8-1980

Bedding as a Factor in the Survival and Total Height of Two Year Old Planted Loblolly Pine Seedlings in East Texas

Edgar Wilkins
Stephen F Austin State University

Bedding as a Factor in the Survival and Total Height of Two Year Old Planted Loblolly Pine Seedlings in East Texas

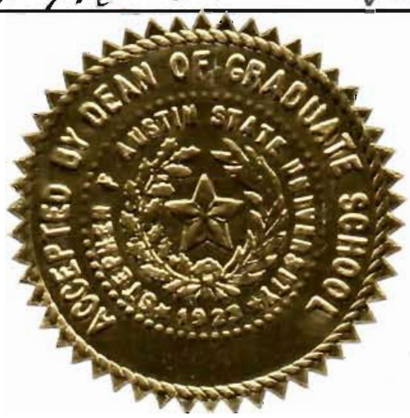
BEDDING AS A FACTOR IN THE SURVIVAL
AND TOTAL HEIGHT OF TWO YEAR OLD PLANTED
LOBLOLLY PINE SEEDLINGS IN EAST TEXAS

APPROVED:

Kenneth G. Watterston
(Thesis Director)

James E. Howard

M. Victor Bilan



Edwin W. Gaston Jr
Dean of the Graduate School

BEDDING AS A FACTOR IN THE SURVIVAL AND TOTAL HEIGHT OF TWO YEAR OLD PLANTED LOBLOLLY PINE SEEDLINGS IN EAST TEXAS

by

EDGAR C. WILKINS, B.S.F.

Presented to the Faculty of the Graduate School of
Stephen F. Austin State University
In Partial Fulfillment
of the Requirements

For the Degree of
Master of Science in Forestry

STEPHEN F. AUSTIN STATE UNIVERSITY
August, 1980

ACKNOWLEDGMENTS

The author is especially grateful to his major professor, Dr. Kenneth G. Watterston for his guidance and counsel throughout this research endeavor. Appreciation is also extended to Dr. M. Victor Bilan, Dr. James Howard, and Dr. George Rink, for their unselfish devotion of time and patience spent in assisting me. The author is also grateful to Dr. Leon Young for his invaluable assistance in soils analysis.

A special debt of gratitude is extended to my former employer, Southland Paper Mills, Inc., and to my present employer, St. Regis Paper Co., without whose generous and unselfish support, this project would not have been pursued.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Cultivation is the art and science of managing the physical condition of the soil to provide a favorable root environment for plant growth. The rooting habit of a tree is determined by its heredity and by the environment in which it grows. Soils must provide the necessary water, air, nutrients, anchorage, and warmth for root metabolism and development. The quantity and quality of these ingredients vary among soils with a resulting variation in tree productivity. An ideal soil for root development has been described as having 50% solids (45% mineral and 5% organic), 25% air and 25% water at field capacity (Moehring, 1970). The air capacity of soils is largely determined by the arrangement of individual soil particles. In sand, this arrangement usually results in large air capacity but low water retention. However, in single grain, silty soils with few large pores and many micropores, aeration is often deficient but with high water retention ability. Soil aeration is further impaired by factors limiting soil drainage evident on flat and concave landforms where surface water movement is slow. This results in ponding and reduction of aeration in the upper soil profile.

Granular structured soils provide a better balance between macro and micropore volumes and allows both good aeration and water retention. Such structure develops best in soils with high organic matter content and numerous microorganisms, such as the surface soils. In the subsoils, structure becomes blocky and massive, usually with an abrupt reduction in air capacity.

The actual physical resistance to root penetration is probably related to a combination of factors: (1) soil strength, (2) the size and structural rigidity of soil pores, (3) high soil bulk density, (4) and insufficient gas diffusion to the root. Reduced aeration and soil resistance to root penetration are most often associated with mechanical disturbance of the soil (Moehring, 1970).

The practice of bedding is a form of cultivation for the purpose of improving the soil conditions conducive to plant growth. Frequently, in the process of regenerating certain sites to pine, soil types and slopes encountered require that some degree of cultivation be conducted before pine can be successfully established. Areas subject to flooding which will not support pine seedlings can be made to do so by the construction of raised beds. The pine seedlings are then planted on top of the beds, thus allowing the seedling root system to be above the saturated soil. Also, both clay and compacted soils which resist root penetration can benefit greatly from the aeration provided as a result of bedding.

LITERATURE REVIEW
(Published Material)

A number of investigators working in wet sites from Florida to North Carolina have reported large gains in early growth of loblolly pine (P. taeda, L.) and slash pine (P. eliottii, Engelm.) as a result of elevating beds or ridges 5 to 8 inches high with plows or discs (Bethune, 1963; Mann and McGilvray, 1974; Shultz and Wilhite, 1973; Terry and Hughes, 1975). Successes in the Southeast, predominantly on sandy loam soils, led to studies further west on heavier, siltier soils common in the flatwoods of Southwest Louisiana and Southeast Texas. The earliest bedding studies on these problem sites have been in progress since 1960 (Mann and Derr, 1977).

In a study conducted by Mann and Derr (1970) loblolly and slash pine seedlings at age 5 years on furrowed, flat disced, and mound disced (bedded) plots were significantly taller and larger in diameter than those planted on unprepared plots. Both loblolly and slash pine seedlings were hand-planted on 4 acre plots with treatment as follows:

A. CHECK - Seedlings planted in undisturbed heavy grass rough.

B. FURROWED - Furrows 3 to 4 inches deep and about 4 feet wide edge to edge of the berm were plowed with fire units 11 months before planting.

C. FLAT DISCING - Strips were double-disced in the summer before planting with a heavy-duty offset disc that cut about 4 inches deep.

D. MOUND DISCING (Bedding) - Also, in the summer, plots were cut twice with a terracing disc that made mounded strips 7 feet wide and about 1 foot in elevation from the bottom to crest.

Spacing was about 6 x 8 feet on a three percent slope. The soil was a Beauregard silt loam (Plinthaquic Paleudult).

RESULTS - Slash

1. The results on the slash pine indicated that none of the site treatments significantly influenced first year survival which ranged from 83% to 92% on the furrowed plots.

2. The mortality was low in all treatments, averaging 12%.

3. Site treatments were equal in promoting height growth.

4. At age 5 slash averaged 10.3 feet on unprepared plots and 11.5 to 11.9 feet on the prepared plots.

5. Similar differences were found with the 100 largest trees per acre. They averaged 13.6 feet in height on the check and 14.8 feet on the prepared plots.

RESULTS - Loblolly

1. Initial survival of loblolly was high with an average of 92% ... with the exception of the mound-disced plot.

... lower than on

... heck-plots and

... ater on prepared

... tter or to poorer

... planted trees.

... at some of the

... prepared and un-

... ing with age.

... ghly equivalent to

... wth shortens the

... r failed to show a

... nsive and consider-

... uipment and logging

In Britain, extensive areas of upland heath have been successfully reforested with conifers through the use of raised beds or "riggs" (Read, Armstrong, and Weatherell, 1973). This treatment has a structure designed to increase run-off and improve drainage. Since the top of the "rigg" is elevated above the undisturbed soil surface, there is an increase in the potential rooting depth available above the water table.

Measurements of oxygen status indicate it was higher at 50 cm in depth in the "riggs" than in other treatments such as furrowing and deep plowing.

Cultivation in any form is seen to stimulate growth compared to plots receiving no cultivation. The most effective cultivation treatment at the time of this study was the "riggs" in which tree heights are more than 30 cm greater than those of any other treatment. The study also proved that drainage and aeration were improved by cambered beds or "riggs".

At the time of the study it was not certain whether soil amelioration was facilitating better growth directly by permitting deeper root penetration or whether the improved aeration was stimulating microbial growth and release of nutrients which were previously unavailable.

From the standpoint of tree growth, the "rigg" has another advantage in that the soil horizons of which it is constructed are largely organic, providing the most concentrated source of soil nutrients. Also, by establishing oxydizing conditions in the rooting environment, the mineralization of nutrients is greatly speeded up.

In wet sites, there is reason to believe that the drainage and aeration will improve as a function of the height of the "rigg" above the saturated horizon.

It was concluded in the British study that the better growth on the "riggs" was thought to arise from a combination of deeper root penetration and increased microbial release of nutrients. (Read, Armstrong, and Weatherell, 1973).

In a study conducted by Mann and Derr, (1970), on Caddo-Beauregard silt loam (Plinthaquic Paleudult), 8 year old loblolly and slash pine on flat disced and bedded plots were 2.2 to 2.7 feet taller than those on unprepared check plots. Beds were about 6 inches higher than normal soil surface following settling.

In both species, the response to the site treatment was consistent over the span of the study.

Linnartz and McMinn (1973) conducted a study on growth of two slash pine varieties following site preparation in South Florida. The sites were flatwoods, almost level, with acid sands with poor surface drainage - subject to both drought and flooding. Site preparation consisted of burning, chopping, double-chopping, clearing, and bedding. Control plots were untreated.

Clearing and bedding produced the best improvement in growth. Double-chopping greatly improved growth at several locations but not as much as with bedding and clearing.

Many of the height differences were evident 5 years after planting, and growth from the fifth through the tenth year was also considerably increased by site preparation. Five years after planting, bedding had greatly improved growth at four of six locations of slash pine. From the fifth through the tenth year, significant increase in growth on bedded plots occurred on only one of six plantings.

