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**A GUIDE FOR
TIMING INITIAL TREE HARVESTS
IN
EAST TEXAS
LOBLOLLY AND SLASH PINE PLANTATIONS**

BY
J. David Lenhart
and
H. Alexis Ross



REPORT 30

FROM
THE
EAST TEXAS PINE PLANTATION RESEARCH PROJECT
COLLEGE OF FORESTRY
SFASU
NACOGDOCHES, TX 75962

SEPTEMBER...1994

INTRODUCTION

In East Texas, there are approximately 3 million acres of loblolly (*Pinus taeda* L.) and slash (*Pinus elliotii* Engelm.) pine plantations. Most of these plantations, which represent about 25% of the forested area of East Texas, have been planted since 1970.

As these planted trees age, East Texas foresters may be considering initial timber harvesting decisions for unthinned plantations. Often the timing of the harvests can be determined by considering combinations of economic and non-economic values, utilization standards and timber growth factors. However, in some situations, it may be appropriate to ascertain the proper timing by considering only timber growth factors.

Decision-making models that determine the optimum timing of timber operations by maximizing a measure of economic utility, such as present net worth, provide accurate and useful information to the plantation manager. In other models, useful decisions on timing timber operations can also be obtained only by considering the development of stand factors, such as yield per acre, basal area per acre, stand height growth and stand diameter growth.

The purpose of this paper is to present observed patterns of unthinned planted loblolly and slash pine diameter development and survival trends in East Texas and, based on the patterns, recommend the timing of:

- An initial (or intermediate) harvest to remove only some of the planted pine trees
- or
- An initial (or final) harvest to remove all of the planted pine trees,

while realizing that the growth patterns present in some unthinned East Texas pine plantations may suggest that no immediate timber harvests may be appropriate.

PLANTATION MEASUREMENTS

Information from the East Texas Pine Plantation Research Project (ETPPRP)¹ was utilized in this study. A total of 196 and 86 ETPPRP permanent plots have been established in unthinned loblolly and slash pine plantations, respectively, and each plot is in a separate plantation. Loblolly pine plots are scattered from the Gulf Coast to the Red River Basin, while slash pine plots are concentrated in Southeast Texas. Plots were established during a three year period (1982-1984) and, since then have been remeasured every three years. As of 1993, each plot had been measured four times (unless the plot was destroyed by man or nature) with a spacing between measurements of 3 years. Each measurement represents a measurement cycle (MC).

Of the plantation variables available from the ETPPRP, only three -- site index (S) with base age 25 years, number of trees per acre (T) and quadratic mean diameter (D) -- were considered in this study.

To prepare the plantation data for analysis, an observation for a MC was excluded, if D equaled zero for that MC. In addition, for a plot to be included in the study, D values from at least two consecutive MCs were required. This requirement was necessary in order to illustrate diameter growth development and survival trends from MC to MC. As a result, values from 175 loblolly pine plots and 80 slash pine plots were available for analysis. The site index was obtained from the last available MC.

A characterization of sample plots is presented in Table 1. For both species, average age is around 13 years with an average diameter of about 6 inches. Average number of loblolly and slash pine trees per acre is relatively low at 300 - 400.

¹Support of the participating industries -- Champion International Corp., International Paper Co., Louisiana-Pacific Corp. and Temple-Inland Forest Products Corp. -- is appreciated.

Table 1. Characterization of the ETPPRP plots by species and site index classes.

| Species | Characteristic | | | | | |
|----------|-----------------------|-----------------|----------------------|-------------------------------|----------------|------------------------------|
| | Site Index Class (ft) | Number of Plots | Plantation Age (yrs) | Quadratic Mean Diameter (in.) | Trees Per Acre | Basal Area Per Acre (sq. ft) |
| Loblolly | | | | | | |
| 50 | | 13 | | | | |
| Mean | | | 13 | 4.6 | 373 | 43 |
| Range | | | (11 - 19) | (2.5 - 7.0) | (87 - 622) | (11 - 74) |
| 60 | | 24 | | | | |
| Mean | | | 14 | 5.7 | 446 | 77 |
| Range | | | (9 - 20) | (3.6 - 8.7) | (139 - 827) | (28 - 154) |
| 70 | | 81 | | | | |
| Mean | | | 14 | 6.4 | 455 | 99 |
| Range | | | (8 - 24) | (4.2 - 9.1) | (161 - 928) | (42 - 170) |
| 80 | | 34 | | | | |
| Mean | | | 13 | 6.8 | 452 | 108 |
| Range | | | (9 - 20) | (4.2 - 9.2) | (222 - 723) | (60 - 192) |
| 90 | | 23 | | | | |
| Mean | | | 12 | 6.5 | 535 | 114 |
| Range | | | (9 - 19) | (4.2 - 9.2) | (186 - 906) | (57 - 158) |
| Slash | | | | | | |
| 50 | | 4 | | | | |
| Mean | | | 13 | 3.7 | 242 | 15 |
| Range | | | (11 - 18) | (1.9 - 5.4) | (112 - 345) | (7 - 21) |
| 60 | | 4 | | | | |
| Mean | | | 16 | 6.6 | 338 | 64 |
| Range | | | (12 - 24) | (4.6 - 8.6) | (129 - 776) | (34 - 91) |
| 70 | | 30 | | | | |
| Mean | | | 13 | 6.0 | 375 | 66 |
| Range | | | (9 - 21) | (3.2 - 8.7) | (90 - 895) | (27 - 166) |
| 80 | | 31 | | | | |
| Mean | | | 14 | 6.6 | 345 | 78 |
| Range | | | (9 - 22) | (4.6 - 9.1) | (113 - 579) | (32 - 140) |
| 90 | | 11 | | | | |
| Mean | | | 12 | 6.1 | 424 | 78 |
| Range | | | (6 - 16) | (3.3 - 8.0) | (178 - 684) | (41 - 104) |

