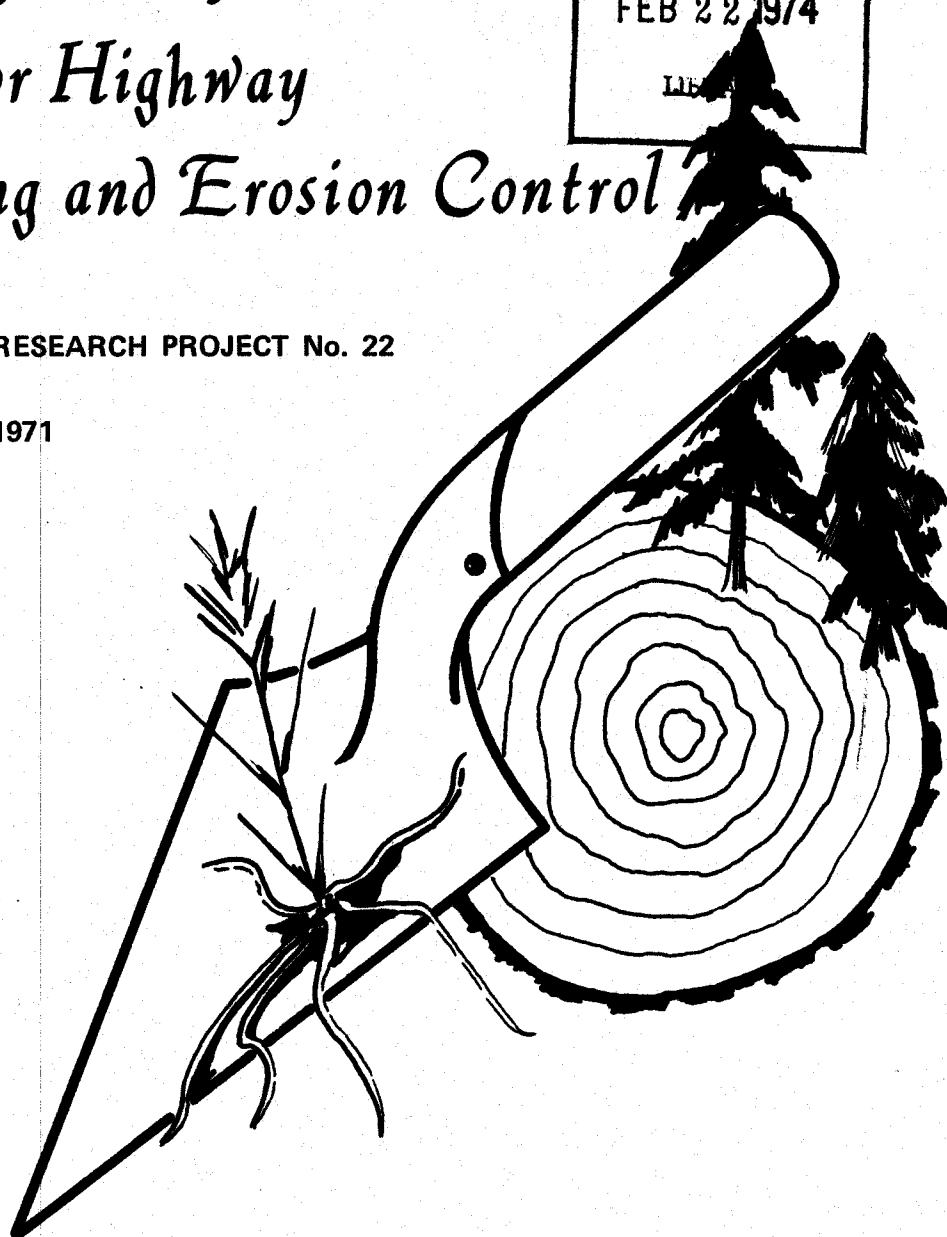


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HIGHWAY RESEARCH PROJECT No. 22

Final Report

August 31, 1971



by

A. W. Tennille, Agronomist

Dr. A. J. Langlois, Horticulturist

ARKANSAS STATE UNIVERSITY
Division of Plant Sciences

for the
ARKANSAS STATE HIGHWAY DEPARTMENT

in cooperation with the
U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

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Selection of Woody Plants
to be Used for Highway
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Division of Plant Sciences
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16. Abstract The types of woody plants best adapted to erosion control and landscaping have been determined. An index of existing plants on Arkansas highway rights-of-way was compiled. Native plants which may be used effectively have been determined. A guide for the establishment and maintenance practices has been developed according to the various geographical areas and soil types in the state. Different methods of propagation were studied. Plant arrangements were designed for checking erosion, screens, beautification and other safety factors. A guide for care and transplanting of plant material has been included as an appendix to the report.					
17. Key Words Plants, soil, fertilizer, planting, native vegetation, erosion control, headlight deterrants, lime.				18. Distribution Statement	
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NOTE - Type no more than 72 characters (Elite) per line, including all spaces and punctuation. Use all **CAPS**

8	9	80
Card	Study Objectives	
G	INDEX NATIVE WOODY PLANTS; DETERMINE FERTILITY LEVELS OF NATURAL	
H	GROWTH; COMPARE ADAPTABILITY OF NATIVE TO CULTIVATED PLANTS;	
I	STUDY ECONOMIC ASPECTS OF PROPAGATION ESTABLISHMENT & MAINTENCE;	
J	AND RECOMMEND PRESERVATION OF NATURAL LANDSCAPE FEATURES.	

8	9	80
Card	Study Findings	
M	RECOMMENDS PLANT TYPES USEABLE; FERTILIZER RATES LIME	
N	REQUIREMENTS; TRANSPLANTING AND CARE OF PLANTS; SOIL PREPARATION.	
O	PRUNING & WEED CONTROL	
P		
Q		
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8	9	80
Card	Implementation - How Done	
V	ONLY LIMITED IMPLEMENTATION AS PROJECT PROGRESSED	
W		
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Indicate who to contact for any followup information.

_____ Name

_____ Name

ACKNOWLEDGEMENTS

The personnel of this research project wish to thank the personnel of the Arkansas State Highway Department and the Federal Highway Administration for their interest and cooperation in this project. This research was made possible by the financial assistance of these two agencies.

The opinion, findings and conclusions expressed in this report are those of the authors and not those of the Arkansas State Highway Department or the Federal Highway Administration.

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FORWARD

The following is the final report for Research Project No. 22, Selection of Woody Plants to be used for Highway Landscaping and Erosion Control. Results of individual experiments are reported by experiment number. The first number represents the individual experiment number and the second number represents the planting year in which the experiment was established.

Survey data is labeled by use of the soil association areas within Arkansas.

Each of these experiments has been reported in greater detail in the annual reports of this project. If more details about individual experiments are desired, the annual report for the year in which the experiment was established should be consulted.

This project was initiated in June, 1966. The following funds were expended by the University during this time.

Total Funds Expended on HRC - 22

(1) Salaries and Wages	\$53,680.06
(2) Materials, Supplies, ect.	4,778.07
(3) Travel	4,869.57
(4) Indirect Costs	<u>8,052.02</u>
Total	\$71,379.72

ABSTRACT

Experiments in this project during the period of 1966-1971 are discussed in this report. Laboratory analysis were conducted in the soils laboratory of Arkansas State University at Jonesboro. Survey and field experiments were conducted on or near highway rights-of-way throughout the state.

Laboratory analysis of the various soil samples taken throughout the state show that most all areas of the state are low in lime and fertility status. Nearly all areas will require some lime in order for best growth. Phosphorus and nitrogen content of soils were generally low throughout the State while the potassium content of the soils was medium.

Fertilizer amounts needed for each plant will vary according to size and type of growth habit. However, from the results of the laboratory analysis of soil samples it was determined that a 1-2-1 ratio of fertilizer would be best for all soil areas of the state.

During the first year of the research a plant survey was conducted. From these surveys it was found that most of the native vegetation along Arkansas highways consist of trees with very few vining or clinging types of plant material. The results obtained from this survey indicate that very few native plants can be adapted for use along highway right-of-way for soil stabilization purposes.

Field experiments were conducted throughout the state using many types of vining and low growing shrubs. From this it was found that bare root material did not survive the dry conditions readily. Best results were obtained by using balled and burlapped or container grown plant material.

From field experiments it was determined that the best erosion control of steep rights-of-way could be accomplished by use of certain of the junipers along with certain other creeping shrubs.

Fertilization of the experimental plots were conducted yearly. From this it was found that a complete fertilizer applied once per year was sufficient to maintain good growth of the plant material. Water seemed to be the most limiting factor of survival and growth of the plant material, whether it be bare root, container grown or balled and burlapped.

The best material found in the experimental plantings using bare root material was loblolly pine seedling. During the latter year of the experiment scotch broom began to show promise as a soil stabilizing plant material.

RECOMMENDATIONS

These recommendations are based upon experimental findings during the duration of this project. It is recognized that plant growth is slow and will require longer time periods for complete evaluation; certain trends in shorter periods can be established and recommendations can be made.

Many researchers do not realize that the practical application of their findings will at times be very difficult. Economics will play a great part in the implementation of the findings of this project. It is suggested that personnel of the Highway Department, responsible for implementing these practices, study these suggestions and put into practice those that are economical in their area.

A guide for the planting and care of trees and shrubs on highway rights-of-way as well as general fertilizer and lime recommendations is in the appendix of this report. Since these are a part of this report, no recommendations on how to plant or amount, type and rate of fertilizer will be given here. Only the type and kind of planting materials will be recommended in this section of the report.

Bare Root Plant Material:

Several species of bare root material were tried through the time of this project. The plant species which appears to give the best results as to survival is loblolly pine. Other bare root species which shows some adaption is Rose-acasia (Robina Hispida), American bittersweet

(clasture scandenel), and Scotch broom (cystisur scoparus).

Container grown and balled and burlapped plant material.

Species of container grown and balled and burlapped utilized in this experiment were numerous. Of the species utilized all of the junipers were very well adapted except two; those which show good promise for erosion control are: Pjitzer; Blue Pjitzer; Shore; Andorra; a Variegated horizontal; a prostrate Virginiana; and a prosptate horizontal. One other balled and burlapped plant specie which shows good adaptation for erosion control of hillsides was Santolina (Santolina Chamaecyparissur).

Plant material used for Headlight Deterrants.

Several species of upright growing evergreen shrubs were evaluated for use as headlight deterrants. The best plant species adapted for this function seems to be the Bronze Elaeagnus. The ligustrums, both the black wax leaf and wax leaf varieties show promise for use as headlight deterrant planting material.

SECTION I
SURVEY OF NATIVE PLANT MATERIAL
and
FERTILITY STATUS

Survey Data-Plant Material

Introduction:

During the summer and winter of 1966 and the spring of 1967, representative sites along the highway rights-of-way were selected for survey work. These sites were in the various soil association regions of Arkansas.