Clearing alone more drastically reduces competing vegetation but bedding produces the additional effect of altering soil-water relationships. It is possible that the improvement in soil-moisture relations and aeration attributed to bedding have their greatest effect on tree growth during early stages of development or until root systems become fully developed. Then as root mass increases to more fully utilize the site, competition with other vegetation may become the most important factor. (Linnartz and McMinn, 1973)

O. G. Langdon (1962) conducted a study in which two exploratory test plantings of 180 and 200 trees each were established in La Belle, Florida. The purpose was to determine if a difference in survival and height growth could be demonstrated by planting in different positions on a ridged, furrowed planting site. One planting was in an old field at the edge of a wet slough, and the other was on a poorly drained cutover pine flatwoods. In the old field, seedlings were planted in furrow centers and on ridges.

Seedlings in the other location were established in three planting positions: (1) in the furrow centers, (2) at the furrow edge, and (3) on the ridges.

Survival by planting position in the old field area was significantly better on the ridges (91%) than in furrows (24%). Five years after planting, the seedlings planted on the ridges grew considerably better than those planted either in furrow centers or at the furrow edges. Height growth differences between treatments appear to be still increasing at 5 years.

The combined results of these two studies at 5 years showed that the slightly elevated ridge planting position had superior growth in both studies and better survival in one.

Mann and Derr (1977) in a series of bedding studies conducted in Southwest Louisiana observed growth responses by slash and loblolly pine. Of the 6 studies conducted, 5 included two species, slash and loblolly pine - one, a three-year-old installation, tested slash pine alone.

Treatments common to all tests were untreated check, thorough flat discing, and flat discing plus bedding. The method of constructing beds varied as improved implements became available. In the early trials, modified agricultural tools produced beds that were rough, full of air pockets, and usually had a narrow base. Later, an implement developed for forest land bedding was used; it has 6 cutting discs for finer soil pulverization and a shaping roller that compacts the bedded soil. The bed extends about 8 inches above ground line before settling and is about 8 feet wide. Soils included in the bedding trials are Wrightsville, (Typic Glossaqualf) which is very poorly drained and unproductive without treatment; Caddo, (Typic Glossaqualf) which has poor to good drainage and quality; and Beauregard, (Plinthaquic Paleudult), normally does not include excessively wet areas.

Bedding reduced initial survival of loblolly pine significantly in 2 of 5 tests and of slash pine in 1 of 6 tests. Thorough flat discing reduced first year survival of slash pine significantly in one test; otherwise, it had little effect. Combined results of all tests show that differences in survival between treatments were smaller at age 5 than age 1 and none were highly important.

For loblolly pine, the merits of bedding are less convincing than for slash. In each of the five tests that included loblolly, bedded plots showed added height but in only one test was the increase significant. In this study, flat discing was as effective for loblolly as bedding. Loblolly is so sensitive to changes in site quality within a test location that variation within treatments was high in every test. Consequently, statistical significance could not be shown. The main reward for bedding poorly drained soils in the West Gulf area apparently is a modest increase in height growth.

Discing plus bedding reduces first-year competition considerably, and elevating the planting location on saturated soil should also improve survival. Yet, this treatment increased first year mortality in some plantings. Some poor results in early tests were attributed to rough, unsettled beds full of air pockets. Improved equipment makes a firmer bed; so survival should not be a problem if the soil is allowed to settle for 2 to 3 months before planting.

REVIEW

(Consensus Material)

In an effort to determine consensus held by industrial forestry practitioners on the benefits of bedding for site preparation, 24 timber industries in the South and Southeastern United States were polled of which 21 responded. The following reflect their experiences with bedding.

Research conducted by a paper company in Georgia justifies their program of bedding approximately 90 percent of the planting acreage in the Savannah area. Dry, upland sites as well as wetlands are bedded. Their conclusions are based on a study of an 11 year old loblolly pine plantation.

A 12 year old study of slash pine, (Pinus elliottii, Engelm.) on moderately drained spodosols near Gainesville, Florida, indicated bedding had a very positive effect on growth.

An 8 year old study conducted by another respondent in the somewhat poorly drained to poorly drained flatwoods in Southeast Georgia shows the same trend. Measurements at 2, 4, 5, and 8 years indicate bedding has a positive effect on growth.

In Alabama, another timber industry has concluded that bedding has a positive effect on growth and survival on wet sites and upland, heavy clay soils.

One Georgia timber industry is bedding all planting sites. Results based on observations indicate bedding on bottomland and upland sites increases height growth, particularly in the first few years. Height growth and survival are greatly enhanced by bedding on wetter sites.

Bedding has been used on a "large percentage of site prepared land" by a paper company in Virginia. They have concluded from observations that it is necessary to bed on wetter sites to assure satisfactory seedling survival.

Another company in Georgia uses bedding prior to planting pine seedlings on the poorly drained sites. They have determined that bedding on these sites increases survival. Over 40,000 acres of bedded sites have been planted in loblolly pine in Central Alabama. They have been bedding upland sites since 1970 and are convinced that bedding has a distinct positive effect on both survival and growth on the upland sites.

A South Carolina landowner employs bedding on most planting sites. Their research results indicate that bedding not only increases height growth of loblolly pine seedlings but is also the most economical site preparation technique for providing a planting site resulting in fast initial growth on all sites.

Summary of Review

The following is a listing, in order of importance, of the benefits derived from bedding as evaluated by those polled:

1. Favorable soil cultivation and aeration.
2. Effective control of vegetative competition.
3. Increased absorption and retention of moisture on the slopes.
4. Appears to increase nutrient availability.
5. More favorable anchorage for seedlings provided the beds are allowed to settle.
6. Row spacing is predetermined making stocking levels more controllable.

EXPERIMENTAL PROCEDURES

Study Areas

Two sites were selected in Angelina County, Texas (Figure 1) - one upland site and one bottomland site (Figures 2 and 3). Both sites were cleared, windrowed and burned. Two sample areas were chosen on each site. Particular caution was exercised in selecting sample areas on a given site so that they would be similar in slope, soils, drainage, adjacent openings, and timber stands. The sample areas on the bottomland site were part of a total of 133 acres. The sample areas on the upland site were part of a total of 912 acres. Soil series involved in this study are Marietta loam (Aquic Fluventic Eutrocrept) on the bottomland site and Rosenwall (Aquic Hapludult) on the upland site (Appendix).

Field Procedures

Both sites were bedded with the exception of a 20 acre area in the bottomland and an 18 acre area on the upland. These 2 were used for establishment of check plots. The 2 sites were then mechanically planted at a spacing of 6 by 12 feet with one year old loblolly pine nursery stock from the St. Regis nursery in Jasper County, Texas.

Ten 100 foot linear (or row) plots were then established on each bedded and unbedded area for a total of 40 sample plots. For sampling purposes, every fifth row was used as a plot on each site with the exception of the unbedded bottomland area where the distance between windrows would not allow the use of every fifth row. In this case, every fourth row was used.

At the end of the second growing season the total height was measured and survival recorded for each plot.

Seven random soil samples were taken with a soil tube on each of the 40 plots for a total of 280 sample cores, one inch in diameter and six inches in length. Sample extractions were approximately 14 feet apart in the row.

Slope for each of the four sample areas was determined with the use of a Dumpy level.

Bottomland

Upland

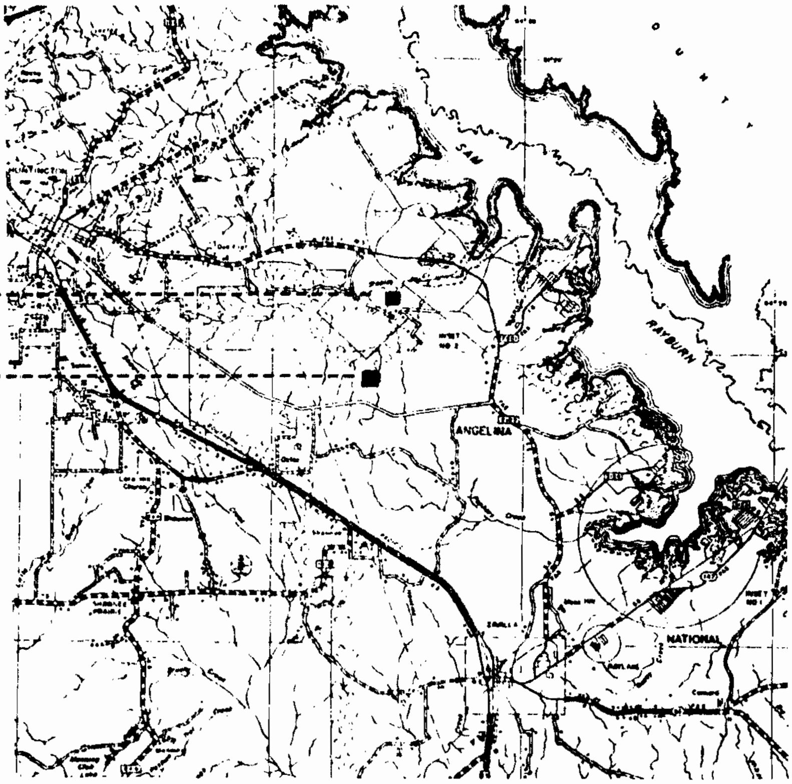


Figure 1. Location of study areas.

