12-1994

Research Report No. 32, Trends of Non-straight Tree Stems in Loblolly and Slash Pine Plantations in East Texas, 1985-1994

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Trends of Non-Straight Tree Stems in Loblolly and Slash Pine Plantations in East Texas 1985-94

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REPORT 32

FROM

THE

EAST TEXAS PINE PLANTATION RESEARCH PROJECT

COLLEGE OF FORESTRY

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NACOGDOCHES, TX 75962

DECEMBER ... 1994

Introduction

Trees from East Texas loblolly (*Pinus taeda* L.) and slash (*Pinus elliottii* Engelm.) pine plantations are one of the sources of raw material for conversion into products such as paper, veneer and lumber by East Texas forest product mills. The utilization of the planted trees may depend on various biological and economical factors. Factors such as tree size, tree condition, stumpage prices and interest rates can play a role in the merchandizing process.

One of the factors, tree condition, may be affected by tree crown position in canopy, incidence of disease, single stem and straightness of stem. Trees with straighter stems may be more suitable for utilization into higher value products, such as veneer, lumber or poles rather than converted into alternative products. Stumpage prices for trees with relatively straight stems usually exceed prices offered for trees with less straight stems.

An initial stand-level analysis of non-straight tree stems of planted pines in East Texas was conducted by Holley (1992). During a time period of 6 years, percentage of non-straight stems for both loblolly and slash pine trees was fairly consistent. Holley also found that tree stem straightness was not related to plantation age.

The purpose of this paper is to build on the work by Holley and attempt to answer the question: do planted pines on a stand-level basis in East Texas tend to become more straight or less straight as they become older?

Plantation Measurements

The East Texas Pine Plantation Research Project (ETPPRP) was the source of data for this study. With the assistance of East Texas forest industries[1], the College of Forestry at Stephen F. Austin State University initiated the ETPPRP in 1982. During 1982-84, the project installed 178 permanent plots in loblolly pine plantations throughout East Texas, and 78 permanent plots were installed in slash pine plantations in Southeast Texas. By 1994, due to acts of nature and inadvertent acts of man, the data set has been reduced to 155 loblolly plots and 66 slash plots.

Each plot consists of two adjacent subplots. A subplot is 100 x 100 ft, and the separation between the two subplots is 60 ft. Every planted pine tree within a subplot is tagged and numbered. In some analyses, it has been useful to use one subplot for model development and the other subplot for model evaluation. In other analyses, both subplots were used in the same data set. That method was used in this study on stand-level tree straightness.

A measurement cycle (MC) in the ETPPRP is three years. Between 1982-94, four complete cycles and one-third of the fifth MC have been recorded. During the 13 years, 13 different field crews have visited the plots. However, to this point, there has always been at least one person on the crew who was a veteran from the previous year, which provides some consistency from year to year.

Every three years, when a plot is measured, numerous information on each planted pine within a subplot is tabulated by the field crew: dbh, total tree height and crown class. In addition, several tree conditions are noted:

1. Is the stem forked?
2. Is the stem straight?
3. Does the tree have a regular crown?
4. Does fusiform rust occur on the stem?

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[1] The support of the participating companies -- Champion International Corporation, International Paper Company, Louisiana-Pacific Corp., Resource Management Services and Temple-Inland Forest Products Corp. -- is appreciated.

Field instructions for recording tree conditions have been consistent during the 13 years of the project. Unfortunately during the first MC, the field crews occasionally mis-interpreted the instructions for classifying planted pines as straight or non-straight. In spite of best intentions, a typical error was in recording a tree as straight even though it was not straight, because "it will grow out of it". In addition, since about 57% of the loblolly and about 50% of the slash pine plots were less than five years old in the first MC, it was sometimes difficult to accurately record tree conditions for the young stems. As a result, in this study, the information for MC 1 was not considered.

Instructions for determining whether or not the stem of a planted pine tree is straight or non-straight are:

1. Two field crew members view the tree stem from two different positions.
2. If significant bow, sweep or twist occurs along the stem that represents a definitive departure from the stem centerline, the tree is recorded as non-straight. A 2-3" bow/sweep in a 10-12" dbh tree may not be definitive, however that same bow/sweep in a 3-4" dbh tree may be definitive. The former tree will be classified as straight, and the latter tree will be non-straight.