Objective:

The objective of this survey was to determine the amounts and size of the various native species of plants growing adjacent to the highway right-of-way and also those growing on the disturbed portion.

Method:

Survey sites of the various soil association areas within the state were selected. (Soil association areas were described in the Annual report dated April 1, 1967). These selections were based on an undisturbed area being adjacent to the highway. Four random areas of 900 square feet each were used as the basis of the plant material count.

Results and Discussion:

Detailed tables can be found in the Annual Report dated April 1, 1967 and April 1, 1968. For this report the survey sites have been averaged to show only the type of plant material found in each soil association area.

Table 1 shows that the largest amount of plant material found on the undisturbed areas are trees of a deciduous nature.

In some areas vining material such as the grape plant were found. Also some blueberry plants were growing in these undisturbed areas.

From Table 2 the major plant species found in the disturbed areas are upright deciduous trees. However, in previous reports it can be found that nearly all of the plants found in these areas were less than 2 feet tall. This was probably due to the continued mowing of the highway right-of-way during this time.

Table 1: The Occurrence of Various Species Found in Undisturbed Areas for the Different Soil Association Regions of Arkansas.

SOIL ASSOCIATION AREA

Species	Loessial Hills	Bottomland	Loessial Terraces	Ozark Mtns.	Ozark Highlands	Ark. Valley	Boston Mtns.	Ouachita Mtns	Coastal Plains
Red Maple	X	X	X				X	X	X
Devils Walking Stick	X								
River Birch		X							
Ironwood		X							
Bitternut Hickory			X						
Mockernut Hickory	X		X		X	X	X	X	X
Redbud	X							X	
Dogwood	X				X	X	X	X	X
Persimmon		X	X		X				
Possumhaw	X	X	X						
Ink Berry	X								
Red Cedar					X	X		X	X
Sweet Gum		X	X					X	X

Table 1 Cont. Soil Association Area

Table 1 Cont.

Species	Loessial Hills	Bottomland	Loessial Terraces	Ozark Mtns.	Ozark Highlands	Ark. Valley	Boston Mtns.	Ouachita Mtns	Coastal Plains
Apple									X
Mulberry		X							X
Black Gum		X					X	X	X
Shortleaf Pine					X	X	X	X	X
Water Elm		X	X						
Sycamore								X	
Plum		X							
Pear							X		
White Oak	X		X	X	X	X	X	X	X
Red Oak					X			X	X
Shingle Oak					X				
Blackjack Oak	X				X	X		X	
Chinquapin Oak					X				
Water Oak		X							
Pin Oak		X	X				X	X	

Table 1 Cont. Soil Association Area

Species	Loessial Hills	Bottomland	Loessial Terraces	Ozark Mtns.	Ozark Highlands	Ark. Valley	Boston Mtns.	Ouachita Mtns.	Coastal Plains
Willow Oak	X	X	X						X
Post Oak	X		X	X	X	X	X	X	X
Black Oak				X					
Rose	X	X			X				
Buckthorn		X							

Table 1 Cont.

Soil Association Areas

Species	Loessial Hills	Bottomland	Loessial Terrace	Ozark Mtns.	Ozark Highlands	Ark. Valley	Boston Mtns.	Ouachita Mtns.	Coastal Plains
Staghorn Sumac	X	X			X	X	X	X	X
Smooth Sumac				X					X
Sassafras	X			X	X				
Cypress		X							
Winged Elm	X		X		X		X		X
American Elm		X			X			X	
Slippery Elm	X	X	X		X	X		X	
Blueberry	X		X	X	X	X	X	X	X
Viburnum			X						
Muscadinegrape	X	X	X	X	X	X	X	X	
Black Cherry					X				

Table 2: The occurrence of various species found in disturbed areas for the different soil association regions of Arkansas.

Soil Association Areas

Species	Loessial Hills	Bottomland	Loessial Terraces	Ozark Mtns.	Ozark Highlands	Ark. Valley	Boston Mtns.	Ouachita Mtns.	Coastal Plains
<u>Red Maple</u>			X						
<u>River Birch</u>			X						
<u>Mockernut Hickory</u>						X		X	
<u>Persimmon</u>					X	X			X
<u>Sweet Gum</u>			X					X	X
<u>Black Gum</u>	X								
<u>Shortleaf Pine</u>	X							X	X
<u>Sycamore</u>									X
<u>Blackjack Oak</u>		X			X			X	
<u>Post Oak</u>					X	X		X	X
<u>Staghorn Sumac</u>		X			X	X		X	X
<u>Slippery Elm</u>		X	X			X		X	
<u>Blueberry</u>					X				
<u>Muscadine Grape</u>					X				

Survey Data - Fertility Status

Introduction:

At each survey site during the collection of the plant material data, soil samples were obtained. From these various sample sites throughout the State, routine soil analysis were made on the samples.

Objective:

The major objective in this phase of the experiment was to determine something about the fertility level of the various soil associations within Arkansas.

Method:

Soil samples were obtained from each area utilized for plant material counts. Samples were gathered in a random manner throughout each 900 square feet area. The samples were then allowed to air dry in the laboratory. Chemical analysis to determine the pH; pounds per acre of potassium, phosphorus, and calcium; and percent organic matter were determined, in accordance with procedures as outlined in Bulletin No. 102 of the Southern Cooperative Series (Procedures used by State).

Results and Discussion:

The detailed data for all chemical analysis of the soil samples can be found in the annual reports dated April 1, 1967 and April 1, 1968. Only the average for each analysis will be utilized for this report.

From soil test data it was found that the pH values for all areas are low. Organic matter content, which is an indication of nitrogen, was found to be medium along with the available potassium. Phosphorus was found to be low in nearly all areas.

The soil test data indicates that the best fertilizer ratio to use in all areas in a 1-2-1 ratio such as 10-20-10.

Table 3: The average analysis of surface and sub-surface soil samples from undisturbed areas taken within the various soil associations.

Soil Association	pH	Potassium lbs/a	Phosphorus lbs/a	Calcium lbs/a	Organic Matter %
<u>Loessial Hills</u>	4.51	107.5	10.0	277.0	2.48
<u>Bottomland</u>	4.81	88.0	68.5	1067.0	2.00
<u>Loessial Terraces</u>	4.61	71.5	19.5	423.0	2.57
<u>Ozark Mountains</u>	5.81	163.5	13.5	1209.5	2.87
<u>Ozark Highlands</u>	4.95	73.0	18.5	175.5	2.76
<u>Arkansas Valley</u>	5.13	131.5	14.5	599.0	2.83
<u>Boston Mountains</u>	5.43	142.0	12.0	887.5	4.23
<u>Ouachita Mountains</u>	5.05	139.0	33.0	990.0	4.09
<u>Coastal Plains</u>	5.46	106.0	15.5	202.5	1.66

Table 4: The average analysis of surface and subsurface soil samples from disturbed areas within the various soil associations.

Soil Association	pH	Potassium lbs/a	Phosphorus lbs/a	Calcium lbs/a	Organic Matter %
Loessial Hills	4.80	92.5	7.0	571.5	2.21
Bottomlands	5.08	73.0	41.0	1238.5	1.40
Loessial Terrace	5.42	74.5	22.0	858.5	1.31
Ozark Mountains	6.18	220.5	13.0	1553.5	2.63
Ozark Highlands	4.70	71.0	25.5	118.5	0.67
Arkansas Valley	4.79	124.5	13.5	213.00	1.04
Boston Mountains	4.73	113.5	19.0	367.5	0.83
Ouachita Mountains	5.01	129.5	22.5	670.0	1.61
Coastal Plains	5.29	123.5	16.5	494.5	1.30

SECTION II
Description and Evaluation
of
Experimental Plantings Concerning
The Establishment of Plants
On Arkansas Highway Rights-Of-Way

DESCRIPTION AND EVALUATION
OF
1967 EXPERIMENTAL PLANTINGS

EXPERIMENT NO. 1-67

Previously discontinued due to high mortality rate of plants.

EXPERIMENT NO. 2-67

Evaluation of Bronze Elaeagnus for use as Headlight Deterrants.

Planting Date: February 24, 1967

Location: Mississippi County; at interchange of I 55 and Highway 140.

Thirty plants of Bronze Elaeagnus (*Elaeagnus pungens* 'Fruitlandi') were planted 6 feet apart in a straight line 18 feet from the edge of the pavement opposite the north and south entrances of Highway 140 onto I 55.

From the time that they were planted to Spring, 1970, these plants made excellent growth. In the spring of 1970, when this planting was evaluated, a number of the plants showed symptoms of fertilizer excess. It was assumed that highway maintenance personnel had so fertilized them. In July of 1971, only 18 of the plants were alive, out those remaining are making good growth.

In spite of the problems with this particular planting, this species continues to demonstrate that it is a very useful plant for headlight deterrants and beautification.

EXPERIMENT NO. 3-67 DISCONTINUED

EXPERIMENT NO. 4-67 DISCONTINUED

EXPERIMENT 5-67

Evaluation of Cherry Laurel and Bronze Elaeagnus for use as Headlight Deterrants.

Planting Date: April 21, 1967

Location: St. Francis County; at interchange of I 40 and Highway 1.

At the west entrance of Highway 1 onto I 40, 19 Cherry Laurel (*Prunus caroliniana*) were planted in the median in a straight line, 10 feet apart and 18 feet from the pavement edge. At the east entrance of Highway 1 onto I 40, 21 Bronze Elaeagnus (*Elaeagnus pungens* 'Fruitlandi') were planted 6 feet apart in the median in a straight line, 18 feet from the pavement edge.

The Elaeagnus were slow in getting established, apparently due to a very compact soil condition. They have, however, during the past year, made a large amount of growth. The average plant is approximately four feet tall and they have increased in width sufficiently to cause the disappearance of open space between plants. A few of the plants are missing, apparent victims of vehicles.

The Cherry Laurel on the west entrance have not performed very well. Only 8 of 19 are living after four seasons, and the surviving plants are making very little growth. This particular group of Cherry Laurel are the poorest of several plantings. This is probably due to a combination of factors including poor soil, compact soil, and lack of water.

EXPERIMENT NO. 6-67

Evaluation of Cherry Laurel, Wax Leaf Ligustrum and Black Wax Ligustrum as Headlight Deterrants.

Planting Date: April 21, 1967

Location: St. Francis County; at the interchange of I 40 and Highway 38.

At the west entrance of Highway 38 onto I 40, 19 Cherry Laurel (*Prunus caroliniana*) were planted 10 feet apart, in the median and 18 feet from the pavement edge. At the east entrance of Highway 38 onto I 40, 16 Black Wax Ligustrum (*Ligustrum texanum*) and 15 Wax Leaf Ligustrum (*Ligustrum lucidum*) were planted 6 feet apart in the median and 18 feet from the pavement edge.