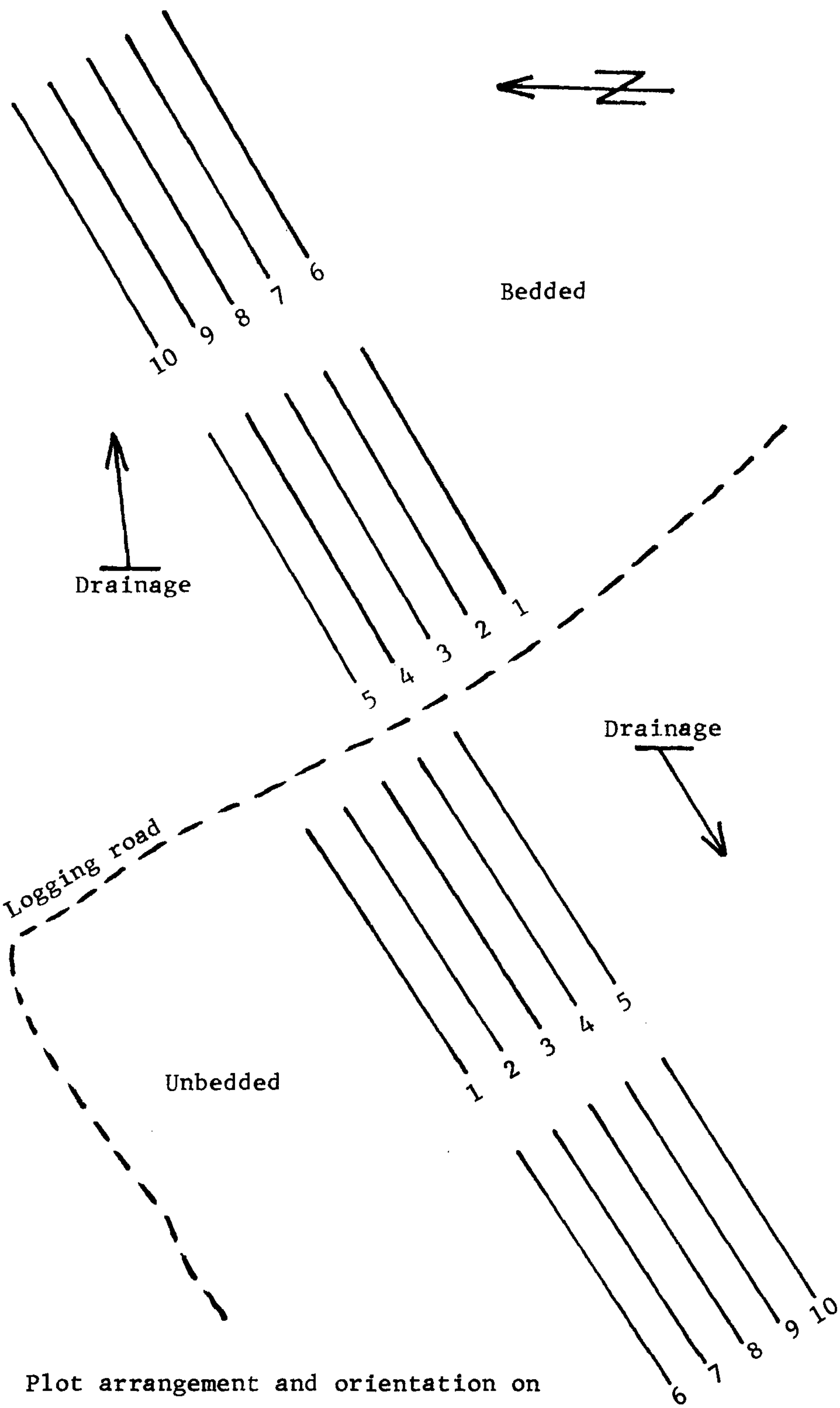


Figure 2. Plot arrangement and orientation on upland site.

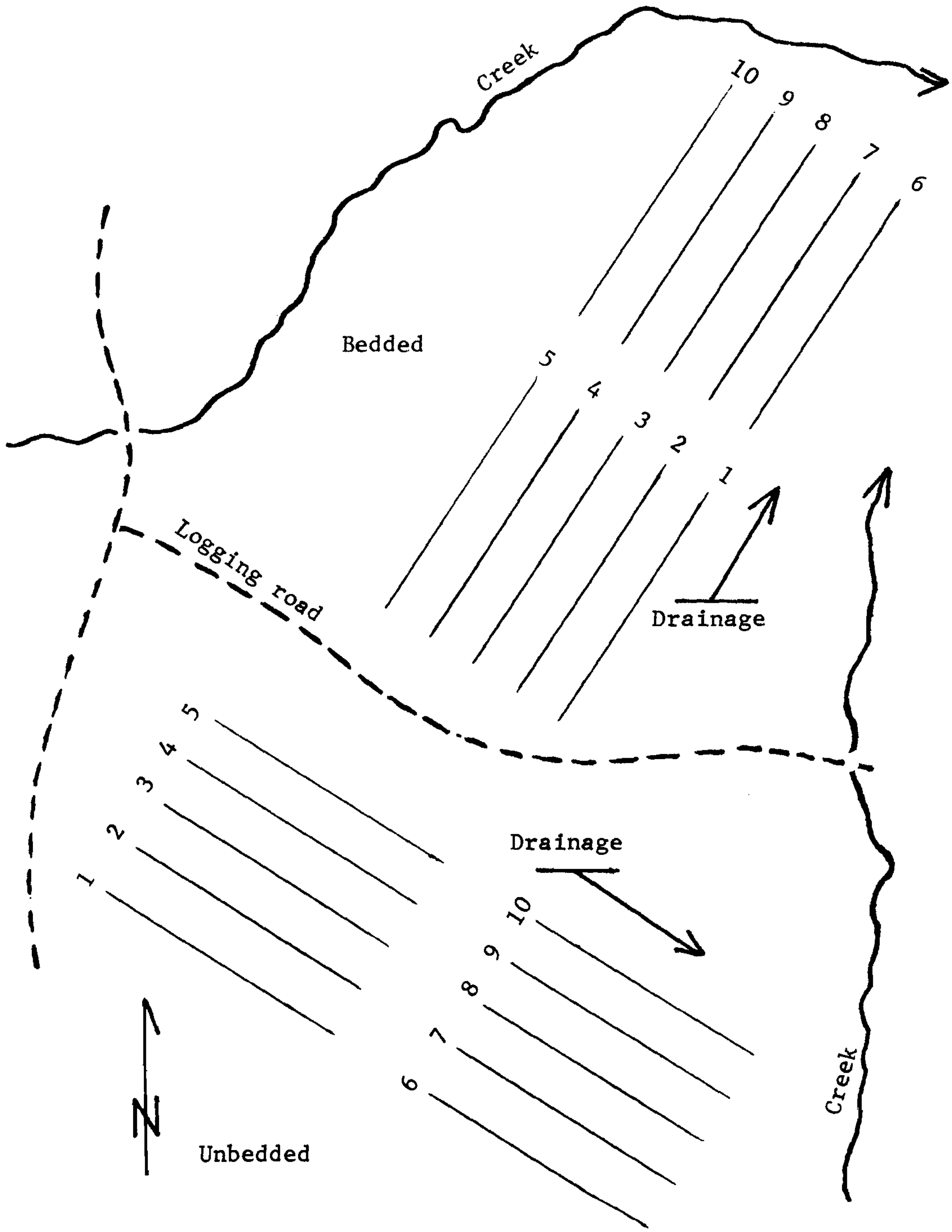


Figure 3. Plot arrangement and orientation on bottomland site.

Laboratory Procedures

The seven soil samples from each plot were thoroughly mixed with the resulting composite representing the plot from which the samples came. The following chemical and physical properties were determined: pH, calcium, phosphorous, potassium, magnesium, and textural class.

Percent of sand, silt, and clay were determined by the Buoyoucos Hydrometer Method. The determination of pH and the chemical analysis was by standard soil testing procedure at the State Soil Testing Lab at Stephen F. Austin State University. Textural class was determined with the use of the textural triangle.

Data Analysis

The sources of variation and degrees of freedom to be used in analysis of variance are as follows:

Table 1. Basis of data for analysis.

Source of Variation	Degrees of Freedom
Site	1
Treatment	1
2-Way Interactions Site - Treatment	1
Residual	36
Total	39

RESULTS AND DISCUSSION

Seedling Survival

Analysis of variance indicated that site did not have a significant effect on seedling survival (Table 2). However, the effect of treatment on survival was significant at the 1 percent level (Table 2).

Seedling Height

Seedling height variation between sites was significant (Table 3). Treatment did not have a significant effect on height (Table 3).

Nutrient Elements

Variation in soil calcium was significant between sites and non-significant between treatments (Table 4). There was an average of 485 pounds more per acre of calcium on bottomland than on upland, a difference of 45 percent. By treatment, there was an average of 50 pounds more per acre of calcium on unbedded plots than on bedded plots, a difference of 2 percent (Table 14).

Analysis of variance indicated that phosphorous levels varied with both site and treatment (Table 5). Chemical analysis of the soils indicate there were 6.7 pounds per acre of phosphorous on bottomland sites

Table 2. Analysis of variance of site and treatment effects on seedling survival.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	624.87	624.87	2.85
Treatment (2)	1	5264.69	5264.69	24.01**
2-Way Interaction	1	133.60	133.60	.61
Residual	36	7893.25	219.26	
Total	39	13916.41	356.83	

Table 3. Analysis of variance of site and treatment effects on seedling height.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site [(1)]	1	233.28	233.28	5.30*
Treatment [(2)]	1	162.40	162.40	3.69
2-Way Interaction	1	342.25	342.25	7.78**
Residual	36	1,584.42	44.01	
Total	39	2,322.33	59.55	

Table 4. Analysis of variance of site and treatment effects on soil Ca.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site [(1)]	1	2,401,000.00	2,401,000.00	19.11**
Treatment [(2)]	1	9,000.00	9,000.00	.07
2-Way Interaction	1	441,000.00	441,000.00	3.51
Residual	36	4,524,400.00	4,524,000.00	
Total	39	7,375,000.00	189,102.56	

** Significant at 1 percent level.

* Significant at 5 percent level.