All determinations are ocular; no instruments are used.

After initial summary and analysis of the ETPPRP data set for this study, values for the following variables were determined by species for each subplot at MCs 2-5:

1. Plantation age - number of years since plantation establishment.
2. Site index (base age 25 years) - feet.
3. Total trees per acre.

Means and ranges of the variables are listed according to species and MC in Table 1. Ranging from 69' to 74', average site index for both species has been somewhat consistent during the four MCs. Average number of trees per acre based on the sample subplots in loblolly pine plantations has been declining relatively slow. In contrast, average number of trees per acre based on slash pine sample subplots has been declining relatively fast.

Stand-level Non-straight Tree Stem Trends

The next step in this study was to develop six different counts of the non-straight trees occurring in each subplot for each MC:

1. Total number of non-straight trees per acre.
2. Number of trees per acre that are non-straight but do not have a concurrent forked stem, irregular crown or fusiform rust on stem and do not have a history of a forked stem, irregular crown or fusiform rust on the stem at a previous MC.
3. Total number of non-straight trees per acre with crowns in upper canopy.
4. Number of non-straight trees per acre with crowns in upper canopy that also meet the criteria described in (2.) above.
5. Total number of non-straight trees per acre with crowns in lower canopy.
6. Number of non-straight trees per acre with crowns in lower canopy that also meet the criteria described in (2.) above.

Six measures of stand-level percentage of crooked trees per acre were calculated by dividing each of the six divisional counts by total trees per acre. The result is six stand-level values of the percentage of non-straight stems per acre for each subplot for each of the four MCs.

With data summarized in this manner, several analyses of average stand-level non-straight stem trends are possible:

- Non-straight trends regardless of tree properties.
- Non-straight trends for trees with crowns in lower canopy, where more-dominating trees may affect the condition of the less-dominating trees.
- Non-straight trends for trees with crowns in upper canopy, where less competition may be occurring.
- Role of other tree conditions such as forked stems, a crown with a broken/missing terminal leader and incidence of fusiform rust on the stem.

Table 2 lists the average non-straight stand-level percentages according to species, crown position, tree history and MCs 2-5 with combined age classes. To illustrate the trends, values from Table 2 were plotted in:

- Figure 1 for trees in the lower canopy.
- Figure 2 for trees in the upper canopy.
- Figure 3 for all trees.

Trends for trees with crowns in the lower canopy - without restrictions (Figure 1)

For planted loblolly pine trees with crowns in this part of the canopy, the percentage of non-straight trees was relatively consistent during the sampling period. The trees do not appear to become more straight or less straight during the nine-year period.

However, for slash pine trees, it may be argued that as time passes and the trees become older, the percentage of non-straight stems is decreasing.

Trends for trees with crowns in the lower canopy - with restrictions (Figure 1)

By stratifying both species data sets (loblolly and slash) to remove some of the factors which may influence tree stem straightness, a more precise trend picture is available.

The percentage of crooked loblolly stems does not appear to change during the study period. However, it appears that slash pine trees with crowns in this part of the canopy are tending to become more straight as time goes by.

Trends for trees with crowns in the upper canopy - without restrictions (Figure 2)

The condition of trees with crowns in this more dominant canopy position may be less influenced by competition from neighboring trees.

For loblolly pine, the initial trend was decreasing - until MC 5, when the non-straight percentage changed from about 50% to about 65%. Perhaps a more definitive answer will appear after MC 5 is completed in 1996. A similar pattern is evident for slash pine, which increased from about 35% to 45%.

For trees in this canopy position, slash pine appears to be more straight than loblolly pine. At each of the four sampling points along the nine-year time line, the percentage of non-straight slash pine trees is 15-20 percentage points less than loblolly pine.

Trends for trees with crowns in the upper canopy - with restrictions (Figure 2)

Non-straight trends for trees with no history of other possible causative conditions, which may affect straightness, are conflicting for the two species.

On a stand-level basis, the percentage of non-straight loblolly pine trees was decreasing until MC 5. However, the overall trend for slash pine appears to be decreasing.

Once again, in these restricted samples, slash pine is more straight than loblolly pine.