After four seasons, only 12 of the 19 Cherry Laurel remain. They have made a moderate amount of growth and performance generally has not been adequate to make this plant a good one for use as a headlight deterrant.

None of the Ligustrums (Wax Leaf and Black Wax types) have died. They have made a moderate amount of growth, (about 3 1/2 feet tall) and seem to be well established and performing well.

EXPERIMENT NO. 7-67

Establishment of Yellow Jasmine and Shore Juniper for Erosion Control.

Planting Date: April 28, 1967

Location: Lawrence County; approximately 1 mile east of Smithville on Highway 117.

Two replications, each consisting of 10 plants, 5 feet apart in both directions, of Shore Juniper (*Juniperus conferta*) and Yellow Jasmine (*Jasminum primulinum*) were planted on the face of a slope.

All of the Jasmines in this planting are dead. They died, for the most part, after exposure to the winter of 1968. This species is definitely not adapted to locations in extreme northern Arkansas.

Only one of the Shore Junipers died (in 1969) but two have been stolen. The remaining plants have made excellent growth. They have grown to the extent of touching one another. This slope is especially undesirable from a plant growth standpoint. It is steep, with extremely compact type soil, yet the Junipers are performing very well.

EXPERIMENT NO. 8-67

To determine the Suitability of Cherry Laurel, Wax Leaf Ligustrum, and Black Wax Ligustrum for use as Headlight Deterrants.

Planting Date: May 6, 1967

Location: Pulaski County; on I 40, 1 mile west of Morgan Interchange.

Two replications, each consisting of 8 plants of Wax Leaf Ligustrum (*Ligustrum lucidum*) and Black Wax Ligustrum (*Ligustrum texanum*) and three replications, each consisting of 17 plants of Cherry Laurel (*Prunus caroliniana*) were planted in the median 18 feet from the pavement edge.

This planting was made in a shallow, heavy silt loam soil underlain by deposits of broken shale. This site is very droughty and root penetration seems to be difficult. The plants suffer easily from dry weather due to the low water holding capacity of this soil.

At the time of this evaluation, all of the Ligustrums were alive. They have not made good progress, being only about 12 inches taller and wider than they were at planting time. The poor soil condition is no doubt the reason for this.

Nineteen of the Cherry Laurel (the same number as a year ago) are still living and are not progressing well. They have made very little growth.

EXPERIMENT NO. 9-67

To determine the Effectiveness of Shore Juniper and Yellow Jasmine in Controlling Erosion.

Planting Date: May 12, 1967

Location: Craighead County; Highway 63; 1.5 miles north of the junction of Highways 18 and 91.

Three replications, each consisting of 12 plants, of Shore Juniper (*Juniper conferta*) and Yellow Jasmine (*Jasminum primilinum*) were planted 6 feet apart on a badly eroded cut.

All of the Jasmines have died, due to cold weather in the winter of 1968. Only one of the Junipers has died, due to having been washed out. The remaining Junipers are progressing very well, having made excellent growth. The soil surface is not completely covered indicating that the planting interval in this experiment (our first with Shore Juniper) was probably too great.

EXPERIMENT NO. 10-67

To Determine the Suitability of Adding "Improved" Fill to Newly Transplanted Shrubs.

Planting Date: June 9, 1967

Location: Fulton County; Highway 62, 2.0 miles east of Bridge Log 62 - 13, 11.13.

Four plants of each of the following shrubs were used; two receiving improved soil (1/2 peat moss and 1/2 native soil) and the other two receiving only the native soil from that site.

<u>Common Name</u>	<u>Scientific Name</u>
Shore Juniper	Juniperus conferta
Cherry Laurel	Prunus caroliniana
Wax Leaf Ligustrum	Ligustrum lucidum
Black Wax Ligustrum	Ligustrum texanum
Bronze Elaeagnus	Elaeagnus pungens 'Fruitlandi'
Yellow Jasmine	Jasmine primulinum

The Jasmines died three seasons ago. Three of the Cherry Laurel have died this year and the fourth was stolen. Two of the Wax Ligustrums have died and the other two were stolen. One of the Black Wax has died and the other three are making only moderate progress. Three of the Junipers remain and are making very good growth, the fourth was stolen. All of the Elaeagnus are alive and are also making very good growth.

Although the number of plants of each species in this experiment is too small for a valid evaluation of benefits of adding peat moss to fill soil, there does not seem to be any advantages to its addition. There appeared to be no correlation between mortality of plants and the presence or absence of peat moss.

EXPERIMENT NO. 11-67

To Determine the Effectiveness of Santolina in Controlling Erosion.

Planting Date: July 19, 1967

Location: Craighead County; Highway 1, just south of the Greene County line.

Fifty Santolina (*Santolina chamaecyparissus*) were planted three feet apart on a badly eroded slope.

All of the plants are alive and are growing very well. They have just about made enough growth to cover the surface of the soil. The stems of this plant roots where it touches the ground, but there is still some erosion taking place underneath the canopy of the plants.

Table 1. Summary of Purpose, Location, Species and Type of Plants used in Experimental Plantings of the 1967 Season.

Purpose of Planting	Planting Number	County	No. of Species	Balled Shrubs
Erosion Control	1-67	Hot Springs	(discontinued)	
Headlight Deterrant	2-67	Mississippi	1	60
Propagation	3-67	Craighead	(discontinued)	
Erosion Control	4-67	Craighead	(discontinued)	
Headlight Deterrant	5-67	St. Francis	2	50
Headlight Deterrant	6-67	St. Francis	3	50
Erosion Control	7-67	Lawrence	2	40
Headlight Deterrant	8-67	Pulaski	3	82
Erosion Control	9-67	Craighead	2	72
Soil Admendent	10-67	Fulton	6	24
Erosion Control	11-67	Craighead	1	50
TOTALS			(Different Species)	428
			9	

DESCRIPTION AND EVALUATION

OF

1968 EXPERIMENTAL PLANTINGS

EXPERIMENT NO. 1-68

Discontinued due to poor survival.

EXPERIMENT NO. 2-68

Discontinued due to poor survival.

EXPERIMENT NO. 3-68

Discontinued due to poor survival.

EXPERIMENT NO. 4-68

Establishment of Spreading-type Evergreen Shrubs for Erosion Control.

Planting Date: March 8, 1968

Location: Sharp County; 3 miles east of Sidney on Highway 58.

Plots consisting of 16 plants of Andorra Juniper (*Juniperus horizontalis* 'Andorra') and Compact Pfitzer Juniper (*J. pfitzeriana* 'Compacta') were planted 5 feet apart on a cut.

In July, 10 of the Andorra Junipers were alive, four were dead and two had been stolen. Fifteen of Compact Pfitzers were alive, none were dead, but one had been stolen. The remaining plants of both species have not made good growth. This is probably due to the site rather than the adaptability of the plant.

EXPERIMENT NO. 5-68

Establishment of Loblolly Pine for Erosion Control.

Planting Date: March 15, 1968

Location: Lawrence County; 0.6 mile west of Bridge Log 117-2, 4.83.

Three hundred Loblolly Pine (*Pinus taeda*) seedlings were planted, using a dibble, approximately 3 feet apart in both directions up the face of a cut.

The cut on which these seedlings were set, though not seriously eroded, was rocky and very droughty. The survival of these pines is the same as it was last year, 76%. The trees have made considerable growth, appear to be vigorous and are apparently very well established.

EXPERIMENT NO. 6-68

Discontinued due to high mortality.

EXPERIMENT NO. 7-68

Discontinued due to high mortality.

EXPERIMENT NO. 8-68

Establishment of Loblolly Pine, Fragrant Sumac and Rose-acasia for Erosion Control.

Planting Date: March 29, 1968

Location: Hot Springs County; I-30, 0.8 mile south of Saline county line on east side of highway.

Two hundred and ninety-seven seedling Loblolly Pine (*Pinus taeda*) (33 rows across and nine plants up the slope) were planted four feet apart with a dibble. Ninety-six bare-root Rose-acasia (*Robinia hispida*) and Fragrant Sumac (*Rhus aromatica*) plants were planted (8 rows across and 12 plants up) three feet apart in adjacent plots.

Very few of the Sumac and Rose-acasia are alive. Because of this, they will be discontinued as part of this experiment.

Two hundred and nineteen of the pine, or 83% of the pine, are alive. They have made remarkably good growth, averaging approximately 5 feet, in spite of the steep, rocky slope on which they have been planted. This should serve as good evidence that pine should be very useful and economical as soil stabilizers.

EXPERIMENT NO. 9-68

Establishment of Loblolly Pine Seedlings for Erosion Control.

Planting Date: March 29, 1968

Location: Craighead County; Highway 1 just south of Greene County line.

One hundred and fifty Loblolly Pine (*Pinus taeda*) were planted approximately 5 feet apart in both directions, using a dibble, on the face of a cut.

After four summers, survival is 51%, slightly lower than a year ago. The trees have not made as much growth as pine in other plantings.

EXPERIMENT NO. 10-68

Establishment of Certain Vining Plants on the Tops of Cuts.

Planting Date: March 29, 1968

Location: Craighead County; east side of Highway 1, one half mile north of Brookland School.

The object of this experiment was to attempt to get vining plants established in generally good soil at the tops of cuts and study the effectiveness of these plants to trail down and cover the cut, thus stabilizing the soil.

Twenty-five plants of Hall's Honeysuckle (*Lonicera japonica* 'Hall's'), American Bittersweet (*Claytonia scandens*), Goldflame Honeysuckle (*Lonicera japonica* 'Heckrotti') and Virginia Creeper (*Ampelopsis quinquefolia*) were planted 2 feet apart at the top of the cut.

Eighty-five percent of the Hall's Honeysuckle and 50 percent of the Goldflame Honeysuckle are alive. Both species have made moderate growth but only the Hall's has run down the cut.

EXPERIMENT NO. 11-68

Establishment of Fragrant Sumac and Rose-acasia for Erosion Control.

Planting Date: March 29, 1968

Location: Craighead County; east side of Highway 63, 1.6 miles west of Highway 18 Junction.

This planting consisted originally of 100 plants of Rose-acasia (*Robinia hispida*) and 88 plants of Fragrant Sumac (*Rhus aromatica*). Both species were bare-root liners planted 3 feet apart in both directions.

All of the sumac have died (most were destroyed when a water line was placed over the site). The Rose-acasia has made excellent growth and stolons developing from original plants make counting impossible.

EXPERIMENT NO. 12-68

Establishment of Spreading type Evergreen Shrubs for Erosion Control.

Planting Date: May 3, 1968; July 3, 1968; July 17, 1968

Location: Craighead County; west side of Highway 63, 1 mile south of Bono.