(1) Upland and bottomland.

(2) Bedded and unbedded.

and 6.2 pounds per acre on upland sites, indicating that phosphorous levels were 8 percent greater on bottomland than on upland (Table 5). By treatment, there was an average of 8.2 pounds of phosphorous per acre on bedded plots as opposed to 4.8 pounds per acre on unbedded plots, indicating phosphorous levels were 70 percent greater on bedded areas (Table 14).

Variation of site had a significant influence on potassium levels while the influence of treatment on potassium levels was nonsignificant (Table 6). Laboratory analysis indicated there were 195 pounds per acre of potassium on bottomland sites as opposed to 291 pounds per acre on upland sites. Potassium content was 49 percent greater on upland than on bottomland (Table 14). Potassium levels on bedded areas were 293 pounds per acre compared to 271 pounds on unbedded areas. Potassium content was 8 percent greater on bedded than on unbedded (Table 14).

Table 5. Analysis of variance of site and treatment effects on soil P_2O_5.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	2,924.10	2,924.10	9.63**
Treatment (2)	1	2,131.60	3,131.60	7.02**
2-Way Interaction	1	4,000.00	4,000.00	13.17**
Residual	36	10,930.21	303.62	
Total	39	19,985.91	512.46	

** Significant at 1 percent level.

* Significant at 5 percent level.

(1) Upland and bottomland.

(2) Bedded and unbedded.

There was a significant variation among both site and treatment on magnesium levels (Table 7). Chemical analysis indicated unbedded areas had a magnesium content 24 percent greater than bedded areas. Also, upland had a magnesium content 24 percent greater than bottomland (Table 14).

Table 6. Analysis of variance of site and treatment effects on soil K_2O.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	122,544.88	122,544.88	9.81**
Treatment (2)	1	47,196.90	47,196.90	3.78
2-Way Interaction	1	95,452.88	95,452.88	7.64**
Residual	36	449,622.44	12,489.51	
Total	39	714,817.13	18,328.64	

Table 7 Analysis of variance of site and treatment effects on soil Mg.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	83,722.50	83,722.50	10.48**
Treatment (2)	1	61,622.50	61,622.50	7.71**
2-Way Interaction	1	58,522.50	58,522.50	7.32*
Residual	36	287,610.06	7,989.17	
Total	39	491,477.56	12,601.99	

** Significant at 1 percent level.

* Significant at 5 percent level.

(1) Upland and bottomland.

(2) Bedded and unbedded.

Soil pH and Soil Texture

Variation between site and treatment on soil pH and soil texture was nonsignificant (Table 8 and Table 14). Soil pH on bottomland was .3 greater than on upland and .1 greater on bedded than on unbedded (Table 14).

Analysis of variance indicated that variation of clay content was nonsignificant between bottomland and upland. However, there was a significant variation of clay content among treatments (Table 10). Laboratory analysis indicated there was 27 percent clay content on bottomland sites and 29 percent clay on upland. Bedded areas had 26 percent clay content compared to 30 percent clay content on unbedded.

Table 8. Analysis of variance of site and treatment effects on soil pH

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	69.17	69.17	1.36
Treatment (2)	1	44.94	44.94	.89
2-Way Interaction	1	41.21	41.21	.81
Residual	36	1828.24	50.78	
Total	39	1983.56	50.86	

Table 9. Analysis of variance of site and treatment effects on soil texture class.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	.40	.40	.50
Treatment (2)	1	.00	.00	.00
2-Way Interaction	1	6.40	6.40	8.00**
Residual	36	28.80	.80	
Total	39	35.60	.91	

Table 10. Analysis of variance of site and treatment on soil texture - clay.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	31.87	31.87	1.49
Treatment (2)	1	102.51	102.51	4.78*
2-Way Interaction	1	238.65	238.65	11.14**
Residual	36	771.49	21.43	
Total	39	1,144.51	29.35	

Table 11. Analysis of variance of site and treatment on soil texture - silt.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	912.42	912.42	10.60**
Treatment (2)	1	276.24	276.24	3.28
2-Way Interaction	1	426.17	426.17	4.95*
Residual	36	3,099.65	86.10	
Total	39	4,714.48	120.88	

** Significant at 1 percent level.

* Significant at 5 percent level.

(1) Upland and bottomland.

(2) Bedded and unbedded.

Variation of silt content among sites was significant at the 1 percent level. Among treatments, silt variance was nonsignificant (Table 11). Mechanical analysis indicated bottomland had 11 percent greater silt content than upland and bedded areas had 4 percent greater silt content than unbedded.

Sand content variation among sites was significant at the 1 percent level. Among treatments, sand content variance was nonsignificant (Table 12). Laboratory analysis indicated sand content on bottomland sites was 9 percent greater than on upland sites. Bedded areas had 1 percent greater sand content than unbedded sites.

Table 12. Analysis of variance of site and treatment effects on soil texture - sand.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Site (1)	1	1,458.02	1,458.02	17.00**
Treatment (2)	1	37.21	37.21	.43
2-Way Interaction	1	255.14	255.14	2.97
Residual	36	3,088.19	85.78	
Total	39	4,838.56	124.07	

** Significant at 1 percent level.
* Significant at 5 percent level.
(1) Upland and bottomland.
(2) Bedded and unbedded.

Evaluation of results based on comparison of field data also indicates that bedding had a distinct, positive effect on survival on both upland and bottomland sites (Figures 4 and 5). Average survival on

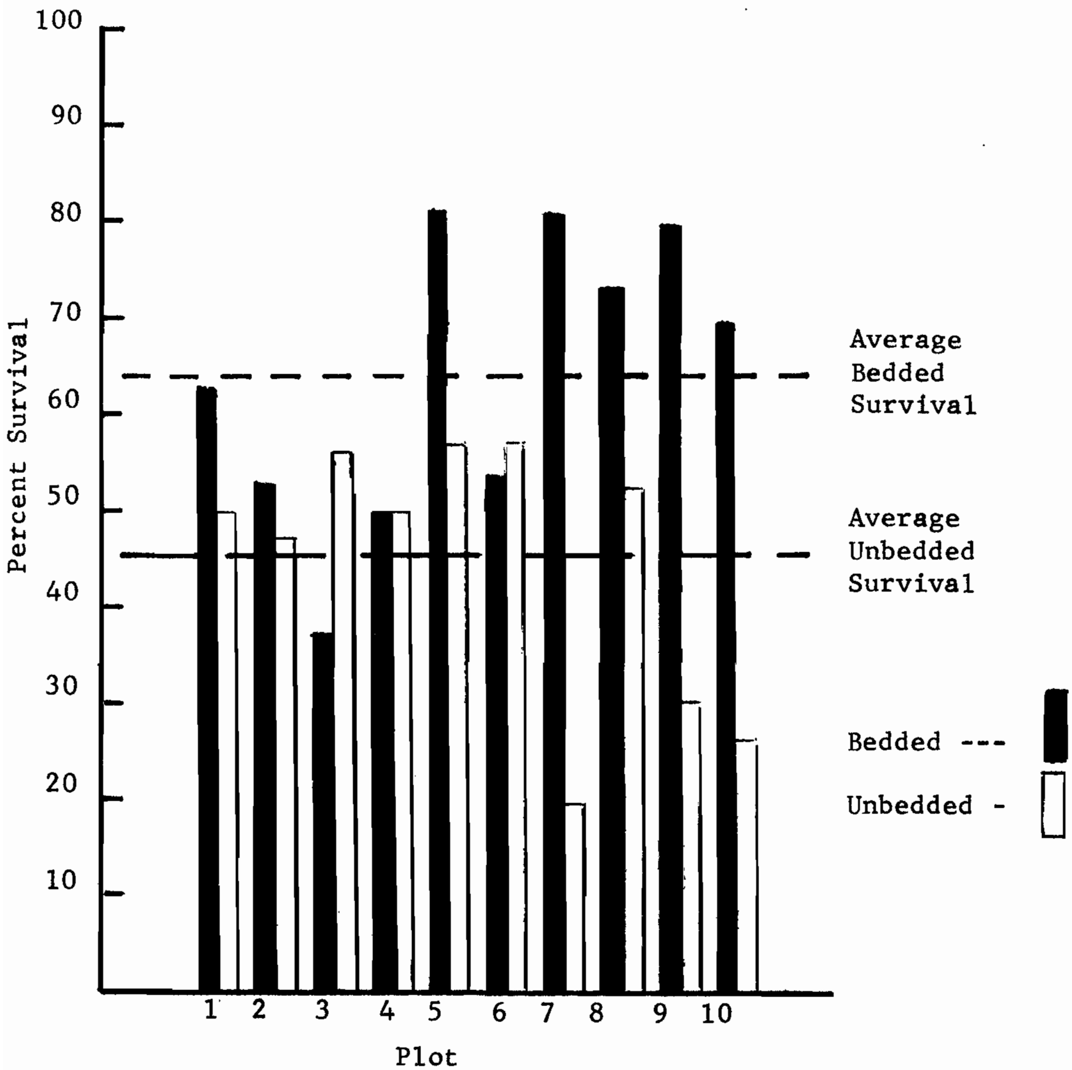


Figure 4. Percent seedling survival by plot on bottomland, bedded and unbedded.