DEVELOPMENT OF THE TIMBER HARVEST GUIDES

For each species:

- 01) Pairs of D and T values for each MC were tabulated for each plot.
- 02) Each plot the available pairs were connected with a line and drawn on a graph using logarithmic (base 10) scales for the x- and y-axis.
- 03) The line graph for each plot represented a diameter development and survival pattern, trend or path.
- 04) For each species, all paths were combined on one graph, which resulted in 175 paths for the loblolly graph and 80 paths for the slash graph.
- 05) An initial examination of the graphs was conducted in an attempt to develop stand density management diagrams based on techniques described by McCarter and Long (1986), Dean and Jokela (1992), Dean and Baldwin (1993) and Williams (1994).
- 06) However, this approach was not successful due to an inability to determine an equation representing the maximum tree size-density line for each of the species.
- 07) A further examination of the graph for each species was conducted and indicated no definitive patterns that could be useful in recommending the timing of initial tree harvests that might enhance survival and diameter growth.
- 08) After reasoning that land productivity might play a role in the decision-making process, the site index value for each plot's last MC was noted.
- 09) Then, the plots were separated into five site index classes ($\leq 55'$, $56'-65'$, $66'-75'$, $76'-85'$ and $\geq 86'$).
- 10) For each site index class, a graph of observed paths representing diameter development and survival trends was drawn.
- 11) The 10 graphs or "Guides for timing initial tree harvests" are shown in the last part of this report.
- 12) Each guide includes a recommendation for an initial timber harvest.
- 13) The guides depict a variety of interesting growth and survival patterns. As a result, foresters studying the observed paths may reach different harvesting conclusions.
- 14) A challenging component of East Texas pine plantations is fusiform rust (*Cronartium quercuum* [Berk.] Miyabe ex Shirai f. sp. *fusiforme*). On the average, the incidence of rust is 10% and 50% for planted loblolly and slash pine, respectively (Lenhart et al. 1994). Fusiform rust was a factor in the development of the slash pine harvesting guides.

- In Sabine county, perhaps a local business person owns an unthinned slash pine plantation with site index = 91', trees per acre = 404, average diameter = 7.1", and the incidence of fusiform rust = 65%.

The owner may ask the question: Is this the time to remove all the trees?

A possible answer may be found in the Guide for Initial Timber Harvesting ... Slash Pine Plantations ... Site Index Class 90'. The combination of observed trees per acre and diameter is located within the rounded rectangle, implying the answer to the question is probably yes. The observed paths indicate a dramatic decrease in survival and diameter growth. Also, a relatively high incidence of fusiform rust (65%) may affect future survival and growth. The time is probably advantageous to remove all the trees.

LITERATURE CITED

Dean, T. J. and E. J. Jokela. 1992. A density-management diagram for slash pine plantations in the lower coastal plain. *South. J. Appl. For.* 16(4):178-185.

Dean, T. J. and V. C. Baldwin, Jr. 1993. Using a density-management diagram to develop thinning schedules for loblolly pine plantations. *USFS Res. Pap. SO-275.* 7 p.