Trends for all trees - without restrictions (Figure 3)

Overall, about 3 of 4 loblolly pine trees are crooked, and the trend appears to be increasing as the trees grow older. In contrast, about 1 of 2 slash pine trees is crooked, and the trend appears to be decreasing as the trees grow older.

Trends for all trees - with restrictions (Figure 3)

In this view of planted loblolly pine trees, the general pattern is about 20% crooked during the nine-year period. However, as slash pine trees grow older, they appear to become more straight. The percentage of non-straight stems changes from about 10% to about 5%.

Role of plantation age

In an attempt to investigate the effect of different age classes on non-straight trends, the data sets for each species were stratified into six age classes:

- 11-12 years at last MC observation.
- 13-14 years at last MC observation.
- 15-16 years at last MC observation.
- 17-18 years at last MC observation.
- 19-20 years at last MC observation.
- ≥21 years at last MC observation for loblolly and ≥20 years for slash.

For each age class, average stand-level non-straight tree stem percentages were computed according to species, crown position, tree history and measurement cycle. After examination of the trends, the non-straight tendencies for the various age classes appeared to mimic the trends for the combined age classes. The tendency for the younger age classes to become more straight or less straight was similar to the patterns shown for the older age classes.

Conclusions

In East Texas pine plantations, based on repeated observations of ETPPRP permanent plots during a nine-year period, and on a stand-level basis:

- Loblolly pine has a higher percentage of non-straight stems than slash pine.
- Non-straight loblolly pine trees are likely to remain non-straight.
- There is a possiblilty that some straight loblolly pines may have a tendency to become non-straight.
- Non-straight slash pine trees may become straight.
- Plantation age classes do not appear to be influencing factors.

In 1996, when MC 5 is completed, these analyses will be repeated. And in 1999, when MC 6 is completed, another analysis will be conducted. The results are anticipated to be interesting relative to percentage of non-straight stems closer to possible harvest and utilization of the planted pine trees.

Literature Cited

Holley, A. G. 1992. Analysis of visible tree quality of planted loblolly and slash pine trees in East Texas. MSF thesis. Stephen F. Austin State University. 104 p.

Table 1. Data characterized by age, site index, trees per acre and number of observations according to species and measurement cycle.

Species / Value	Measurement cycle 2	3	4	5[a]
Loblolly				
Number of observations	345	340	322	120
Age (yrs)				
Mean	8.0	10.8	13.5	16.9
Range	(2 - 19)	(5 - 21)	(8 - 24)	(12 - 27)
Site Index (ft)				
Mean	69	69	72	71
Range	(21 - 114)	(32 - 104)	(35 - 116)	(51 - 92)
Trees per acre				
Mean	485	472	460	438
Range	(105 - 1002)	(87 - 998)	(87 - 928)	(87 - 845)
Slash				
Number of observations	158	148	132	38
Age (yrs)				
Mean	8.3	10.7	13.3	16.6
Range	(3 - 18)	(6 - 20)	(9 - 24)	(12 - 23)
Site Index (ft)				
Mean	71	72	72	74
Range	(21 - 114)	(32 - 104)	(35 - 116)	(51 - 92)
Trees per acre				
Mean	424	347	383	273
Range	(113 - 1002)	(91 - 923)	(91 - 847)	(78 - 597)

[a] Measurement cycle not completed at time of study.

Table 2. Average stand-level non-straight tree stem percentages according to species, crown position, tree history and measurement cycle.

Species Canopy position Tree history	Measurement cycle 2	 3	 4	 5[a]
Loblolly				
Lower canopy				
All trees[b]	11.9	12.8	13.4	11.5
Restricted trees[c]	3.1	3.2	3.5	3.0
Upper canopy				
All trees	60.5	59.0	50.1	64.9
Restricted trees	19.0	16.9	14.0	18.5
Total				
All trees	71.2	71.8	63.5	76.3
Restricted trees	20.5	20.1	17.5	21.5
Slash				
Lower canopy				
All trees	13.9	11.5	12.7	7.9
Restricted trees	1.8	2.2	2.2	0.2
Upper canopy				
All trees	47.5	41.4	35.8	46.1
Restricted trees	5.8	6.9	6.4	3.9
Total				
All trees	58.7	52.9	48.6	54.1
Restricted trees	10.0	9.2	8.6	4.1

[a] Measurement cycle not completed at time of study.