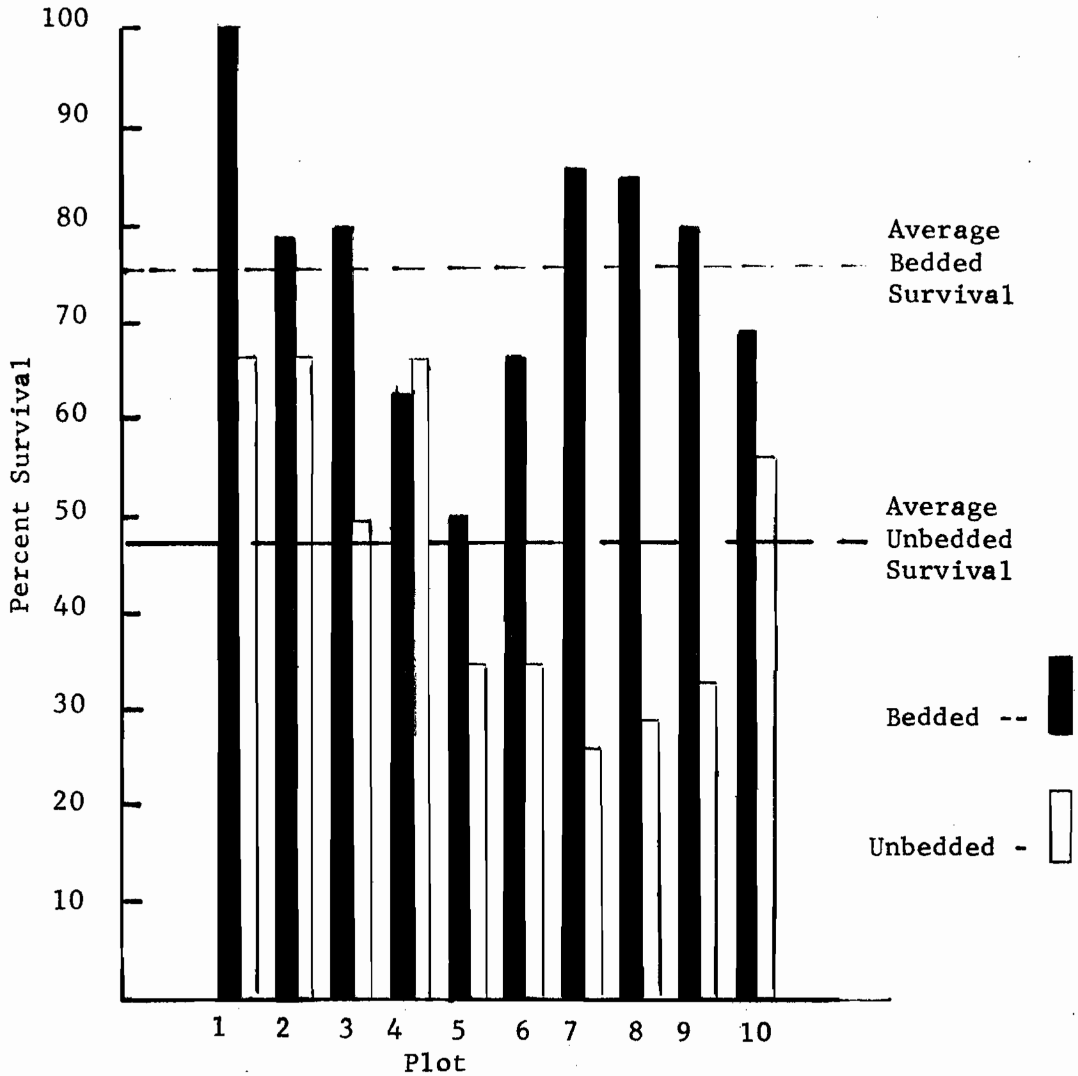


Figure 5. Percent seedling survival by plot on upland, bedded and unbedded.

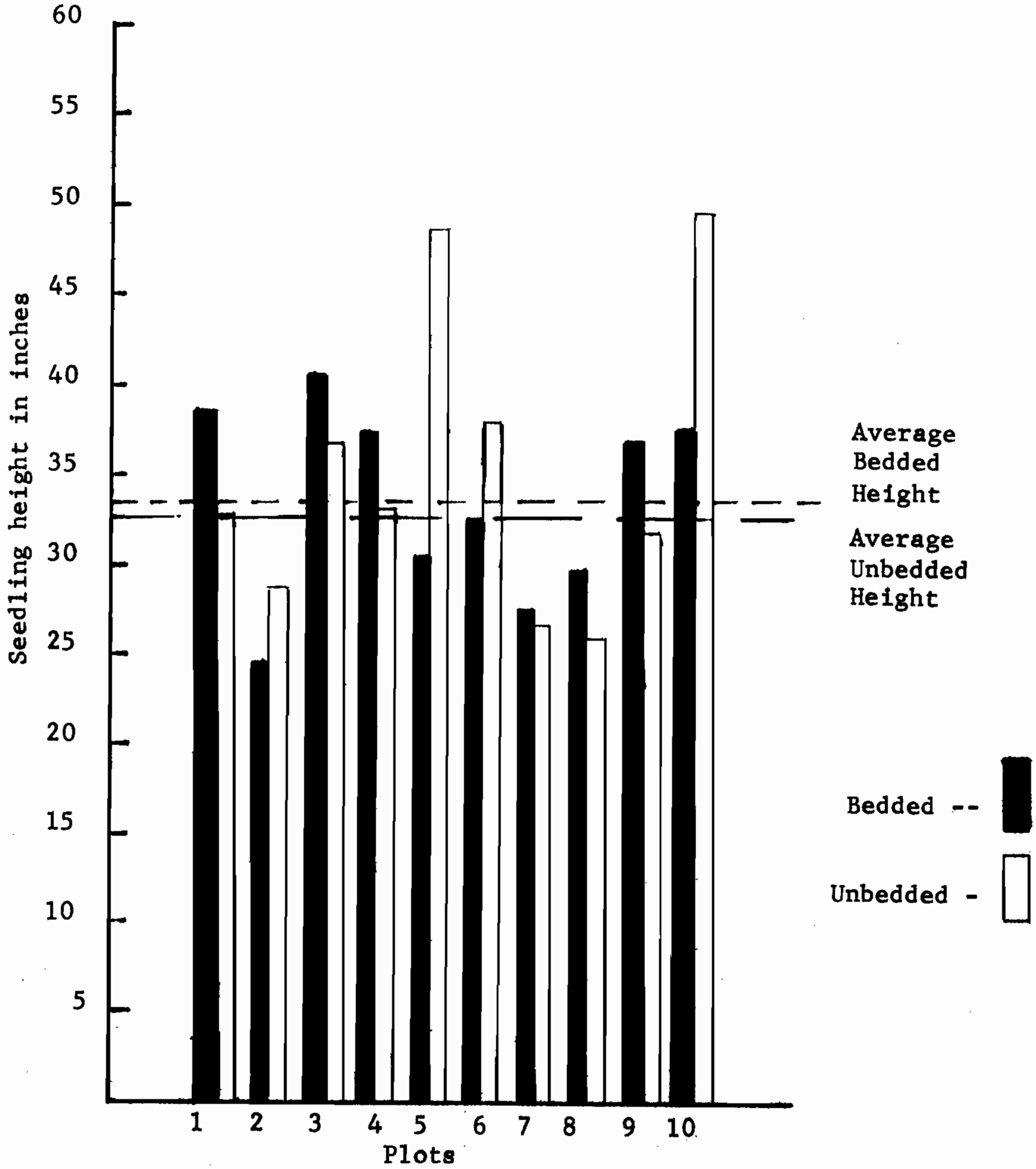


Figure 6. Average seedling height by plot on bottomland, bedded and unbedded.