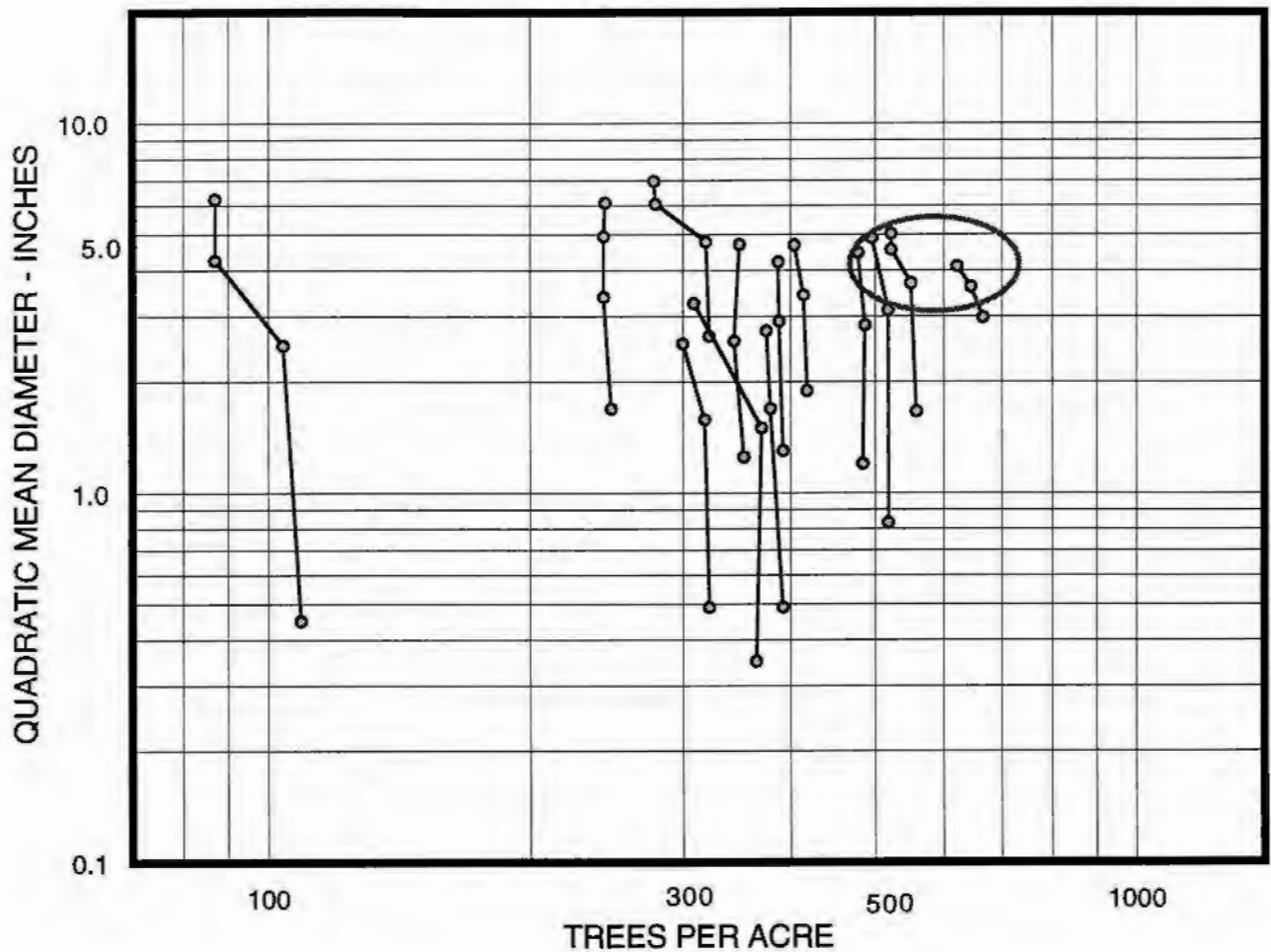
Lenhart, J. D., T. G. Gregoire, G. D. Kronrad and A. G. Holley. 1994. Characterizing fusiform rust incidence and distribution in East Texas. *South. J. Appl. For.* 18(1):29-34.

McCarter, J. B. and J. N. Long. 1986. A lodgepole pine density management diagram. *West. J. Appl. For.* 1(1):6-11.

Williams, R. A. 1994. Stand density management diagram for loblolly pine plantations in North Louisiana. *South. J. Appl. For.* 18(1):40-45.

A GUIDE FOR INITIAL TIMBER HARVESTING IN EAST TEXAS LOBLOLLY PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) ... ≤ 50 FEET



RECOMMENDATION:

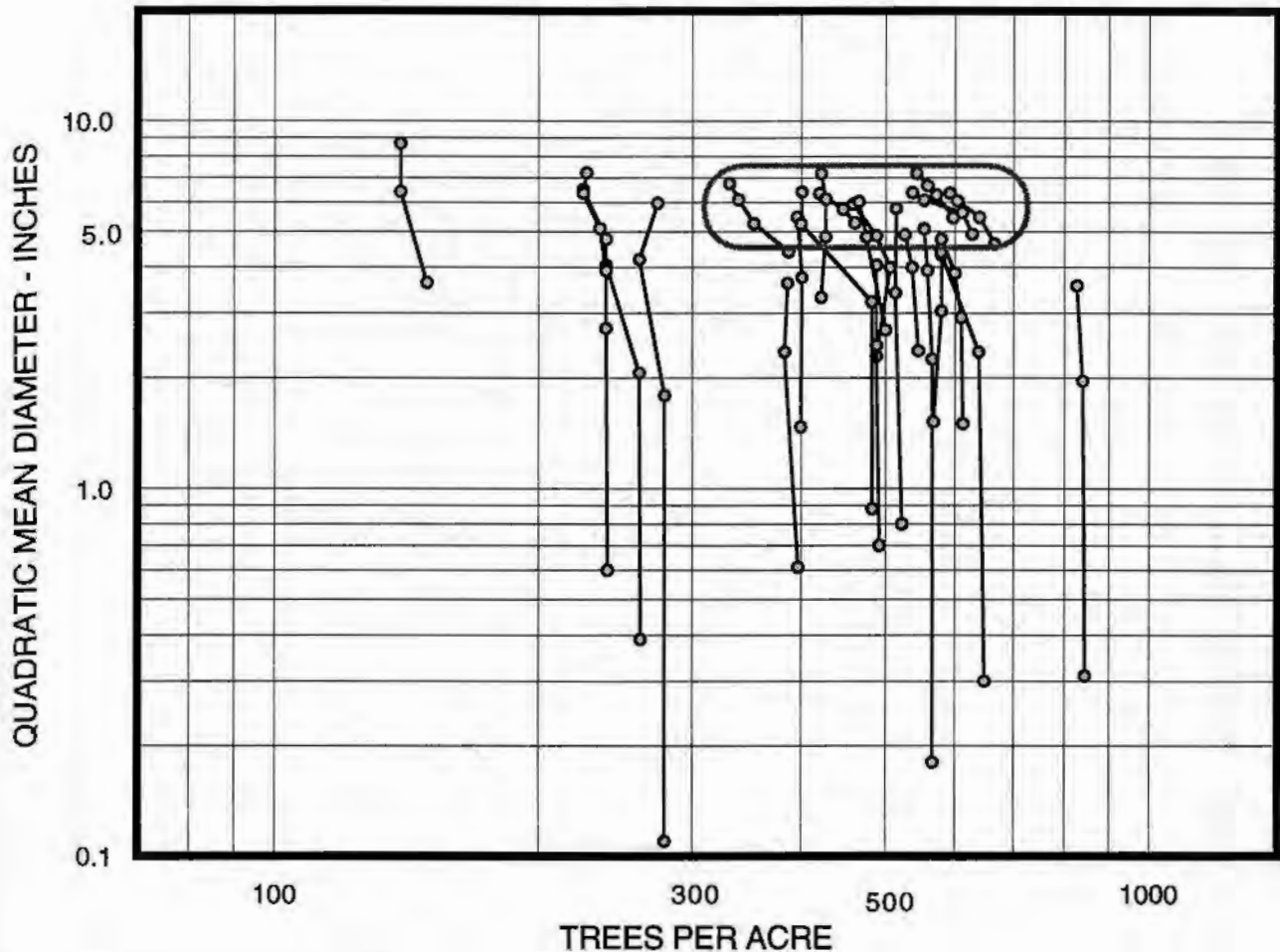
In loblolly pine plantations situated on these relatively low productivity sites, most diameter development/survival trend paths appear to indicate fairly consistent survival and diameter growth.

However, it may be argued that if a plantation has a diameter and trees per acre combination located within or close to the ellipse, decreased survival and diameter growth may occur.

For plantations in that area, perhaps a reduction in trees per acre to a level of about 400 or less may enhance subsequent survival and diameter growth performance. For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING
IN
EAST TEXAS LOBLOLLY PINE PLANTATIONS
SITE INDEX CLASS (BASE AGE 25 YEARS) ... 60 FEET