[b] Trees may or may not have a history of forked stems, irregular crowns or fusiform rust occurrence on stem.

[c] Trees with any history of forked stem, irregular crowns, or fusiform rust occurrence on stem were excluded.

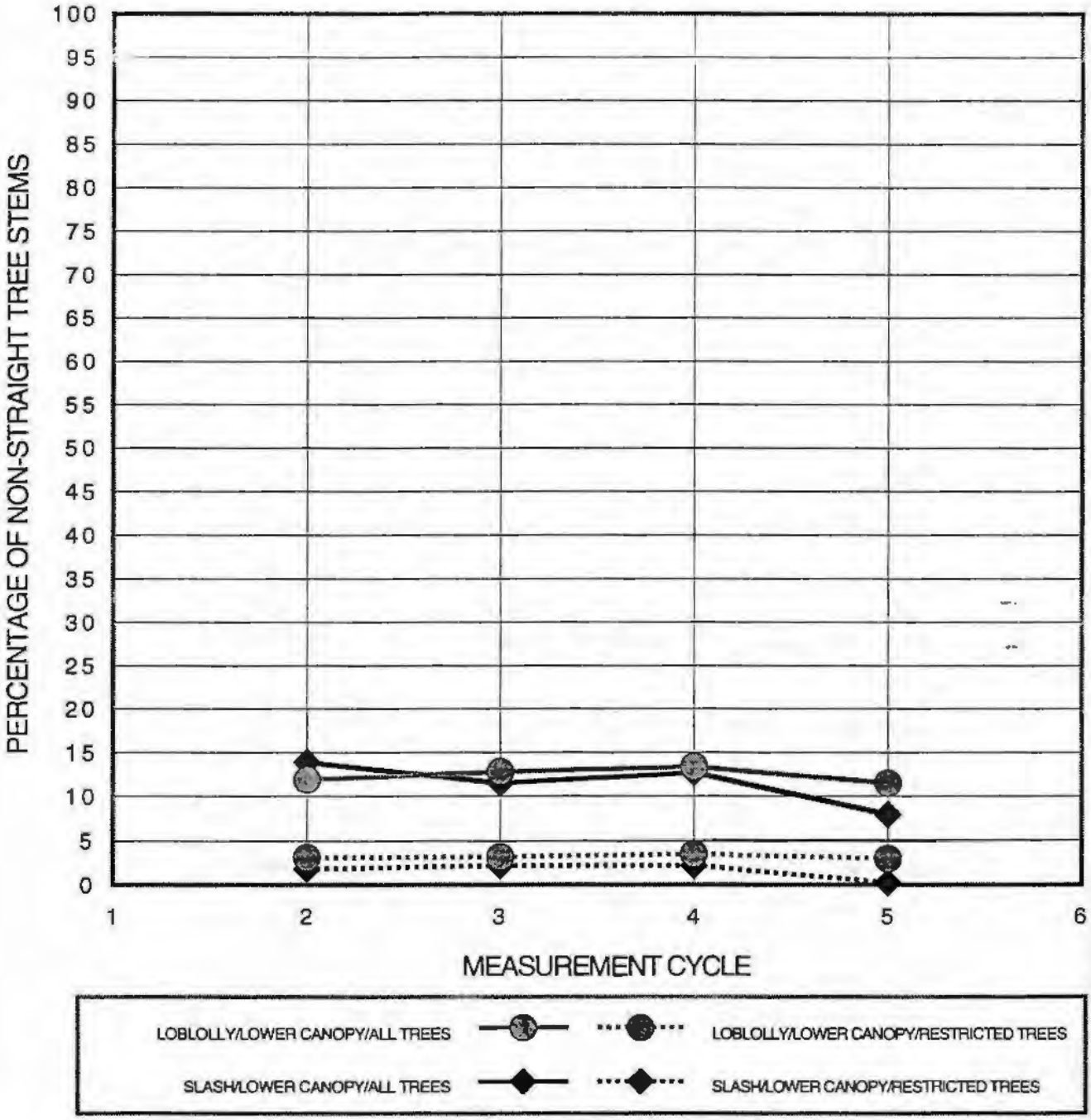

Figure 1. Average stand-level non-straight tree stem percentage trends for planted loblolly and slash trees in East Texas with crowns in the lower canopy.