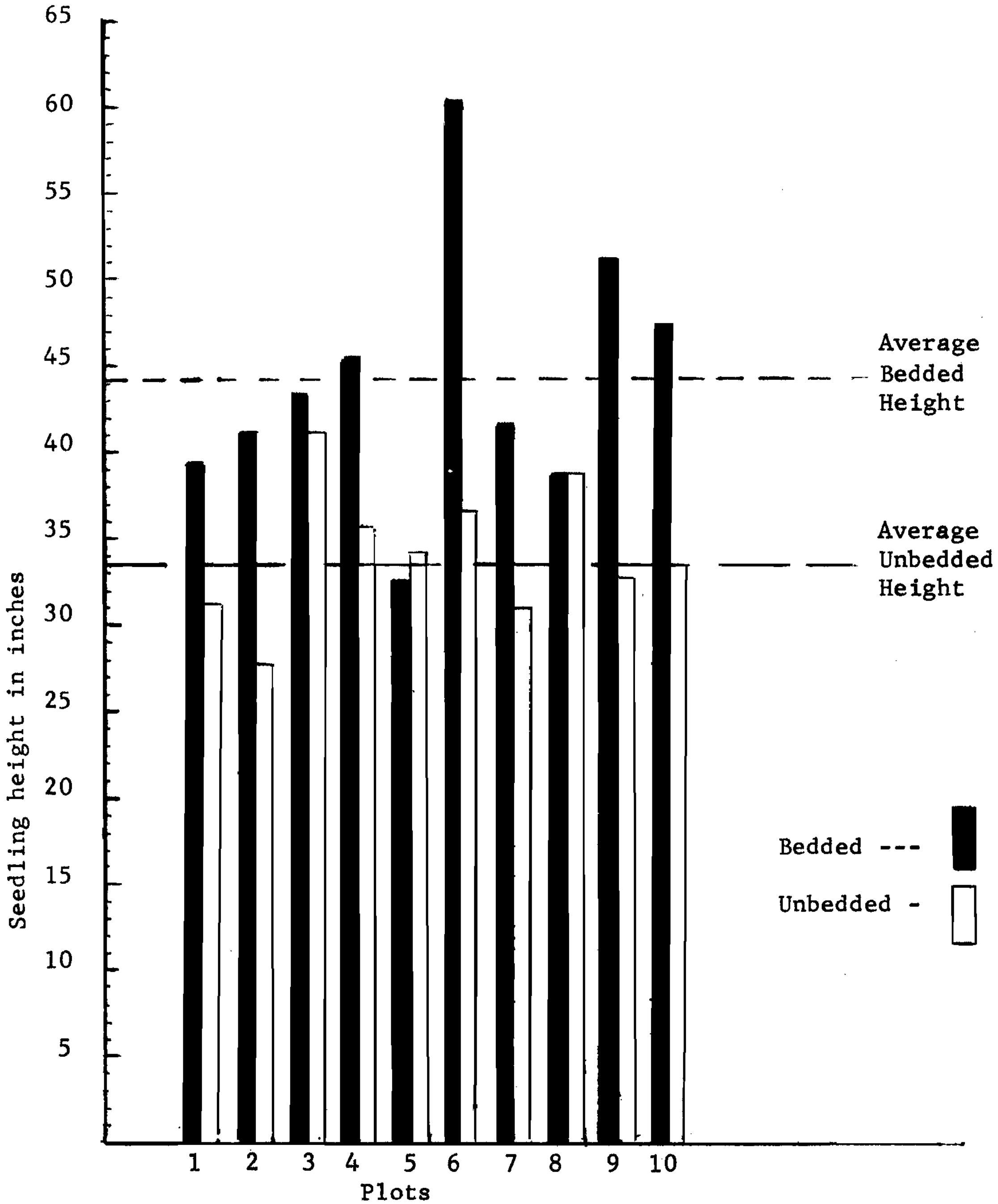


Figure 7. Average seedling height by plot on upland, bedded and unbedded.

bedded, bottomland was 21 percent greater than on unbedded, bottomland. Average survival on bedded, upland was 29 percent greater than on unbedded, upland (Table 13 and Figure 5).

On bottomland, bedded sites, average seedling height was 33.4 inches compared to 32.7 inches average height on bottomland, unbedded (Figure 6). Upland, bedded sites, had an average seedling height of 44.1 inches compared to 34.2 inches on upland, unbedded (Table 13 and Figure 7).

Indications of these results support most findings of bedding studies in the South and Southeastern United States. Results of this study suggest that total height on upland sites, as well as survival on upland and bottomland sites, were enhanced by bedding. The positive effect of bedding on both upland and bottomland sites was probably due to:

1. Effective control of sprouting and reduction of competing vegetation.
2. Effective soil cultivation and conditioning.
3. Increased absorbtion and retention of moisture on slopes in clay loam soils.
4. Enhancement of the soil moisture and available oxygen mixture for the seedling root system on bottomland soils.

Table 13. Average survival and total height by site and treatment.

Site	Treatment	Survival(%)	Height (Inches)
Bottomland	Bedded	64.1	33.4
	Unbedded	44.8	32.7
Upland	Bedded	75.7	44.1
	Unbedded	46.7	34.2

Table 14. Average pH and pounds per acre of nutrient elements by site and treatment. (Site column is bottomland average and upland average.)

	Bottomland			Upland		
Elements	Bedded	Unbedded	Site	Bedded	Unbedded	Site
pH	5.4	5.0	5.2	4.8	4.9	4.9
Calcium	1660	1470	1565	960	1200	1080
Phosphorous	9.6	3.9	6.7	6.7	5.7	6.2
Potassium	209	180	195	222	360	291
Magnesium	360	370	365	380	530	455

Although this study indicates that bedding has a positive effect on survival and total height on upland clay loam soils and on survival on bottomland loam soils, it is not to be assumed that any effect on height will necessarily be perpetuated through a complete plantation rotation. For such a conclusion to be valid, observation should be continued for a longer period of time.

LITERATURE CITED

Bethune, J.E. 1963. Ridging; low-cost techniques for increasing growth on wet flatwoods sites. Forest Farmer, 3 p.

Langdon, O.G. 1962. Ridge planting improves early growth of South Florida slash pine. Journal of Forestry, 3 p.

Linnartz, M. R., and J. W. McMinn. 1973. Growth of two varieties of slash pine on prepared sites in South Florida - 10 year results. U.S.D.A. Forest Service Res. Pap. SE - 103.

Mann, W. F., Jr., and H. J. Derr. 1977. Site preparation improves growth of planted pines. U.S.D.A. Forest Service Res. Pap. SO - 134, 5 p.

Mann, W. F., Jr., and H. J. 1970. Response of loblolly pine and slash pine to discing on a poorly drained site. U.S.D.A. Forest Service Res. Pap. SO-110, 3 p.

Mann, W. F., Jr., and J. M. McGilvray. 1974. Response of Slash pine to bedding and phosphorous application in Southeastern flatwoods. U.S.D.A. Forest Service Res. Pap. SO-99, 9 P.

Moehring, D. M. 1970. Forest soil improvement through cultivation. Journal of Forestry, 3 p.

Read, D. J., W. Armstrong, and J. Weatherell. 1973. The effect of cultivation treatment on water potential and soil aeration in wet heatherland with special reference to afforestation. The University of Sheffield Botany Dept., Journal of Applied Ecology, 10 p.

Shultz, R. P., and L. P. Wilhite. 1974. Changes in flatwoods sites following intensive site preparation. Forest Science, 7 p.

Terry, T. A., and J. H. Hughes. 1975. The effects of intensive management on planted loblolly pine (Pinus taeda, L.) growth on poorly drained soils of the Atlantic Coastal Plain. Forest Soils and Forest Land Management. B. Bernier and C. H. Winget (editors). Les Presses De L'Universite Laval, Quebec.

APPENDIX

The following appendix consists of field data and laboratory analysis obtained in this study. Shown are; soil descriptions; seedling survival; and total heights by plot, site and treatment. Also presented are results from chemical analysis of the soils showing soil pH, in addition to calcium, phosphorous, potassium, and magnesium content of the soils.

ROSENWALL SERIES

The Rosenwall series is a member of the clayey, mixed, thermic family of Aquic Hapludults. These soils have brown fine sandy loam A horizons, clayey B2t horizons that are dark red in the upper part and mottled dark red and reddish brown in the lower part. The soil is underlain by shale and sandstone at 27 inches.

Typifying Pedon: Rosenwall fine sandy loam - forested. (Colors are for moist soil unless otherwise stated.)

A1 -- 0-6 inches, brown (10YR 4/3) fine sandy loam; weak granular structure; slightly hard, friable; many fine, medium, and coarse roots; common very fine pores; few siliceous pebbles 3/4 to 1 1/4 inches in diameter; slightly acid; clear smooth boundary. (3 to 8 inches thick)

B21t -- 6-12 inches, dark red (2.5YR 3/6) clay; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; many fine, medium, and coarse roots; few fine pores; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary. (4 to 8 inches thick)

B22t -- 12-16 inches, dark red (2.5YR 3/6) clay; many fine distinct brown and yellowish red mottles; strong

<u>Type Location</u>: Walker County, Texas; from the intersection of Texas Highway 19 and Farm Road 230 in Trinity, Texas, 6.1 miles west on Farm Road 230; then north on Chalk Cemetery Road 4.1 miles; then west on logging road 1100 feet and 90 feet south of road in woods.

<u>Range in Characteristics</u>: The solum ranges from 20 to 40 inches thick.

The A horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), brown (10YR 4/3), or dark brown (10YR 3/3). It is slightly acid to very strongly acid.