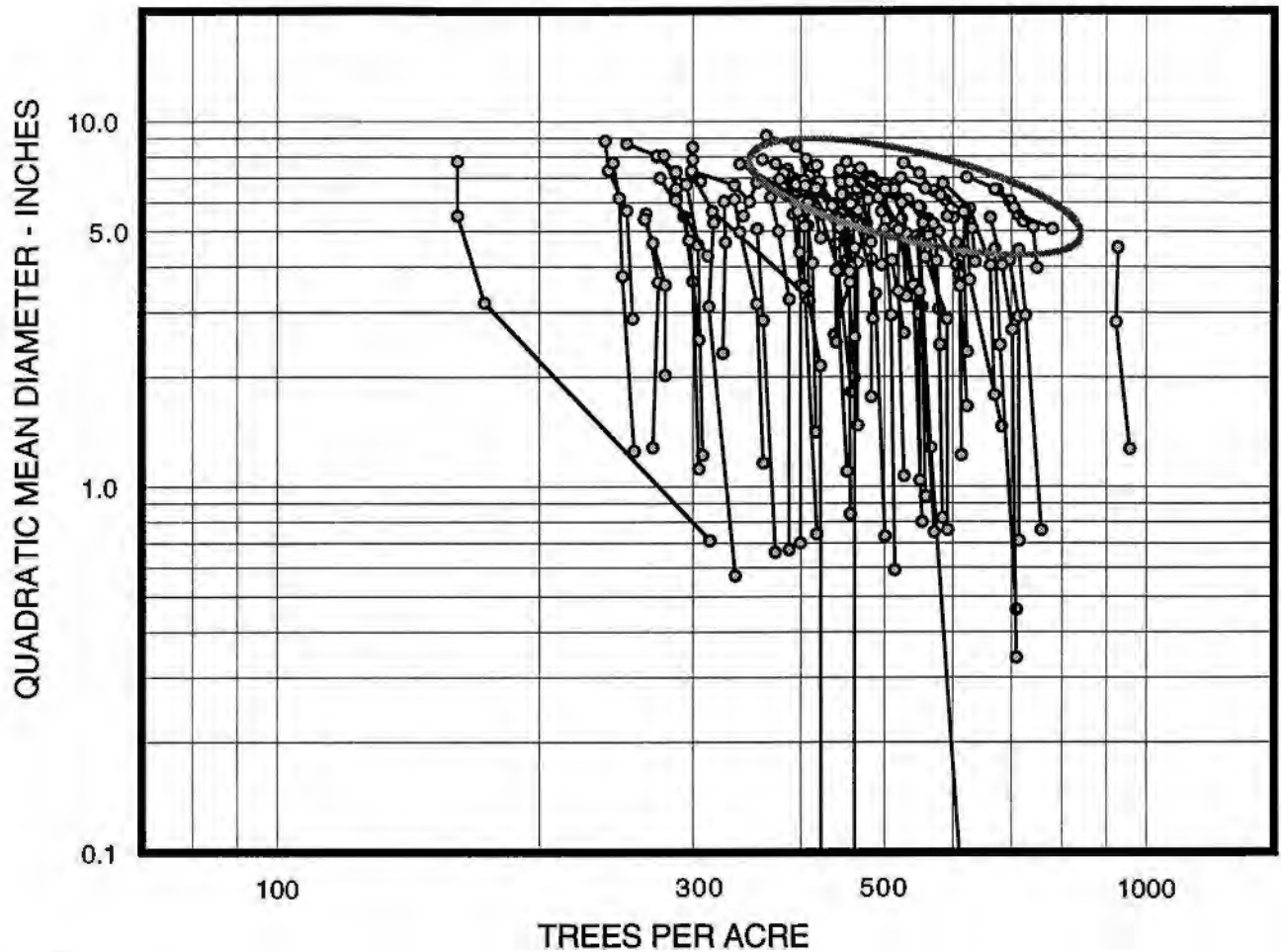
RECOMMENDATION:

In loblolly pine plantations situated on sites with this level of productivity, the rounded rectangle indicates an area of reduced survival and diameter growth.

For a plantation with a diameter and trees per acre combination in that area, or close to it, an enhancement of survival and diameter growth performance may occur, if trees per acre are reduced to about 300 or less. For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING
IN
EAST TEXAS LOBLOLLY PINE PLANTATIONS
SITE INDEX CLASS (BASE AGE 25 YEARS) ... 70 FEET



RECOMMENDATION:

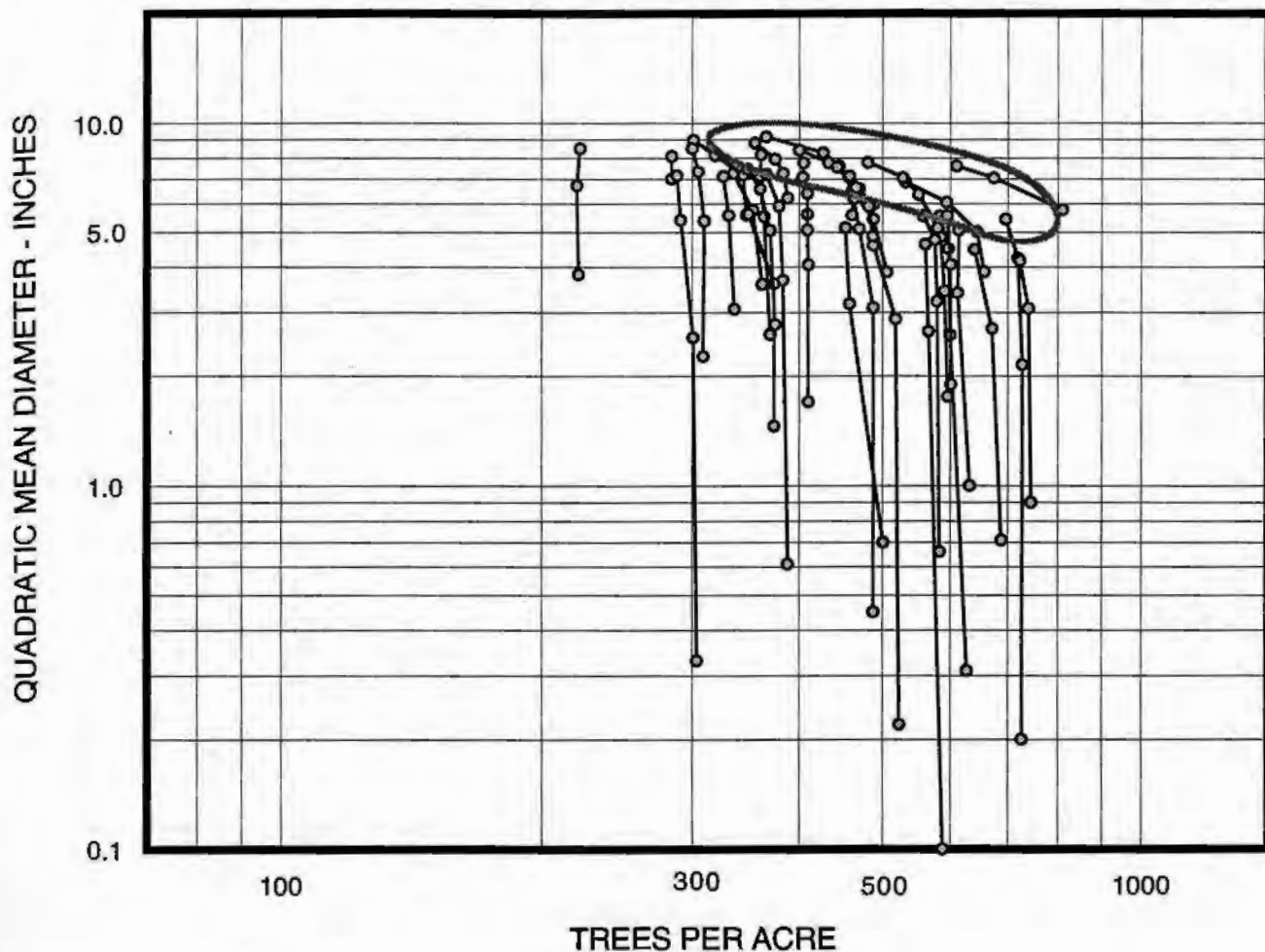
In loblolly pine plantations situated on these mid-level productivity sites, the ellipse indicates an area of reduced survival and diameter growth.