Considers trees with no restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Also considers trees with restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Based on data from the East Texas Pine Plantation Rsearch Project.

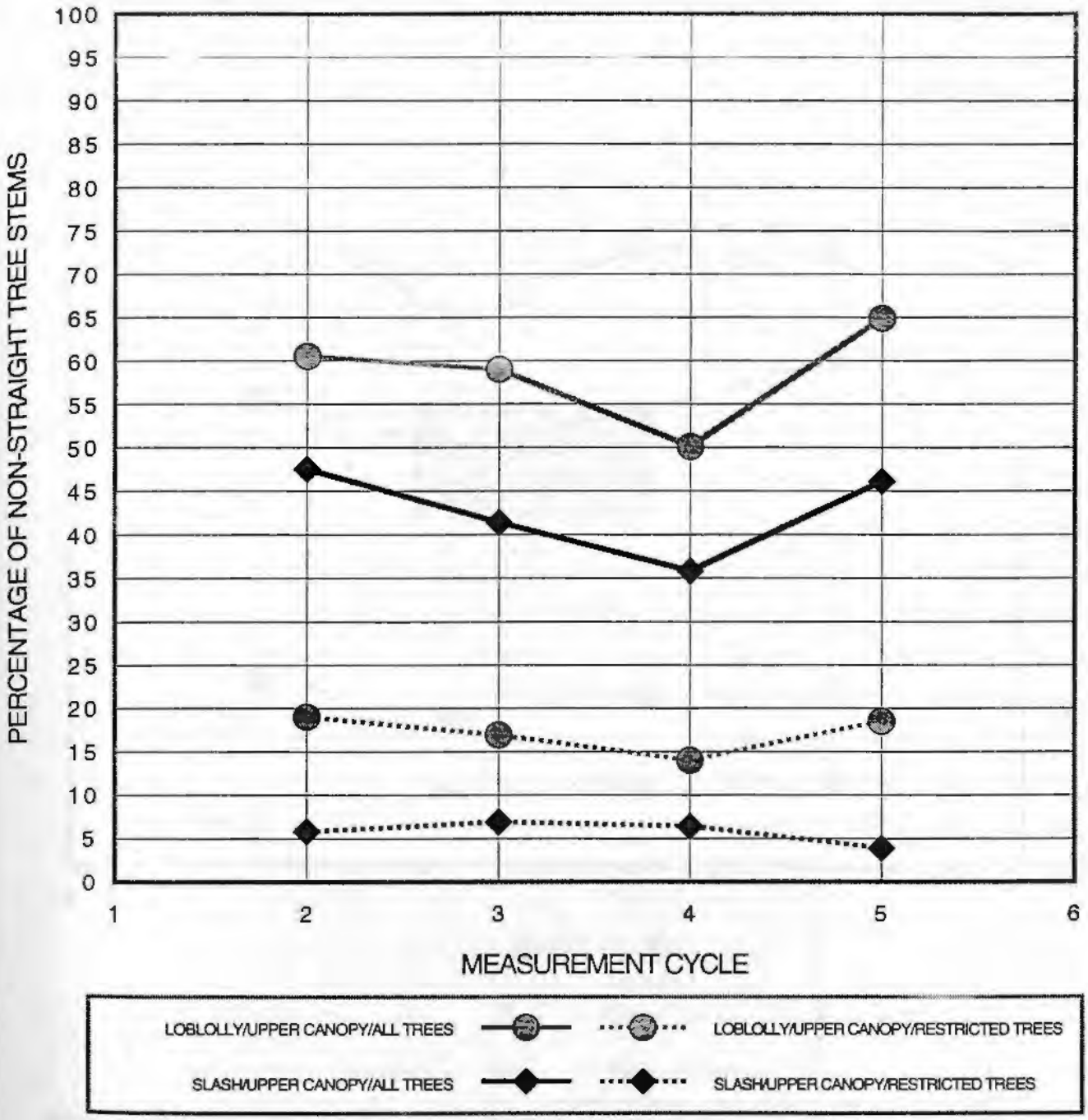

Figure 2. Average stand-level non-straight tree stem percentage trends for planted loblolly and slash pine trees in East Texas with crowns in the upper canopy.

Considers trees with no restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Also considers trees with restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Based on data from the East Texas Pine Plantation Research Project.