Sixteen plants of each of the seven species listed below were included in this experiment. All plants were spaced 5 feet apart in both directions.

<u>Common Name</u>	<u>Scientific Name</u>
*Andorra Juniper	<i>Juniperus horizontalis</i> 'Andorra'
*Shore Juniper	<i>Juniperus conferta</i>
**No Common Name	<i>Juniperus horizontalis</i> 'Prostrata'
**No Common Name	<i>Juniperus prostrata</i> 'Variegated'
**No Common Name	<i>Juniperus virginiana</i> 'Prostrata'
**Bar Harbor Juniper	<i>Juniperus horizontalis</i> 'Bar Harbor'
**Wilton Carpet Juniper	<i>Juniperus horizontalis</i> 'Wiltoni'
**Pfitzer Juniper	<i>Juniperus chinensis</i> 'Pfitzeriana'
**Blue Pfitzer	<i>Juniperus chinensis</i> 'Blue Pfitzer'

*Balled and Burlap
**Container grown - gallon cans

All of the Junipers above show 100% survival except the Blue Pfitzer of which 14 plants were stolen in 1969, and Bar Harbor and Wiltoni which have about a 30% mortality rate this year. The remaining Junipers have made very good growth this year. They have not grown sufficiently to cover the soil surface, but it is anticipated that they will do so in one more year.

The Bar Harbor and Wiltoni varieties are very dwarf forms and cannot compete well with weeds. For this reason they will not be recommended for general planting.

Table 2. Summary of Purpose, Location, Species and Type of Plants Used
In Experimental Plantings of the 1968 Season.

Purpose of Planting	Planting Number	County	No. of Species	Container Shrubs	Balled Shrubs	Bare-root Liners
Propagation	1-68	Craighead	(discontinued)	-	-	-
Erosion Control	2-68	Craighead	(discontinued)	-	-	-
Erosion Control	3-68	Sharp	(discontinued)	-	-	-
Erosion Control	4-68	Sharp	2	-	32	-
Erosion Control	5-68	Lawrence	1	-	-	300
Erosion Control	6-68	Lawrence	(discontinued)	-	-	-
Erosion Control	7-68	Hot Springs	(discontinued)	-	-	-
Erosion Control	8-68	Hot Springs	1	-	-	264
Erosion Control	9-68	Craighead	1	-	-	150
Erosion Control	10-68	Craighead	4	-	-	100
Erosion Control	11-68	Craighead	2	-	-	188
Erosion Control	12-68	Craighead	7	80	32	-
TOTALS			(Different Species)	80	64	1002

DESCRIPTION AND EVALUATION

OF

1969 EXPERIMENTAL PLANTINGS

EXPERIMENT 1-69

Evaluation of Various Junipers for Erosion Control.

Planting Date: October 4, 1968

Location: Lawrence County; Highway 117, about 1 mile south of Highway 63.

Sixteen plants each of the nine species listed below were used in this experiment. All plants were spaced 4 feet apart in both directions.

<u>Common Name</u>	<u>Scientific Name</u>
*Pfitzer Juniper	Juniperus chinensis 'Pfitzeriana'
*Blue Pfitzer Juniper	Juniperus chinensis 'Pfitzeriana' 'glauca'
*Shore Juniper	Juniperus conferta
**Wilton's Carpet Juniper	Juniperus horizontalis 'Wiltoni'
**Bar Harbor Juniper	Juniperus horizontalis 'Bar Harbor'
**Andorra Juniper	Juniperus horizontalis 'Andorra'
**No Common Name	Juniperus prostrata 'Variegated'
**No Common Name	Juniperus virginiana 'Prostrata'
**No Common Name	Juniperus horizontalis 'Prostrata'

- *Balled and Burlapped
- **Container grown - one gallon

During 1970 and again in 1971, quite a number of plants were stolen from this experiment. A stolen plant obviously can not be counted as a dead plant in survival calculations. Because of this, a separate column was used below. A plant was considered dead if plant parts were found, and stolen if an empty hole was found.

<u>Juniper</u>	<u>Alive</u>	<u>Stolen</u>	<u>Died</u>	<u>% Survival</u>
Pfitzer	8	8	0	100
Blue Pfitzer	6	9	1	94
Shore	15	1	0	100
Wiltoni	14	0	2	88
Bar Harbor	16	0	0	100
Andorra	12	4	0	100
prostrata Variegated	15	1	0	100
virginiana Prostrata	16	0	0	100
horizontalis Prostrata	11	5	0	100

All of the Junipers except varieties Wiltoni and Bar Harbor have made excellent growth. Bar Harbor and Wiltoni are very dwarf forms and can not compete well with weeds. All others have become very well established during the past year. The balled plants, which were larger at transplanting time, have made sufficient growth to cover the slope. The container plants are somewhat smaller, but are making very good progress.

EXPERIMENT 2-69

Evaluation of Various Junipers for Erosion Control.

Planting Date: October 18, 1968

Location: Hot Springs County; I-30, 0.8 mile south of Saline County line on west side of highway.

Fifteen plants each of the nine species listed below were used in this experiment. The plants were spaced 4 feet apart in both directions.

<u>Common Name</u>	<u>Scientific Name</u>	<u>% Survival</u>
*Pfitzer Juniper	Juniperus chinensis 'Pfitzeriana'	93
*Blue Pfitzer Juniper	Juniperus chinensis 'Pfitzeriana 'glauca'	100
*Shore Juniper	Juniperus conferta	80
**Wilton's Carpet Juniper	Juniperus horizontalis 'Wiltoni'	67
**Bar Harbor Juniper	Juniperus horizontalis 'Bar Harbor'	93
**Andorra Juniper	Juniperus horizontalis 'Andorra'	73
**No Common Name	Juniperus prostrata 'Variegated'	80
**No Common Name	Juniperus virginiana 'Prostrata'	47
**No Common Name	Juniperus horizontalis 'Prostrata'	87

*Balled and Burlapped

**Container grown - one gallon

A few of the plants in this experiment were stolen during the past year. Because of this, the system of calculating survival will be the same used as that in the previous experiment.

Juniper	Alive	Stolen	Died	% Survival
Shore	12	2	1	93
Pfitzer	9	6	0	100
Blue Pfitzer	15	0	0	100
Wiltoni	10	0	5	67
Andorra	14	0	1	93
prostrata Variegated	9	0	6	60
virginiana Prostrata	9	0	6	60
Bar Harbor	4	0	11	27
horizontalis Prostrata	13	0	2	87

As in experiment 1-69, the balled plants, which were larger at planting time, average about 2 feet tall and 4 feet wide. They are effectively controlling erosion. The container grown shrubs, which were smaller at planting time, average about 18 inches tall and wide. They are very well established and progressing well. Note again the poor performance of the very dwarf types, Wiltoni and Bar Harbor.

EXPERIMENT 3-69

Evaluation of Various Juniper Species for Erosion Control.

Planting Date: November 22, 1968

Location: Pulaski County; Highway 65, 5 miles south of its intersection with I-30.

Fifteen plants each of the four species listed below were used in this experiment. The plants were spaced 4 feet apart in both directions.

<u>Common Name</u>	<u>Scientific Name</u>
*Shore Juniper	Juniperus conferta
**Wilton's Carpet Juniper	Juniperus horizontalis 'Wiltoni'
**Bar Harbor	Juniperus horizontalis 'Bar Harbor'
**Andorra Juniper	Juniperus horizontalis 'Andorra'
*Balled and Burlapped	
**Container grown - one gallon	

This planting is on a very droughty site. In spite of this the plants are making satisfactory growth. The soil surface has not been covered, but erosion has been arrested.

EXPERIMENT 4-69

Evaluation of Shore Juniper for Erosion Control.

Planting Date: December 6, 1969

Location: Fulton County; Highway 62, 2.7 miles east of the Baxter County line.

Twenty-four plants of Shore Juniper (*Juniperus conferta*) were planted 4 feet apart on a rocky cut.

None of these plants have died and none have been stolen. They have just about made enough growth to cover the surface of the soil.

EXPERIMENT 5-69

Abandoned due to high mortality rate of plants.

EXPERIMENT 6-69

Abandoned due to high plant mortality.

EXPERIMENT 7-69

Evaluation of Pine Seedlings for Erosion Control.

Planting Date: February 28, 1969

Location: Independence County; on Highway 167, approximately midway between Batesville and Cave City.

Two hundred Loblolly Pine (*Pinus taeda*) were planted about 5 feet apart in both directions on a steep, badly eroded cut. At the time of evaluation this year 40 or 20% are still alive. They have made good growth during the past season.

EXPERIMENT 8-69

This experiment has been terminated, but another one (1-70) has been planted on some of the same cuts.

EXPERIMENT 9-69

Evaluation of American Bittersweet Vine for Erosion Control.

Planting Date: February 21, 1969

Location: Craighead County; Highway 63; approximately one mile north of intersection with Highway 18.

Two hundred and thirty-six American Bittersweet (*Clastrus scandens*) were planted on a cut on the east side of the highway.

Survival this year is down to 32% (from 45 last year and 70% the year before that). The plants have made only a small amount of growth.

EXPERIMENT 10-69

Evaluation of Various Deciduous Species for Erosion Control.

This planting was destroyed by the placement of a sub-division entrance over the site.

Table 3. Summary of Purpose, Location, Species and Type of Plant Used
In Experimental Plantings of the 1969 Season

Purpose of Planting	Planting Number	County	No. of Species	Type of Plant Used		
				Container Shrubs	Balled Shrubs	Bare-root Liners
Erosion Control	1-69	Lawrence	9	96	48	-
Erosion Control	2-69	Hot Springs	9	96	48	-
Erosion Control	3-69	Pulaski	4	45	15	-
Erosion Control	4-69	Fulton	1	-	24	-
Erosion Control	5-69	Pulaski	(discontinued)	-	-	-
Erosion Control	6-69	Sharp	(discontinued)	-	-	-
Erosion Control	7-69	Independence	1	-	-	200
Erosion Control	8-69	Poinsett	(discontinued)	-	-	-
Erosion Control	9-69	Craighead	1	-	-	270
Erosion Control	10-69	Craighead	(discontinued)	-	-	-
TOTALS		(Different Species)	15	237	135	470

DESCRIPTION AND EVALUATION
OF
1970 EXPERIMENTAL PLANTINGS

EXPERIMENT NO. 1-70

Establishment of Pine for Erosion Control.

Planting Date: February 12, 1970 to April 24, 1970

Location: Poinsett County on a series of 18 cuts on Highway 1 between the Craighead County line south to a point approximately one mile north of the Harrisburg city limits.