For a plantation with a diameter and trees per acre combination in that area, or close to it, survival and diameter growth may be encouraged, if trees per acre are reduced to about 300 or less. For other plantations, no immediate harvests may be required.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING IN EAST TEXAS LOBLOLLY PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) ... 80 FEET



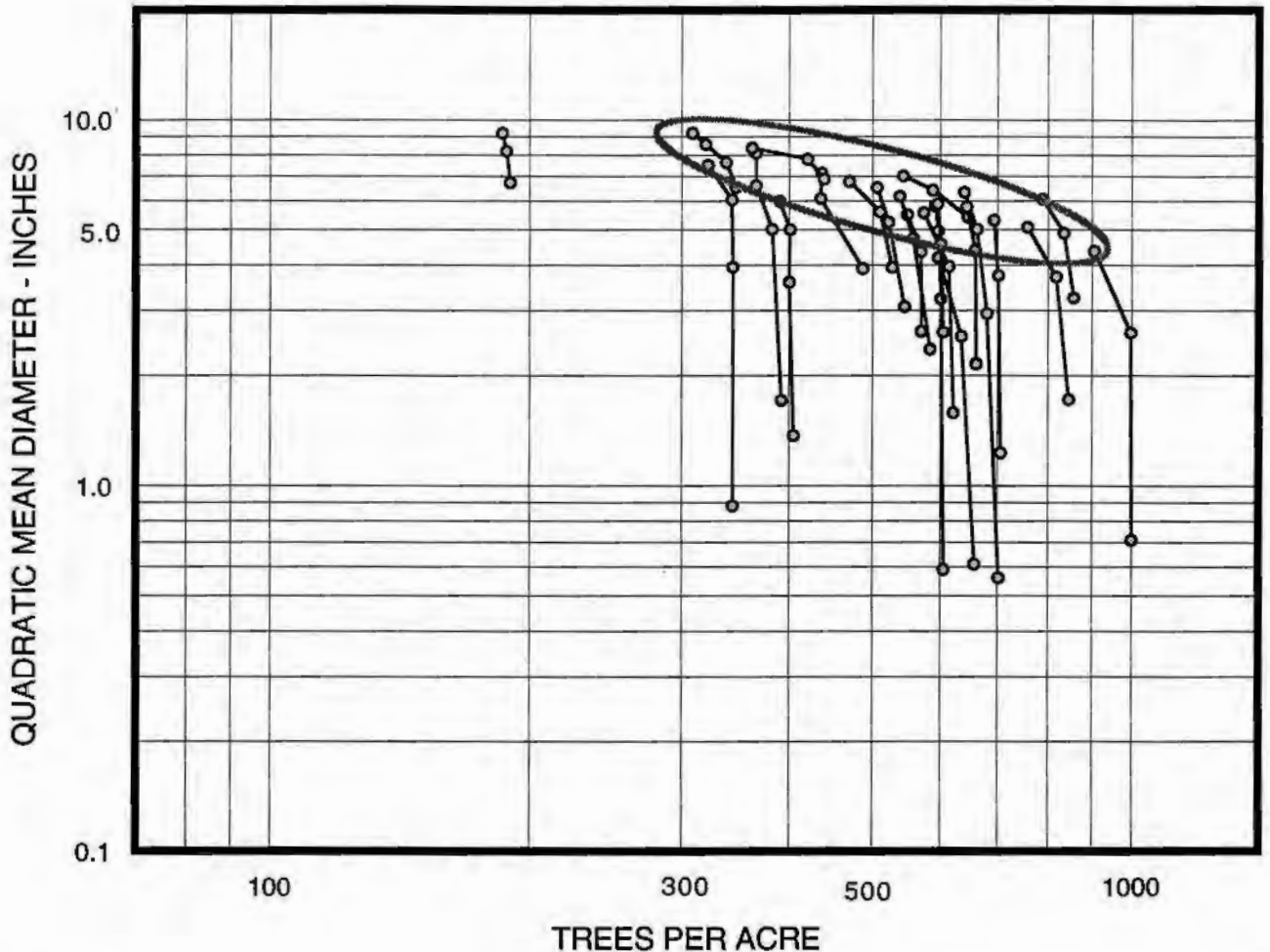
RECOMMENDATION:

In loblolly pine plantations situated on sites with this level of productivity, the bent ellipse indicates an area of reduced survival and diameter growth.

For a plantation with a diameter and trees per acre combination in that area, or close to it, survival and diameter growth may be stimulated, if trees per acre are reduced to about 300 or less. For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING
IN
EAST TEXAS LOBLOLLY PINE PLANTATIONS
SITE INDEX CLASS (BASE AGE 25 YEARS) ... ≥ 90 FEET



RECOMMENDATION:

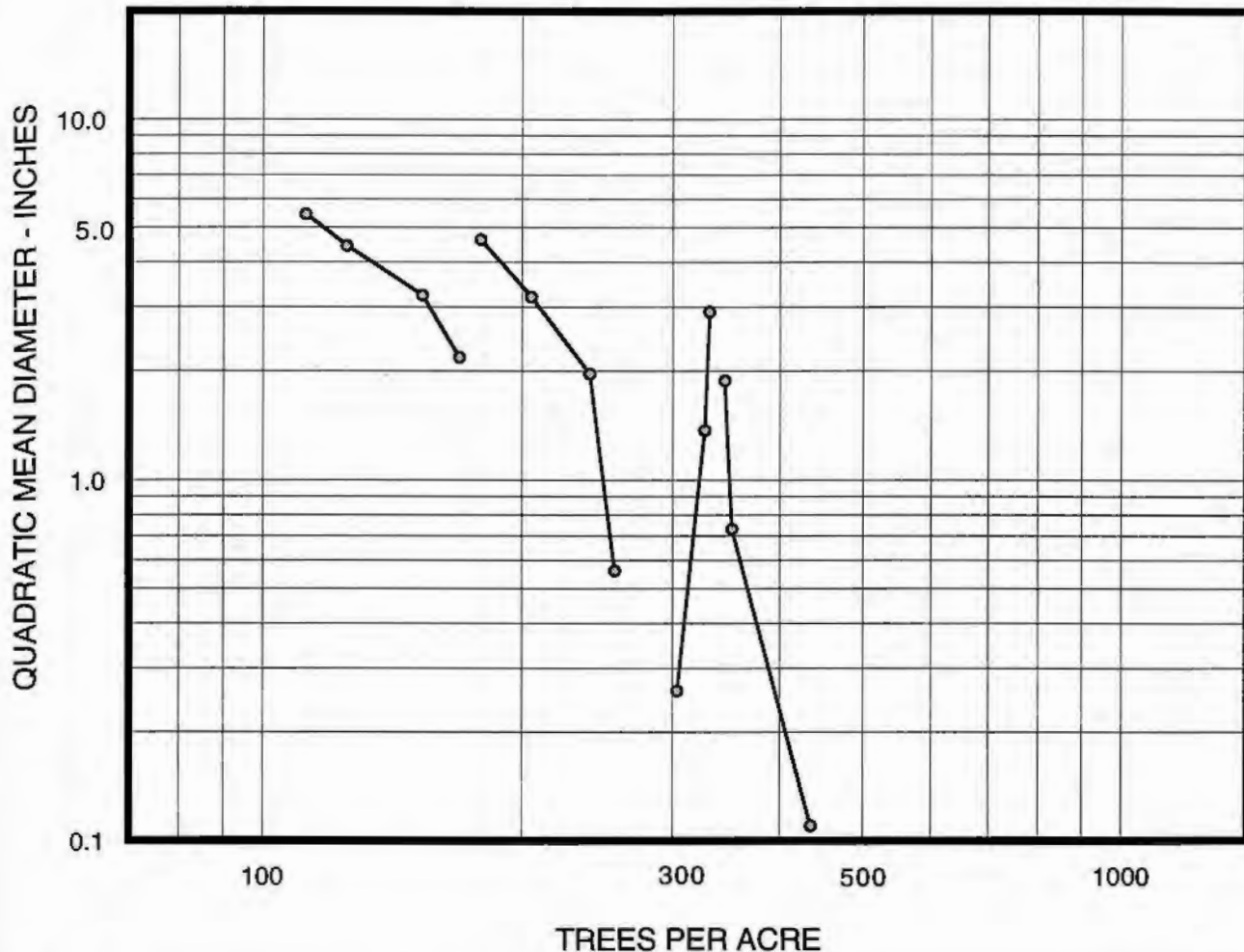
In loblolly pine plantations situated on these relatively high productivity sites, the ellipse indicates an area of reduced survival and diameter growth.