The upper part of the argillic horizon is dark red (2.5YR 3/6), red (2.5YR 4/6, 4/8), dark reddish brown (2.5YR 3/4), yellowish red (5YR 4/6, 4/8, 5/8), reddish brown (5YR 4/4, 5/4), or dark reddish brown (5YR 3/3, 3/4). Mottles in this part of the argillic range from none to common and are dark red, strong brown, and light brownish gray. The middle part of the argillic horizon is dark red (2.5YR 3/6), red (2.5YR 4/6, 4/8), reddish brown (5YR 4/4, 5/4), yellowish red (5YR 4/6, 4/8), reddish gray (5YR 5/2), grayish brown (10YR 4/2), or brown (10YR 4/4). It is mottled red, gray, yellow, and brown. The lower part is reddish brown (5YR 4/3), dark grayish brown (10YR 4/2), dark gray (10YR 4/1), gray (10YR 5/1), brown (10YR 4/3, 5/3; 7.5YR 4/2, 5/2, 5/4), or dark reddish gray (5YR 4/2). It is mottled red, dark red, strong brown, grayish brown, fine subangular blocky structure; very hard, firm, sticky and plastic; many medium and coarse roots; few fine pores; thin patchy clay films on faces of peds; few fragments of gray shale; very strongly acid; clear smooth boundary. (4 to 8 inches thick)

B23t -- 16-20 inches, reddish brown (5YR 4/3) clay; common fine distinct red and grayish brown mottles; strong fine subangular blocky structure; very hard, firm, sticky and plastic; many medium and coarse roots; few fine pores; thin patchy clay films on faces of peds; common fragments of shale 5 to 15 mm. in diameter; very strongly acid; clear smooth boundary. (4 to 8 inches thick)

B3 -- 20-27 inches, stratified dark reddish gray (5YR 4/2) clay; common fine distinct dark red mottles; weak fine subangular blocky structure; very hard, firm, sticky and plastic; hard gray shaly clay that has dark red coatings; massive; hard; few medium and coarse roots; few fine pores; very strongly acid; clear smooth boundary. (5 to 8 inches thick)

Cr -- 27-30 inches, stratified strongly cemented thin sandstone layers and gray shale; massive; hard; the interstices are filled with gray clay; very strongly acid.

reddish brown, pale brown, and brownish yellow. The upper 20 inches of the argillic horizon are clay with the clay content ranging from 60 to 75 percent clay. The argillic horizon is medium acid to very strongly acid.

The B3 horizon is dark reddish gray, reddish gray, dark gray, grayish brown, brown, dark brown, and light grayish brown in hues of 5 YR, 7.5YR, and 10YR. It is stratified clay and shaly clay and sandstone or fragments of shale. The strata are from 1/4 inch to one or more inches in thickness.

The Cr layer is weakly to strongly cemented sandstone or siltstone interbedded with shale, shaly clay, or loamy sediments.

Competing Series and their Differentiae: These include the Beason, Craven, Creedmore, Eulonia, Helena, Sacul, Vinita, and Wolftever series. All of these series have less than 60 percent clay in the upper 20 inches of the B2t horizons. In addition, all of the series, with the exception of the Vinita series, lack bedrock within 40 inches of the surface.

Setting: Rosenwall soils are on gently sloping uplands. Slope gradients range from 1 to 5 percent. The soil formed in clayey deposits interbedded with sandstone and shaly clays mostly within the Manning and Wellborn Formations. The climate is subhumid. The mean annual temperature at the type location is about 68° F., mean annual precipitation is about 46 inches, and Thornthwaite annual P-E index is about 70.

Principal Associated Soils: These are the Gomery and Goreen series. Gomery soils have sandy A horizons 20 to 40 inches thick and sola 40 to 60 inches thick. Goreen soils have a gray argillic horizon and are wet in the moisture control section for longer periods of time.

Drainage and Permeability: Moderately well drained; medium runoff; very slow permeability.

Use and Vegetation: Small acreages have been cleared for cultivation and pasture but most of the areas are in native forest. Native vegetation consists of loblolly and shortleaf pine mixed with hardwoods and an understory of eastern little bluestem, longleaf uniola, purpletop, and panicum grasses.

Distribution and Extent: Southeastern Texas and possibly western Louisiana. Series is of moderate extent.

Series Established: Walker County, Texas; 1975.

Remarks: The Rosenwall series was formerly classified in the Planosol great soil group.

National Cooperative Soil Survey
U. S. A.

MARIETTA SERIES

The Marietta series is a member of the fine-loamy, mixed, thermic family of Aquic Fluventic Eutrochrepts. These soils have brown loamy A horizons, brown loamy B horizons that are mottled with gray, and C horizons of mottled sandy clay.

Typifying Pedon: Marietta loam - cultivated

(Colors are for moist soil.)

Ap1 -- 0-5"--Brown (10YR 4/3) loam; weak fine granular structure; very friable; many fine and medium roots; neutral; clear smooth boundary. (4 to 10 inches thick.)

Ap2 -- 5-10"--Brown (10YR 4/3) heavy silt loam; weak fine granular structure; friable; common fine roots; few gray and red root stains; neutral; abrupt smooth boundary. (0 to 6 inches thick.)

B21 -- 10-15"-- Brown (10YR 4/3) silty clay loam, common fine faint light brownish gray mottles; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; few fine roots; few fine pieces of charcoal; neutral; clear smooth boundary. (4 to 8 inches thick.)

B22 -- 15-24"-- Brown (10YR 4/3) heavy loam, many medium distinct light brownish gray mottles; weak medium subangular blocky structure; friable, slightly plastic, slightly sticky; few fine roots; few fine brown concretions; neutral; gradual smooth boundary. (6 to 12 inches thick.)

B23g -- 24-46"--Mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/8) sandy clay loam; weak medium subangular blocky structure; friable, slightly plastic, slightly sticky; few fine roots; few fine black concretions; slightly acid; diffuse boundary. (14 to 30 inches thick.)

Cg -- 46-62"--Light brownish gray (2.5Y 6/2) sandy clay, many coarse distinct yellowish brown (10Yr 5/8) mottles; structureless, massive; firm, plastic, sticky; common fine black concretions; slightly acid.

Range in Characteristics: Sola range from 28 to 60 inches in thickness. Reaction ranges from medium acid to mildly alkaline. Base saturation is more than 60 percent. Marietta soils are not dry for as much as 90 cumulative days in most years in some subhorizon between 7 and 20 inches. The organic matter content does not decrease regularly with depth. Hue of the A horizon is 10YR, values range from 3 through 5, and chroma from 2 through 4. If the A horizon has moist color values of 3.5 or less, it is less than 10 inches thick. The A horizon has textures of silt loam, very fine sandy loam, loam, or light sandy clay loam. The B21 horizon has hues of 7.5 YR through 2.5Y, value is 4 or 5, and chroma ranges from 3 through 6. Gray mottles are few to common. The B22 horizon has colors similar to those of the B21 horizon, or it is mottled gray, brown, and yellow. Structure grade in the B21 and B22 horizons range from weak to moderate. The B23 and B22 horizons range from weak to moderate. The B23 and C horizons have gray matrix colors or are mottled gray, yellow, and brown. Texture of the B horizon is silty clay loam, clay loam, sandy clay loam, loam or silt loam. The 10- to 40-inch control section ranges from 18 to 35 percent in clay, and more than 15 percent is fine sand and coarser. Few to common black and brown concretions are in the lower part of the B horizon and in the C horizon.

Competing Series and their Differentiae: These are in the Arkabutla, Bruin, Catalpa, Chewacla, Commerce, Leeper, Mantachie, Verona, Weaver, and Whitesburg series. Arkabutla and Commerce soils contain less than 15 percent coarser than very fine sand and their dominant colors are of 2 chroma. Bruin soils, in the 10- to 40-inch control section, contain 10 to 18 percent clay, and less than 15 percent coarser than very fine sand. Catalpa soils have mollic epipedons 10 to 24 inches thick and high shrink-swell properties. Chewacla soils are acid and have less than 60 percent base saturation. Leeper soils have more than 35 percent clay in the 10- to 40-inch control section and they have high shrink-swell properties. Mantachie soils have 18 to 35 percent clay in the 10- to 40-inch control section and their dominant colors are of 2 chroma. Verona soils lack B horizons and their dominant colors are of 2 chroma. Weaver and Whitesburg soils have mean annual soil temperatures of less than 59° F.; and Weaver soils, in addition, are calcareous.

Setting: These soils are on rather wide flood plains in the mixed Coastal Plain and Blackland Prairie sections. Slopes range from 0 to 2 percent. Marietta soils are formed in loamy alluvium. Average January temperature is 44° F., and average July temperature is 81° F. The mean annual precipitation is 51 inches near the type location.

Principal Associated Soils: These are the Arkabutla, Catalpa, Leeper, Mantachie and Verona soils listed as competing series and the Houlka and Tuscumbia series. The Houlka and Tuscumbia soils have more than 35 percent clay in the 10- to 40-inch control sections; and Houlka soils, in addition, are acid in reaction.

Drainage and Permeability: Moderately well drained. Runoff is slow and permeability is moderate. The soil frequently overflows or has standing water on the surface, and the water table is within 2 feet of the surface during periods of high rainfall.

Use and Vegetation: Most of the soil has been cleared and is being used for growing cotton, soybeans, corn and small grains. Some is used for growing pasture and hay. The native vegetation is mixed hardwoods.

Distribution and Extent: In the Coastal Plain and Blackland Prairie sections of Alabama, Mississippi, and Tennessee. The series is of moderate extent.

Series Established: Prentiss County, Mississippi, 1947.

Remarks: The series was formerly classified in the Alluvial great soil group.

National Cooperative Soil Survey
U.S.A.

Table I. Seedling survival and total height by plot - bottomland, unbedded (height in inches, "x" represents mortality).

Plots

1	2	3	4	5	6	7	8	9	10
36	21.7	x	x	x	49	x	45.7	x	x
x	37.5	x	18	36.7	18.2	x	x	27.5	44.5
x	43.7	x	46.7	41.7	30	x	x	28.7	x
36	21.5	24.2	x	52.5	x	x	x	37	x
x	x	48.5	53.7	x	x	x	41	x	x
38.5	x	x	31	50	x	x	x	x	x
x	24.9	x	20.5	x	x	19	16.2	x	x
39.2	x	x	x	x	44.2	x	11.2	x	x
22	x	x	x	49	49.2	x	31.5	39.5	x
43	23.5	28.2	x	37	33.2	x	31.5	x	x
x	27	41.2	x	34.5	x	x	x	x	60
x	x	57.5	x	x	22.5	x	13.7	26.2	x
x	x	40.7	29.5	x	x	15	18	x	x
22.2	x	23.5	32	40	58	45.5	x	x	44.5
27.5	x	40.5				x	x	x	52.2
		25.5						x	
Average height									
32.8	28.5	36.7	33.1	42.7	38.1	26.5	26.1	31.8	50.3
Percent survival									
50.0	46.6	56.2	50.0	57.1	57.1	20.0	53.3	31.2	26.6

Table II. Seedling survival and total height by plot - bottomland, bedded (height in inches, "x" represents mortality).