A total of 2005 pine (*Pinus taeda*) were planted at various times from February 12, 1970, to April 24, 1970, on a series of cuts along Highway 1 South. The number of pines on a site varied from 25 to 225. The sites were marked with foot-long white stakes giving the planting date and the number of pines planted. The seedlings were planted about 5 feet apart using a dibble.

A count of surviving pines was made in August 1971, and individual site as well as total survival of all sites was determined. The average survival for all 18 sites was 56% (identical to last year's average). The range over the entire 18 sites varied from 28 to 100%.

The performance of the pines in these plantings varied considerably. On the steeper, more droughty slopes, the pines made little growth. On the more favorable slopes, they made considerably more growth. Generally, they have not made as good a growth as other similar plantings.

Pine, however, continues to be an excellent, economical soil stabilizer.

EXPERIMENT NO. 2-70

Establishment of Various Species for Erosion Control.

Planting Date: March 6, 1970

Location: Sharp County; on Highway 115, 0.9 mile west of the Lawrence County line.

One hundred plants each of American Bittersweet (*Clastrus scandens*), Scotch Broom (*Cystisus scoparus*), Red Osier Dogwood (*Cornus stolonifera*), Dwarf Ninebark (*Physocarpos opulifolius nana*), and Crown Vetch (*Coronilla varia*) in pots and root pieces, were planted approximately 3 feet apart on a cut.

Survival percentages are given below:

American Bittersweet	88%
Scotch Broom	53%
Dwarf Ninebark	82%
Red Osier Dogwood	91%
Vetch, pots	96%
Vetch, roots	64%

Although the plants in this experiment have come through another growing season with only a slight reduction in survival percentage, they have not made much growth. The soil surface is not covered, but with adequate growth this should occur.

The Crown Vetch (both pots and roots) have made fair growth. Although starting Vetch from seed proved unsuccessful.

EXPERIMENT NO. 3-70

Establishment of Various Species for Erosion Control.

EXPERIMENT NO. 4-70

Establishment of Various Species for Erosion Control.

Planting Date: April 6, 1970

Location: Craighead County; Highway 1 North, 1/2 mile south of the Greene County line.

One hundred plants each of Scotch Broom (*Cystisus scoparus*), Dwarf Ninebark (*Physocarpus opulifolius nana*), American Bittersweet (*Castrus scandens*), and 75 plants of Red Osier Dogwood (*Cornus stolonifera*) and Bare-root Crown Vetch (*Coronilla varia*) were planted 3 feet apart on a steep, rocky cut. Very little growth has been made by these plants.

Survival percentages are listed below:

Scotch Broom	9%
Dwarf Ninebark	50%
American Bittersweet	28%
Red Osier Dogwood	41%
Crown Vetch	0%

EXPERIMENT NO. 5-70

Establishment of Pine for Erosion Control.

Planting Date: April 8 and 17, 1970

Location: Craighead County; Highway 1, approximately 1/2 mile south of the Greene County line.

On April 8, 250 seedling pines (*Pinus taeda*) were planted on a cut on the east side of Highway 1 and on April 17, 130 pines were planted on a cut on the opposite side of Highway 1. All pines were planted with a dibble and spaced about 4 to 5 feet apart. Of those planted on April 8, 140 or 56% were alive at the time of this evaluation. In the later planting of April 17, 75 or 57% survived.

Generally, the plants have made very good growth, averaging about 2 feet tall.

EXPERIMENT NO. 6-70

Establishment of Pine for Erosion Control.

Planting Date: April 10, 1970

Location: Hot Springs County; Interstate 30, approximately 0.9 mile south of the Saline County line.

A total of 1450 seedling pines (*Pinus taeda*) were planted on two cuts on opposite sides of I-30. Dibbles were used to set the pines about 5 to 6 feet apart. Sixteen percent of the pines are alive. This is only a 2% reduction from last year's count. The low survival is probably due to the late planting date.

The surviving pines are making good growth.

EXPERIMENT NO. 7-70

Establishment of Pine for Erosion Control.

Planting Date: April 17, 1970

Location: Sharp County; Highway 115, 0.9 mile west of the Lawrence County line.

Five hundred pine (*Pinus taeda*) seedlings were planted about 5 feet apart with dibbles on a steep, long and narrow cut along the highway. Very excellent survival, 82%, was obtained. These pines are growing very well in spite of the highly erodable site.

EXPERIMENT NO. 8-70

Establishment of Bittersweet for Erosion Control.

Planting Date: April 28, 1970

Location: Craighead County; Highway 63 west, 1 1/4 mile south of Bono.

Two hundred bare-root Bittersweet vines were planted about 3 feet apart on a partially sodded hill.

Only 6% of the plants are presently alive. The plants used in this experiment were smaller (6-12 inches) than those used in previous years. This may have delayed establishment and ultimately lowered survival.

EXPERIMENT NO. 9-70

Establishment of Shore Juniper for Erosion Control.

Planting Date: May 8, 1970

Location: White County; Highway 67, approximately 1 mile north of Bradford.

Fifty, gallon size, container grown Shore Juniper (*Juniperus conferta*) were planted about four feet apart on a steep, partially sodded slope.

In August of this year, only 27 of the 50 plants were alive. This is quite high mortality for Shore Juniper which has shown excellent survival in previous experiments. This planting site is very steep, probably making it more droughty and lowering the survival percentage.

The remaining plants have made only a limited amount of growth.

EXPERIMENT NO. 10-70

Establishment of Shore Juniper for Erosion Control.

Planting Date: June 17, 1970

Location: Sharp County; Highway 115, 0.9 mile west of the Lawrence County line.

Fifty, gallon size, container grown Shore Juniper (*Juniperus conferta*) were planted about 5 feet apart on a slope. In August, only 3, or 6%, had died. The plants were watered about as frequently as those in the previous experiment. Higher livability in this experiment is probably due to a better soil type with greater water holding capacity.

The remaining plants have made a moderate amount of growth.

Table 4. Summary of Purpose, Location, Species and Type of Plant Used In Experimental Plantings of the 1970 Season.

Purpose of Planting	Planting Number	County	No. of Species	Type of Plant Used	
				Container Shrubs	Bare-root Liners
Erosion Control	1-70	Poinsett	1	0	2,000
Erosion Control	2-70	Sharp	5	0	500
Erosion Control	3-70	White	5	0	455
Erosion Control	4-70	Craighead	5	0	550
Erosion Control	5-70	Craighead	1	0	380
Erosion Control	6-70	Hot Springs	1	0	1,450
Erosion Control	7-70	Sharp	1	0	550
Erosion Control	8-70	Craighead	1	0	200
Erosion Control	9-70	White	1	50	0
Erosion Control	10-70	Sharp	1	50	0
TOTALS		(Different Species	7	100	6,085

SECTION III

Economic Aspects in Relation to
Propagation, Establishment and Cultural
Requirements of Various Plants

Economic Aspects in Relation to
Propagation, Establishment and Cultural
Requirements of Various Plants

The basic economic requirement of various plant materials is the cost of the individual plant. Plant material can be obtained from several sources. The main two are commercial, nursery grown stock and propagation and growing of stock by the user. The cost of each individual plant which is commercially grown will vary from year to year. There will also be a variation in cost as the size of the plants varies. Plant material costs will vary as to whether it is bought as bare root liners, container grown, or balled and burlapped. At this time (1972), the cost of the different planting materials will range from approximately \$5.50 per thousand for the loblolly pine seedlings to \$3.50 per plant for a 10 inch diameter balled and burlapped plant. Most of the bare root liners, such as rose-acasia, scotch broom and crown vetch will cost approximately \$40 per thousand plants.

The cost of propagation and growing to planting size by the user is very difficult to estimate. A greenhouse complex containing a mist propagation bed must be available. The cost of the greenhouse will depend upon its size. A rule of thumb for greenhouse construction would be approximately \$15 per square foot for the glass enclosure. The headhouse will vary in cost per square foot with the type of construction utilized. Possibly the smallest greenhouse which should be utilized would be a 20 feet by 30 feet glass enclosure with a minimum of 15 feet by 20 feet headhouse. This cost relationship would probably be enough to secure a mist propagation bed.

The next cost would be land which is available to have a nursery area of sufficient size to grow all of the plants needed. Normally, it would require approximately 25 square feet per plant for approximately 1,750 plants per acre. The soil for this site must be carefully selected in order to have soil material which can be balled and burlapped.

The greatest cost of this entire operation would be labor. One professional horticulturist or plant scientist must be hired for the operation. However, one great advantage of this arrangement would be that this professional would be available to supervise the planting of shrubs along the highway rights-of-way. Other labor needed would be of a non-professional nature, and one full-time employee would probably be sufficient in the greenhouse nursery complex.

A recommendation on the method by which the Highway Department should obtain planting materials is that if only a few hundred plants are to be utilized, it would be more economical to purchase the plant material from commercial sources. However, if many of this type plants are to be established on the rights-of-way, it may prove more economical to grow their own planting stock.

Another economic problem is the cost of establishment of various plants. No dollar cost figures will be utilized in this relationship due to the differences in hourly labor cost.

For bare root planting material, the labor of two men for one hour will be required to plant approximately 200 plants. Normally, two men can plant more than this number, but it must be noted that the planting sites which are being worked are extremely steep and sloping.

Container grown and balled and burlapped shrubs will require approximately 20 minutes of one man's time to dig, prepare the site and plant each plant. In some extremely poor sites, this will require a longer time; and in the better sites, it may not require as much time.

The following cultural practices are needed: watering, fertilizing and pruning. A good estimation of the time required on the job for each plant would be approximately 10 minutes for each operation. This does not include travel time required to reach the plants or time required to transport water to the site. It is extremely important to water the plant material for the first year. The number of times the plants will require water will vary with the amount and timing of the rainfall in the area. It has been found that most sites will require water at least three times and in some cases as many as six times.

Plants are only fertilized and pruned once each year.

SECTION IV

**General Recommendations for
Preservation of Natural Landscape Features**

General Recommendations for
Preservation of Natural Landscape Features

In many sections of Arkansas, we find that our highways have been designed in such a way that rock outcroppings occur along the right-of-way. It is recommended that this type of outcropping be left in its natural state in order to preserve as much of it as possible. If some type of plant material is utilized to cover these areas, normal weathering will be speeded up; and therefore, the erosion process will increase. The only type of plant material which should become established in these types of areas should be those plant species which are seeded into them by natural means.

A highway right-of-way that has wooded areas in the median, as well as along the outer edge of the right-of-way, should be left in its natural state. It is recommended that some type of general fertilization program be conducted in order to stabilize the growth of the wooded areas. This fertilization program can be accomplished at the same time that the grass area ways are being fertilized.

Many times, with a minimum amount of mowing, small trees will begin to grow along the right-of-way. When this occurs, and they are of sufficient distance away from the right-of-way, the erosion control potential of this type of vegetation is of great value. Very little maintenance will be required as the trees become established.