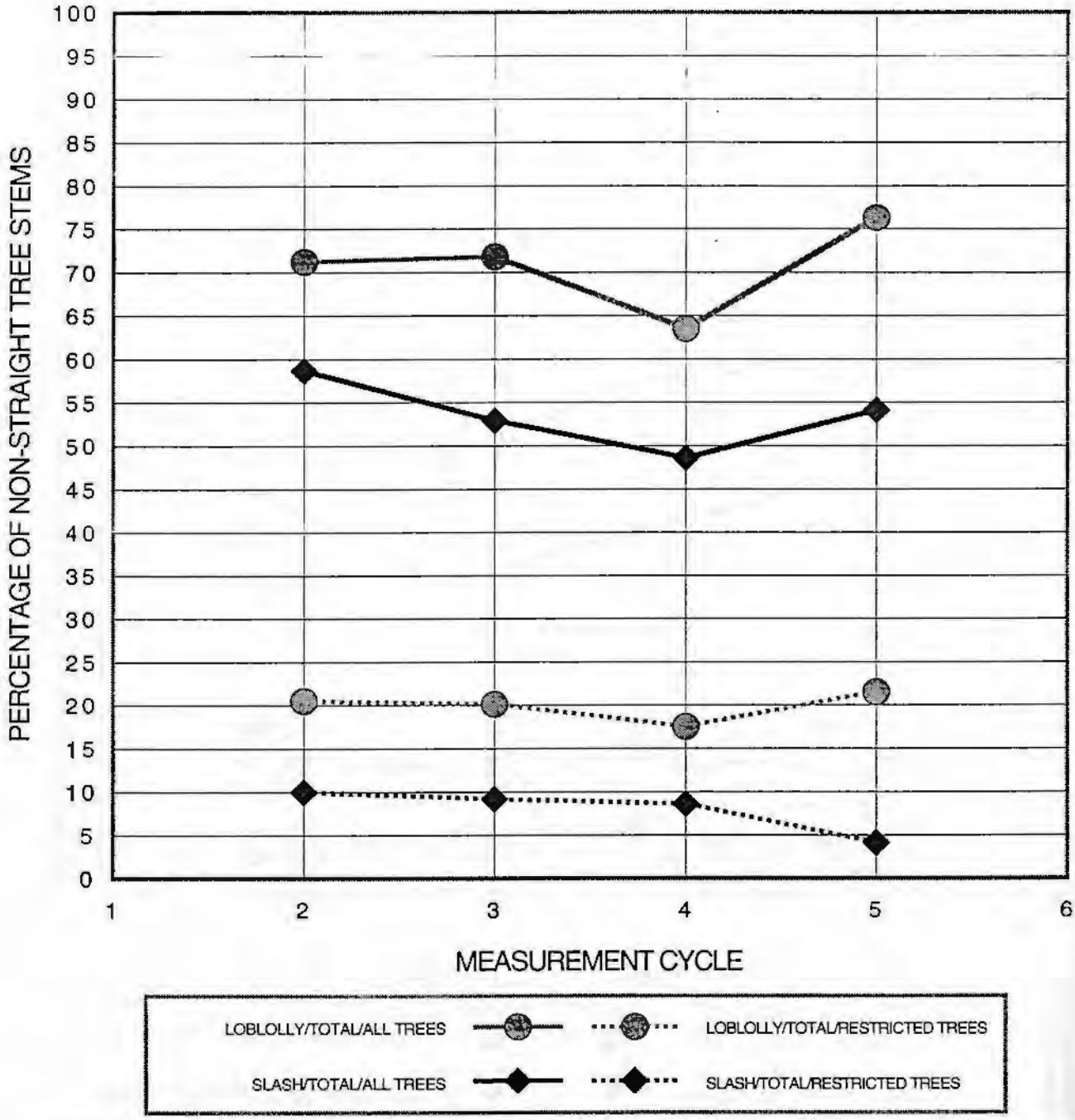

Figure 3. Average stand-level non-straight tree stem percentage trends for planted loblolly and slash pine trees in East Texas with crowns from all canopy positions.

Considers trees with no restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Also considers trees with restrictions as to concurrent status and past history of forked stems, irregular crowns or stem fusiform rust.

Based on data from the East Texas Pine Plantation Research Project.