Plots

1	2	3	4	5	6	7	8	9	10
33.5	25.2	47.2	29.2	35	x	22.5	38	39.7	34.7
x	x	34.2	x	x	x	31.5	23	44.5	x
x	38.7	46	54.5	27	x	24.5	21.7	27.5	x
57.2	22.7	x	61.2	26	17	25.5	22.2	26.5	29.7
32	x	34.7	37.5	12.2	x	20.2	22.2	32.7	x
57.2	x	39.7	32.2	x	28.2	29.7	21	31.7	26.2
35.2	x	x	x	x	x	18.5	28.7	x	55.7
43.5	x	41	x	34.5	39.7	25.2	x	x	x
x	9	x	x	52.5	20.7	x	x	41.5	x
x	19.5	x	x	29.2	43.2	35	27	47.5	50
27.5	x	x	23.2	10	x	x	34	42	55.2
x	43.5	x	29.2	24.7	46.7	x	31.2	38.5	15.5
25.2	15.7	x	x	28.5	x	39.5	51.2	31.2	40.7
32.5	20.5	x	x	28.5	47.7	16.5	x	38.5	36.7
45.5	x	x	30.2	30.5	16.2	34.7	x	x	39.2
x		x	x	54.2		30.2			32
Average height									
38.9	24.3	40.5	37.2	30.2	32.5	27.2	29.1	36.8	37.8
Percent survival									
62.5	53.3	37.5	50.0	81.2	53.3	81.2	73.3	80.0	68.7

Table III. Seedling survival and total height by plot - upland, unbedded (height in inches, "x" represents mortality).

Plots

1	2	3	4	5	6	7	8	9	10
41	40.5	x	24.7	39.5	x	x	45	26.7	x
x	37	x	27.5	x	x	x	x	x	32
24.7	x	53.7	44.2	33	x	x	x	33	15.7
32.5	14	x	14.5	x	65.5	38	x	28	24
x	x	35.5	31.5	x	x	36	x	52.5	x
20.5	x	45	59.5	x	28.2	x	31.2	22.7	32.5
32.5	28.5	40.7	48.5	x	x	x	x	x	37
30.2	21	x	x	x	32	x	x	x	x
33.2	15.5	42.5	32	x	x	x	x	x	35
x	x	x	41.7	29.5	22.5	27.2	x	x	x
37.5	35.5	31.2	x	37.2	x	x	32	x	50
x	30.7	38.7	35	31.5	34.7	x	45	x	x
26	31.2	x	x	x	x	23	x	x	x
34.2	x	x	x	x	x	x	x	x	39.2
x	24		x			x		x	
Average height									
31.2	27.8	41.1	35.9	34.1	36.6	31.1	38.2	32.6	33.2
Percent survival									
66.6	66.6	50.0	66.6	35.7	35.7	26.6	28.6	33.3	57.1

Table IV. Seedling survival and total height by plot - upland, bedded (height in inches, "x" represents mortality).

Plots

1	2	3	4	5	6	7	8	9	10
30	54.5	55.5	x	28.5	31.2	29	x	44.5	47.5
49.2	39.2	37.7	x	36.5	x	36.5	x	x	40.2
39.2	x	45.5	x	30	54	47.7	37.7	47.5	63.7
40.2	42	39	x	x	x	62.5	38.5	24	x
49.2	35.7	40	42	35	62.5	53.7	74.5	46.2	48.2
38.5	x	27	41	35.5	70.7	53.2	32.5	45.5	x
30	45.2	x	42.2	x	x	40.2	50.7	44	51
49.7	29	42	51.2	x	59.2	48.5	40	x	x
25	41.5	72	47	29.2	66.5	36.5	31.7	x	x
25.2	31	34.5	x	37.7	71.2	x	21.2	47.5	49.2
33.5	x	55.5	x	40	67.5	x	48.7	61.7	33.5
53.5	46.2	x	59.5	x	x	21.5	51	70.7	x
43.7	36	x	59.7	x		43.2	34	69	41.5
44.5	51.5	37.2	38.5	x		26.5		52.7	60
		34.7	41	x				61.2	45.2
			31.5	x					41
Average height									
39.4	41.1	43.4	45.3	32.7	60.4	41.6	38.8	51.2	47.4
Percent survival									
100	78.5	80.0	62.5	50.0	66.6	85.7	84.6	80.0	68.7

Table V. Soil pH and chemical analysis by plot and treatment on bottomland.

Plot	pH	Ca	P_2O_5	K_2O	Mg
(Unbedded)					
1	4.9	1400	8	180	360
2	5.1	1200	3	150	330
3	5.2	1300	3	150	340
4	5.0	1600	3	180	370
5	5.2	1800	4	170	410
6	5.2	1400	4	230	330
7	4.9	1200	3	160	330
8	5.0	1400	5	200	360
9	5.0	1800	3	190	430
10	4.9	1600	3	190	400
(Bedded)					
1	5.0	1400	4	170	320
2	5.4	2000	6	290	470
3	6.0	1800	33	250	330
4	6.0	1800	25	200	310
5	5.2	1600	3	160	310
6	5.0	1300	4	210	380
7	5.2	1500	5	190	350
8	5.4	1400	4	210	370
9	5.6	2100	8	220	400
10	5.3	1700	4	190	400

Table VI. Soil pH and chemical analysis by plot and treatment on upland.

Plot	pH	Ca	P_2O_5	K_2O	Mg
(Unbedded)					
1	4.9	700	2	230	440
2	4.9	1000	5	290	600
3	4.8	1100	3	370	600
4	4.7	1000	9	310	540
5	5.0	800	6	200	300
6	5.0	1500	9	440	600
7	5.3	1300	9	390	460
8	4.8	1500	5	440	600
9	4.8	1900	5	550	600
10	4.8	1200	4	390	600
(Bedded)					
1	5.2	1700	5	250	350
2	4.8	400	3	140	130
3	4.7	1100	8	230	480
4	4.6	900	5	280	470
5	4.5	1200	7	420	600
6	4.6	900	8	160	370
7	5.0	1800	4	200	440
8	5.2	400	6	170	300
9	4.8	800	9	200	400
10	4.7	400	12	170	250

BEDDING AS A FACTOR IN THE SURVIVAL
AND TOTAL HEIGHT OF TWO YEAR OLD PLANTED
LOBLOLLY PINE SEEDLINGS IN EAST TEXAS

An Abstract of a Thesis

APPROVED:

Dean of the Graduate School

BEDDING AS A FACTOR IN THE SURVIVAL AND TOTAL HEIGHT OF TWO YEAR OLD PLANTED LOBLOLLY PINE SEEDLINGS IN EAST TEXAS

by

EDGAR C. WILKINS, B.S.F.

AN ABSTRACT OF A THESIS
Presented to the Faculty of the Graduate School of
Stephen F. Austin State University
In Partial Fulfillment
of the Requirements

For the Degree of
Master of Science in Forestry

STEPHEN F. AUSTIN STATE UNIVERSITY
August, 1980

BEDDING AS A FACTOR IN THE SURVIVAL AND TOTAL HEIGHT OF TWO YEAR OLD PLANTED LOBLOLLY PINE SEEDLINGS IN EAST TEXAS

ABSTRACT

With an ever increasing demand placed on wood fiber supply by industry, it has become imperative that every feasible means be pursued which will increase the wood fiber production per acre of land on every plantable site. With this in mind, this study was conducted in an attempt to determine the effect of bedding in intensive site preparation on the total height and survival of two year old loblolly pine (*Pinus* taeda, L.) seedlings planted on bottomland and upland sites.

Forty row (or lineal) plots 100 feet long were established on machine planted areas on bedded and unbedded, bottomland and upland sites. Plot distribution was ten plots on sheared, raked and bedded on both bottomland and upland sites, and ten plots on sheared, raked, and not bedded (control) on the same two sites.

At the end of the second growing season, mechanical and chemical analyses were conducted on 280 soil samples extracted by a soil tube. Seedling survival and total height was also determined on each plot at the end of the second growing season.

Evaluation of the data by analysis of variance revealed that site did have a significant influence on height and that treatment (bedding) had a significant positive effect (at the 1 percent level) on survival.

VITA

Edgar C. Wilkins was born in Monroe, Louisiana, on December 6, 1927, the son of Aaron Weatherly Wilkins and Lucile Carver Wilkins. After completing his work at Neville High School, Monroe, Louisiana, in 1944, he entered the U. S. Navy. After an honorable discharge from the navy, he entered Louisiana State University at Baton Rouge, Louisiana. He received the degree of Bachelor of Science in Forestry from Louisiana State University in May, 1952. In January, 1974 he entered the Graduate School of Stephen F. Austin State University.

Permanent Address: 502 Willow Oak
Lufkin, Texas

This thesis was typed by Joy Nell Walker.