It is recommended that all rock outcroppings, as well as trees which are far enough away from the traveled portion of the roadway, be

preserved to the fullest extent along the highway rights-of-way. This is one of the better procedures for erosion control as well as increasing and improving the appearance of our highways.

SECTION V

**Summary and Implementation
Statement**

Summary and Implementation Statement

Survey of native species and fertility levels of the various soil group associations within Arkansas were conducted with the following results: (1) Most of the native species found were trees with very few vining or clinging type plants. The only native plants found that could possibly be adapted to erosion control might be some type of pine or honeysuckle. (2) The fertility status of soils along the highways were very low in all of the major plant nutrients (calcium, phosphorus and potassium).

The second phase of this research was to determine the best plant materials for erosion control. Two basic types of material were used, bare root planting stock and container grown or balled and burlapped. The best bare root materials utilized in this project were loblolly pine, rose-acasia, american bittersweet, scotch broom, dwarf ninebark, red osier dogwood, crown vetch, fragrant sumac, honeysuckle, ivy, liriope, and certain types of the creeper plants. Of the bare root plantings, certain of the species were discounted due to their low rate of survival. Those plant species which showed promise were pine, rose-acasia, american bittersweet, and scotch broom.

Many different species of low growing junipers and one species of jasmine were utilized. The jasmine could not survive the winters along the highway and was a very poor species. Several of the junipers were well adapted to the function of erosion control.

APPENDIX A
A Guide for the Care and Transplanting
of
Plant Material

The species showing the best promise were: Pfitzer; Blue Pfitzer; Shore; Andorra; a Variegated horizontal; a Prostrate Virginiana; and a Prostrate horizontal. One other balled and burlapped species that has shown good erosion control potential was Santolina.

Species such as Elaeagnus, Cherry Laurel and Ligustrums were utilized in the median for headlight deterrants. All species were fairly well adapted with the exception of the Cherry Laurel.

Implementation Statement

From the research conducted it was found that several plant species can be adapted to the steeply sloping areas of the highway rights-of-way. Better livability can be expected from planting material that is not of a bare root nature.

Specifications as to how far apart each species should be planted is as follows: Bare root material such as pine, 4 feet in each direction; container grown or balled and burlapped species such as shore juniper, 5 feet in each direction.

THE PLANTING AND CARE OF TREES
AND SHRUBS ON HIGHWAY RIGHTS-OF-WAY

A SUPPLEMENT TO THE FINAL REPORT ON HRC-22*

INTRODUCTION

Survival of newly transplanted woody plants on highway rights-of-way requires more careful handling and subsequent aftercare than their counterparts in a home landscape situation. Planting sites on rights-of-way are often steep, droughty and rocky. Successful transplanting is possible only if extra care is taken.

The purpose of this discussion will be to discuss transplanting and care of trees and shrubs with emphasis on highway plantings.

CARE OF PLANTS BEFORE TRANSPLANTING

Bare-root Plants

Among the principal causes of death in transplanted woody plants is drying, especially the roots, before transplanting. The extent of root exposure that a plant will survive varies greatly, some types withstanding very much more than others. The best results are obtained in all cases by reducing exposure to a minimum. The roots should be protected with wet burlap or other moisture holding material from the time that they are dug, even though it is only for a few minutes.

*By Dr. A. J. Langlois, Professor of Horticulture, Arkansas State University.

If for some reason it should be necessary to hold plants for some time after digging, their roots should be covered with soil temporarily, or heeled-in, until planting time. This is usually done by digging a trench large enough to receive the roots. The plants are placed in the trench, usually at an angle, and their roots covered with soil. If the plants are in bundles, these must be opened and roots separated so that all will come in contact with the soil.

Balled In Burlap Plants

Because the soil in the balled plant will provide the plant with moisture and protection from drying out, this class of transplant will require less careful handling than the bare-root ones. If balled plants can be planted within a few days of receiving from the nursery, they can simply be placed on the soil surface and watered as needed. If, however, they will not be planted for an extended period or if they might be subjected to freezing temperatures, they should be grouped together and the balls covered with damp saw dust, wood shavings or some similar material.

Container-grown Plants

In recent years, more and more nurseries are producing shrubs and trees in containers of various types and sizes. Like the balled plants, these are also easy to handle before transplanting. Except for watering, about the only precaution that is necessary is exposure to freezing. This can be accomplished in the same manner as was described for the balled plants.

SEASON TO TRANSPLANT

Bare-root Plants

Deciduous plants (those losing their leaves in winter) are usually the only ones that are moved bare-root. (An exception is pines from forest tree nurseries). They are ordinarily moved while dormant, a period from leaf fall until just before growth starts in spring. In Arkansas, bare-root plants can be transplanted any time during this dormant period as long as soil and weather conditions permit. It is usually considered best to do so early in the dormant period giving the plant a longer period in which root development takes place prior to the appearance of leaves in spring.

Balled in Burlap Plants

Balled plants should also be transplanted during the dormant season, preferably early during this period. They can be transplanted at a later date than the bare-root ones providing that they were dug during the dormant season. Balled plants which are transplanted late in the dormant season or even in the early part of the growing season will require extra care and water and higher mortality can be expected.

Container-grown Plants

This category of plants is undoubtedly the easiest to transplant. Because the entire root system is held by the container, there is little or no damage to the roots during transplanting. Root damage or poor root development following transplanting, which is probably the major cause of death or poor performance of the other two types of transplants, is generally not a problem with container-grown plants. They can usually be

successfully moved at any time during the dormant or growing season. It would be more desirable to transplant such plants in the dormant season, but success is possible if the plants are watered well until they are established.

TRANSPLANTING ESSENTIALS

Soil Preparation

The soils on highway rights-of-way are generally not suitable transplanting soils. Many times the planting site will be on a deep cut of exposed sub soil or on a fill also of sub soil. The transplanting "fill" soil should be "improved" so that it will have a higher water holding capacity and offer a more physically suitable media for new roots to develop in.

"Fill" soil can be improved by adding organic matter, usually peat moss or well rotted leaves, manure or saw dust, to the native soil on the site. If the site soil is very rocky or otherwise undesirable, it will be necessary to haul in top soil from some other site. Usually about 1/4 to 1/3 organic matter by volume is sufficient to render a native soil suitable for transplanting.

Most plants thrive in an almost neutral soil. Soils on Arkansas highway rights-of-way are generally acid. In addition, peat moss is usually acid also. It may be necessary, then, to add a small quantity of lime to the fill soil.

Mineral fertilizers are not usually added to fill soil. There is some danger in burning tender, new roots after transplanting. These, when needed, may be added on the surface of the soil at a later time.

Preparation of The Hole

For bare-root plants, a hole should be dug sufficiently large to take all of the roots without doubling them back and deep enough so that with two to three inches of improved soil in the bottom, the plant will stand at the same depth as in the nursery. Holes for very small plants, such as pine seedlings, are often made at the time of planting (see figure 1) with a dibble, sharp shooter, or mattock.

The hole for balled plants and container-grown plants should be about half again as wide as the diameter of the ball so that the ball can be placed readily and also provide enough space for a suitable quantity of improved soil around and under the ball and still have the plant at the depth it was before transplanting.

Proper Planting

The plant should be set at the same depth it grew in the nursery. This is usually not very difficult with bare-root plants, but holes for larger balled plants should be carefully dug so that the plant will be set at the proper depth.

Very small plants are often set (see figure 1) by making a slit in the soil with a dibble, working it back and forward sufficiently to make an opening, then placing the plant at the proper depth, after which the tool is removed and the soil is firmed around the roots, usually by pressure of the foot or sometimes by another thrust of the tool followed by a push of the handle in such a manner as to press the soil firmly around them.

After placing the larger plant at the proper depth, fine soil should be worked well in among the roots (see figure 2). When the hole is partially

filled, the soil must be firmed either by tramping with the feet or with a blunt stick. The hole should then be filled with loose soil. The soil should be similarly firmed when a balled or container-grown plant is transplanted (see figure 3).

Wrapping material around balled plants need not be removed unless it is of a material that will not deteriorate rapidly. Materials such as burlap will rot easily and do not have to be removed before transplanting.

Containers such as plastic, metal or wood should be removed. This is easily accomplished by wetting the ball, inverting the plant and striking the edge of the container on the edge of a surface, such as a truck bed. Occasionally cans that are not tapered must be cut from the ball if they can not be removed as described above.

If the soil is very dry or if the planting is done late and the weather is hot, or if the plants are evergreen, water should be applied before the hole is finally filled. When it has soaked away, the remainder of the soil should be replaced.

A basin to receive water, at least as large as the diameter of the hole, and about three or more inches deep, should be formed around the base of each newly transplanted tree.

Mulching

After planting, it would be desirable although not entirely necessary, to mulch the plants with two or three inches of peat moss or well-rotted manure, straw or leaves. This will discourage the growth of weeds and help to conserve moisture.

Watering

While the plant is becoming reestablished, it is imperative that an ample water supply be maintained. Evergreens, because they lose water

by transpiration from the leaves even during the winter, require more water than deciduous plants. If the natural rainfall is not enough to keep the ground moist, artificial watering must be substituted.

Proper watering is almost impossible, especially on sloping ground, without the use of a basin about the plant. Watering is best done by pouring on a little and allowing it to soak in, repeating several times until the soil is wet thoroughly to the depth of the roots. Wetting the surface only is useless.

Improper watering is probably the major cause of death in newly transplanted trees and shrubs. Usually watering is necessary only during the first growing season following transplanting. However, if the plant is set in a droughty, or on very compact type soil, watering during the second season may be necessary.

Pruning

After transplanting, 25-30% of the top of deciduous and evergreen shrubs should be cut back in order to reduce leaf surface to compensate for root loss. This will reduce the water requirement of the plant and ultimately improve its survival chances.

Deciduous trees are trimmed in the same way and amount that shrubs are trimmed. The main leader is not removed, but cuts are distributed throughout the head. All cuts are made just above a joint, or, if a branch is to be completely removed, it should be cut off flush with the trunk.

Staking

If there is a possibility of winds swaying and loosening the plant, particularly trees, it should be staked. A simple method is to drive a heavy stake into the ground a few inches away from the trunk

(see figure 4) and by use of wire and piece of hose, or with a piece of soft rope, secure the tree to the top of the stake. With taller trees, three guy wires equidistant around the tree (see figure 4) should be used.

MAINTENANCE

Cultivation

Shrubs and trees need only be cultivated to eliminate weeds. As shrubs mature in size, they will become so dense that weeds will not grow beneath them. After trees have become established and guy wires removed, mowing will control weeds.

Chemical Weed Control

Little information is available on the subject of chemical weed control around shrubs. In addition, this is a rapidly changing field. Manufacturers of herbicides should be consulted before they are used on shrubs and trees.

Watering

Usually the plants will need watering only during the first season following transplanting. However, if the second season is unusually dry or if the plants are on a particularly droughty site, watering during the second season may be necessary.

Fertilizing

Fertilization requirements of trees and shrubs during later years depend upon the fertility of the soil in which the plants are growing. If a need for fertilizer becomes evident, as indicated by short and weak current seasons growth, an application of 10-20-10 or some fertilizer of a comparable analysis should be applied.

Shrubs

Fertilizer applications to shrubs, whether it be to an individual plant or a group in a bed, should be made in spring about the time new growth begins. A precise amount of fertilizer required for each plant is difficult to establish since increasingly larger shrubs will obviously require larger amounts of fertilizer. A rule of thumb, however, for average size shrubs, is approximately four to six ounces of a 10-20-10 or similar fertilizer, broadcast uniformly over the soil surface beneath the plant.

Trees

Moderate fertilization is needed a year after transplanting, assuming the soil is reasonably fertile and the fill soil was prepared as suggested previously.

Complete fertilizers, such as 13-13-13 or a 10-20-10, are commonly used for trees. Nitrogen is the most important element for trees. Use two pounds of either fertilizer, or a comparable amount of other analysis, for each inch diameter of the trunk measured two to three feet above the ground.

The best time to fertilize trees and shrubs is in late winter to spring just before growth starts. The fertilizer may be broadcast on the surface in a ring 5-10 feet wide, under the drip line (edge of branches).

Pruning

Proper pruning of shrubs is essential if their full values are to be realized. There is a general and erroneous belief that all shrubs must be sheared periodically. Such grooming, however, is not adaptable to many shrubs. It destroys the natural beauty and shape of the plant.

Of the many reasons for pruning shrubs, the following are most important: to remove dead, broken, diseased branches; to reduce size; and to control shape or outline. Generally, pruning of plants along the highway should consist of removal of only enough branches to fulfill the objectives listed above.

Trees

Deciduous trees are pruned in much the same way as described previously in the section of pruning newly set plants. In addition, dead and broken branches should be removed close to the trunk or other main branches, never leaving a stub. Care should be taken to maintain the natural shape of the tree.

Usually pruning is done in late winter or early spring. However, some trimming, such as dead branch removal, can be done at any time of the year.

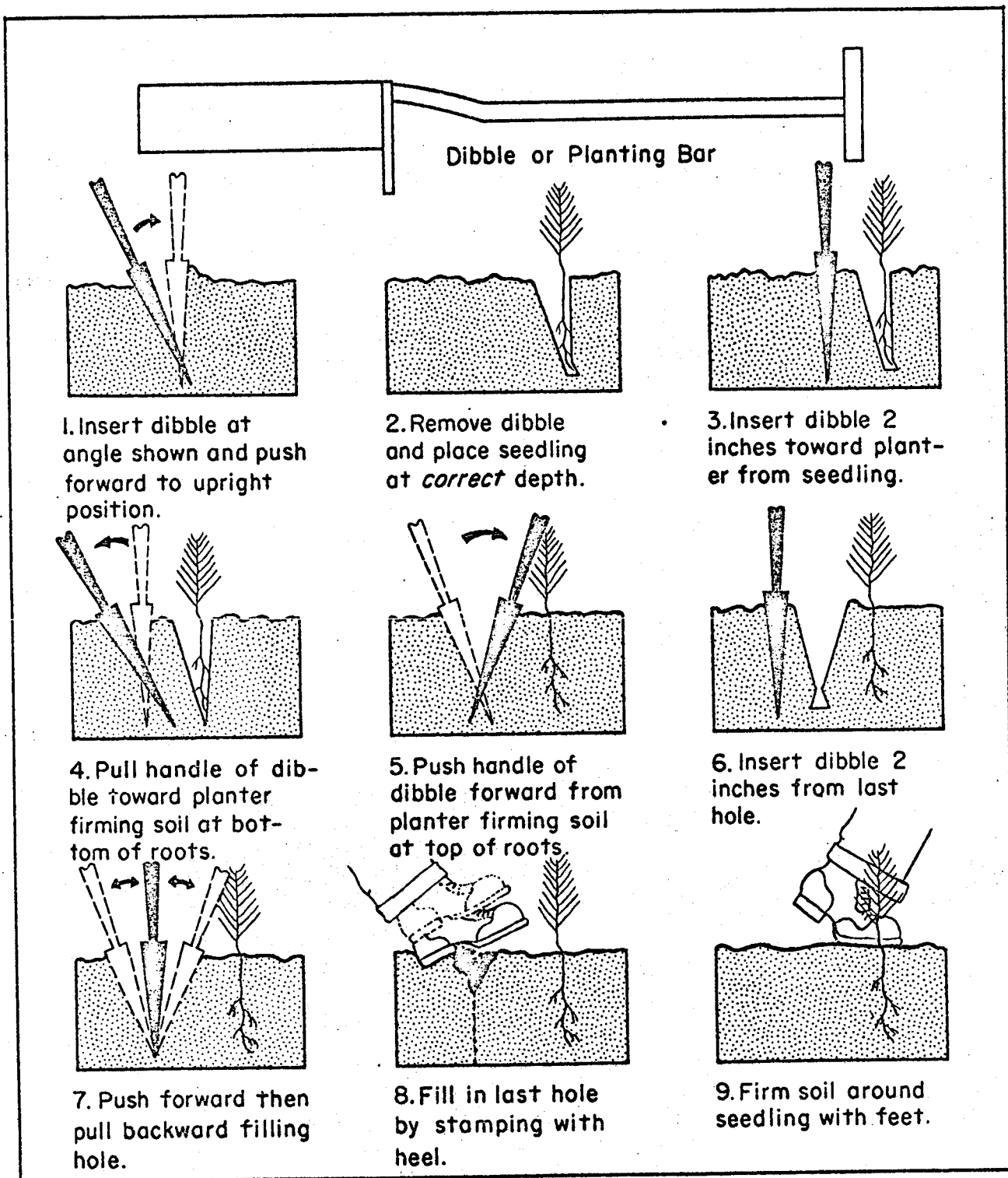


Figure 1
Bar-slit Method of Transplanting

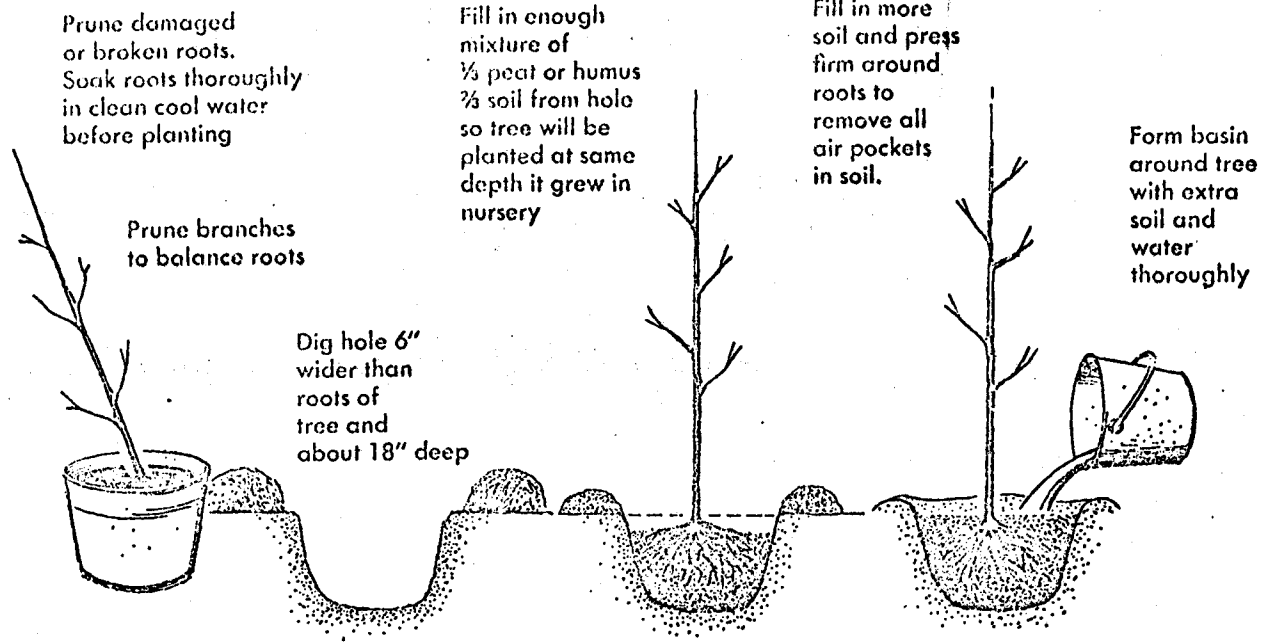


Figure 2
Transplanting Bare Root Plants

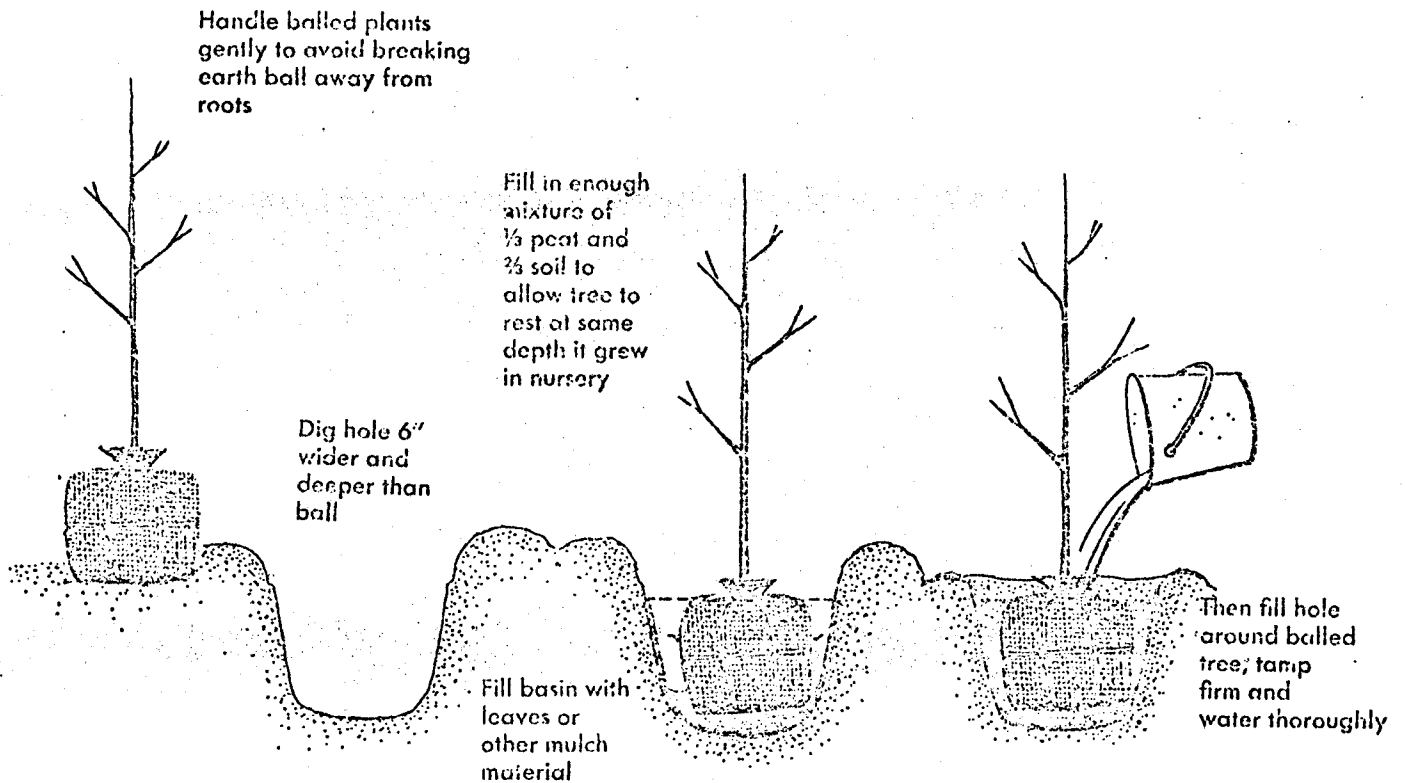
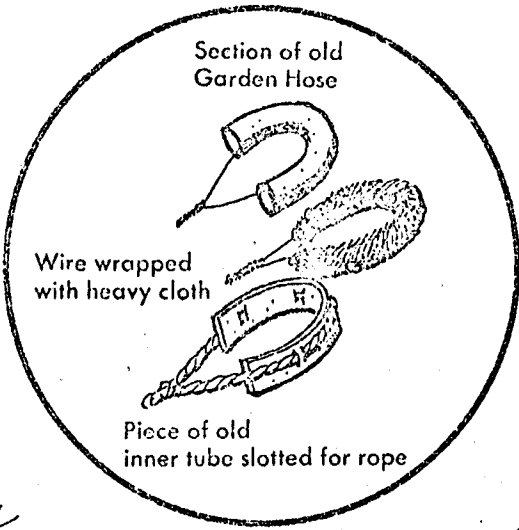
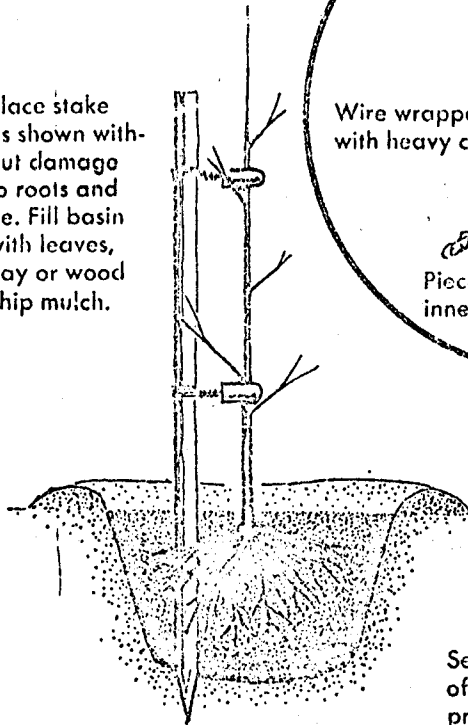


Figure 3
Transplanting Balled In Burlap
or Container-grown Plants

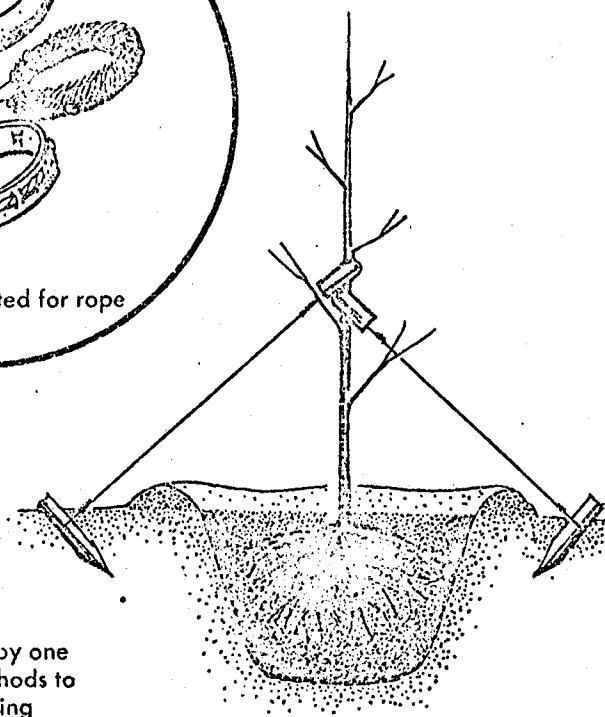
Place stake as shown without damage to roots and tie. Fill basin with leaves, hay or wood chip mulch.



Section of old Garden Hose

Wire wrapped with heavy cloth

Piece of old inner tube slotted for rope



Secure tree by one of these methods to prevent shifting due to wind or accidents.

Figure 4
Staking

APPENDIX B

General Fertilizer and Lime Recommendations

APPENDIX B

GENERAL FERTILIZER AND LIME RECOMMENDATIONS

INTRODUCTION:

Analytical chemical data was obtained from soil samples taken during the first phase of this research project. This data indicated strongly that a complete fertilizer, which is fairly high in nitrogen, phosphorus and potassium should be utilized. Lime should be applied to all plants which are transplanted on Arkansas highway rights-of-way. When transplanting balled and burlapped or container-grown material, this is the time when lime should be applied for best results. Normally, fertilizer should not be utilized the first year due to the limited amount of root system.

TYPE, RATE AND TIME OF FERTILIZER APPLICATION:

A complete mixed fertilizer should be used for plant material used along highway rights-of-way. From soil test data obtained in this research project, it was found that the available phosphorus level of all soils is very low. Certain areas of the state are lower than others, but generally all are low. The available levels of potassium were found to be only moderate in most areas. Nitrogen availability, which is estimated from organic matter content, was found to be moderate in the surface samples but was low in the subsamples.

From the above data, it is concluded that a complete mixed fertilizer such as 10-20-10 needs to be utilized for fertilization purposes on the highway rights-of-way.

The rate of fertilizer to be used must be based upon individual plants because of the variability of size within each group of plants. Also the rate will vary with the type of plant, whether it be ground covering or upright growth. Table 1B lists the amount of 10-20-10 which should not be exceeded for various size and growth types of plants.

TABLE 1B

Amount of 10-20-10 needed for second and subsequent years maintenance of various types of woody plants.

Low growing (such as juniper)

<u>Size of plant</u> <u>Plants that cover:</u>	<u>Pounds fertilizer per plant</u>
A. Approximately 1 sq. ft.	0.03
B. Approximately 2 sq. ft.	0.06
C. Approximately 3 sq. ft.	0.12
D. Approximately 4 sq. ft.	0.15
E. Approximately 5 sq. ft.	0.18
F. 6 or more sq. ft.	0.21

Upright growing (such as Pine and Elaeagnus)

<u>Diameter of stem 6 inches above ground</u>	
G. less than 1 inch	0.05
H. 1-3 inches	0.08
I. 3-5 inches	0.10

The time of fertilization will vary slightly from year to year and from north to south. However, a general rule would be to fertilize in the southern half (South of I40) in mid to late April and those plants north of I40 in late April to early May.

Method of Application should be by hand due to the small amount needed and normally the plants will be on very sloping areas.

RATE AND TYPE LIME TO APPLY:

The correct time to adjust the pH values and add calcium to the growing media is when the plants are being transplanted. When container-grown or balled and burlapped plants are utilized, the lime should be mixed with the soil-peat mixture which is used to cover up the exposed ball.

Two types of liming material will be suitable for the purpose of correcting the pH values. One type will be regular agricultural ground limestone which could be either calcitic or dolomite. Agricultural ground limestone should be used when large areas are to be limed. It is lower in cost than the second type of liming material.

The second type of material which can be used to raise the pH values is hydrated lime (also called water slaked lime or builders lime). This type of material is more expensive than agricultural ground limestone, but it is more convenient to use when only small quantities are required. It can be purchased in 10, 20, or 50 pound bags.

The rate of liming material will vary with the various soil association groups within Arkansas as well as the size of planting site utilized. The soil association groups are listed on the Generalized Soil Association map, State of Arkansas, which is prepared by the Soil Conservation Service in cooperation with the University of Arkansas.

Table 2B gives the amount of lime needed to adjust the pH for three different size planting sites within the various soil associations. (These rates are based on the use of one-third of the mixture being peat.)

TABLE 2B

Rate of limestone for transplanting in the various soil areas of Arkansas

<u>Soil Association</u>	<u>Size of Opening</u>		
	<u>1'x1'x1'</u> <u>lb. lime</u>	<u>1.5'x1.5'x1.5'</u> <u>lb. lime</u>	<u>2'x2'x2'</u> <u>lb. lime</u>
Loessial Hills	0.4	0.6	0.8
Loessial Terraces	0.3	0.45	0.6
Ozark Highland Sandstone Limestone	0.1	0.15	0.2
Ozark Highland	0.3	0.45	0.6
Arkansas Valley	0.4	0.6	0.8
Boston Mountain	0.5	0.75	1.0
Ouachita Mountains	0.4	0.6	0.8
Coastal Plain	0.3	0.45	0.6
Delta or Bottom-land	0.3	0.45	0.6

The amounts of lime recommended should be repeated at approximately four to six year intervals. The method of applying the second and later lime applications will be by placing the lime on the surface and allowing rainfall to slowly leach the calcium into the soil.

SUMMARY:

A general recommendation for fertilizer and lime use on trees and shrubs on highway rights-of-way has been suggested. The rate of fertilizer will vary due to the size of plants which are being fertilized. The analysis of fertilizer used should be one which has a relatively high amount of phosphorus in relation to nitrogen and potassium. Limestone rates varied from one soil association area to another because of the basic pH value differences within Arkansas.

This is only a general recommendation and it is strongly suggested that if extensive plantings are to be made that soil test samples be obtained from the individual sites, then more specific recommendations could be made and some fertilizer and lime rates could vary within soil association areas. Also, lime recommendations are made upon the use of approximately 30 percent acid peat being utilized. If peat is not used the rate of lime should be reduced by approximately one-third.