For a plantation with a diameter and trees per acre combination in that area, or close to it, survival and diameter growth may be enhanced, if trees per acre are reduced to about 300 or less. For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING IN EAST TEXAS SLASH PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) ... ≤50 FEET



RECOMMENDATION:

In slash pine plantations situated on these relatively low productivity sites, a limited number of diameter development/survival trend paths are available for consideration.

Perhaps the incidence of fusiform rust with increased mortality is affecting two of the four paths.

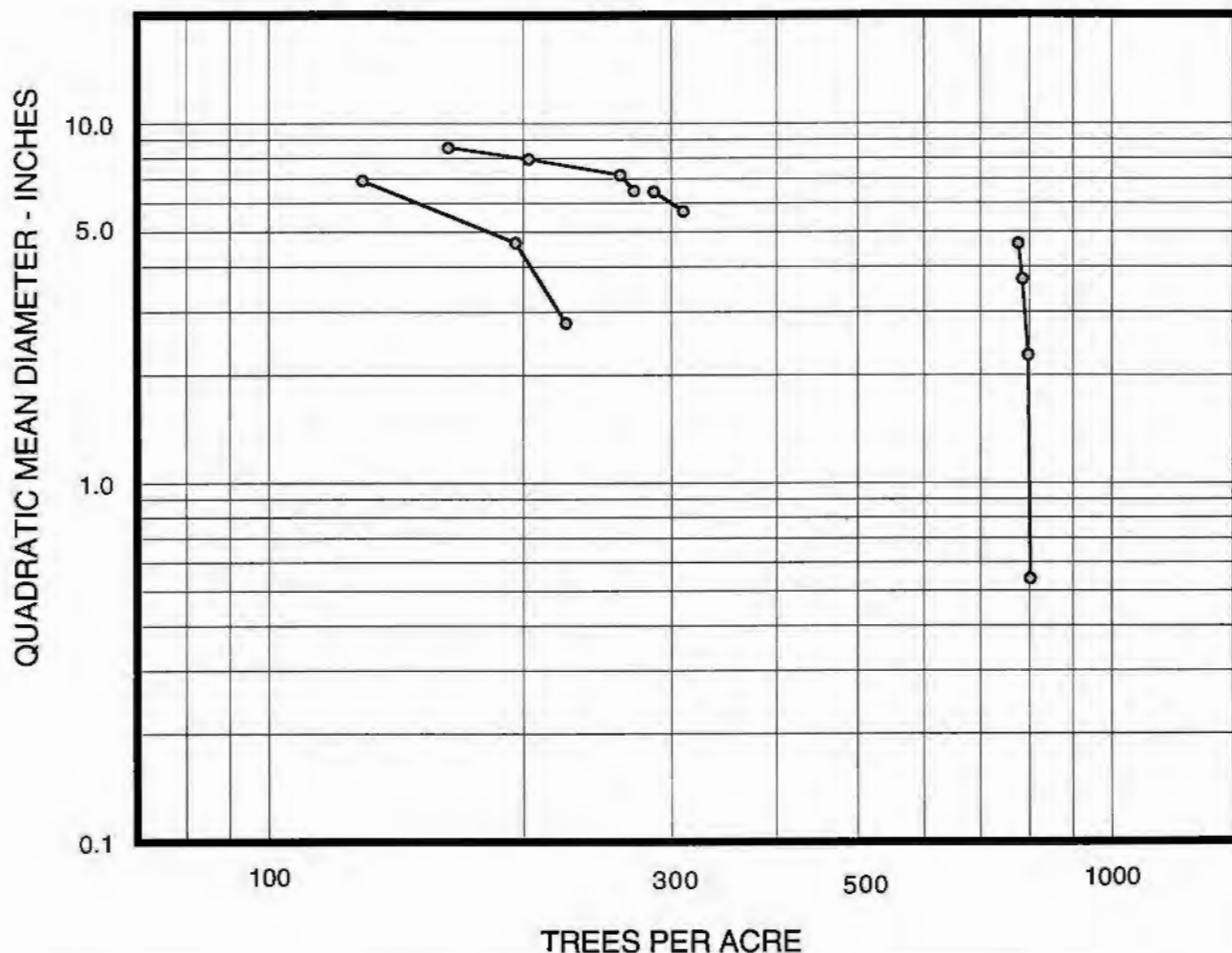
Due to these circumstances, a recommendation on a plausible course of action is not feasible.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING

^N EAST TEXAS SLASH PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) ... 60 FEET



RECOMMENDATION:

In slash pine plantations situated on sites with this level of productivity, a limited number of diameter development/survival paths are available for consideration.

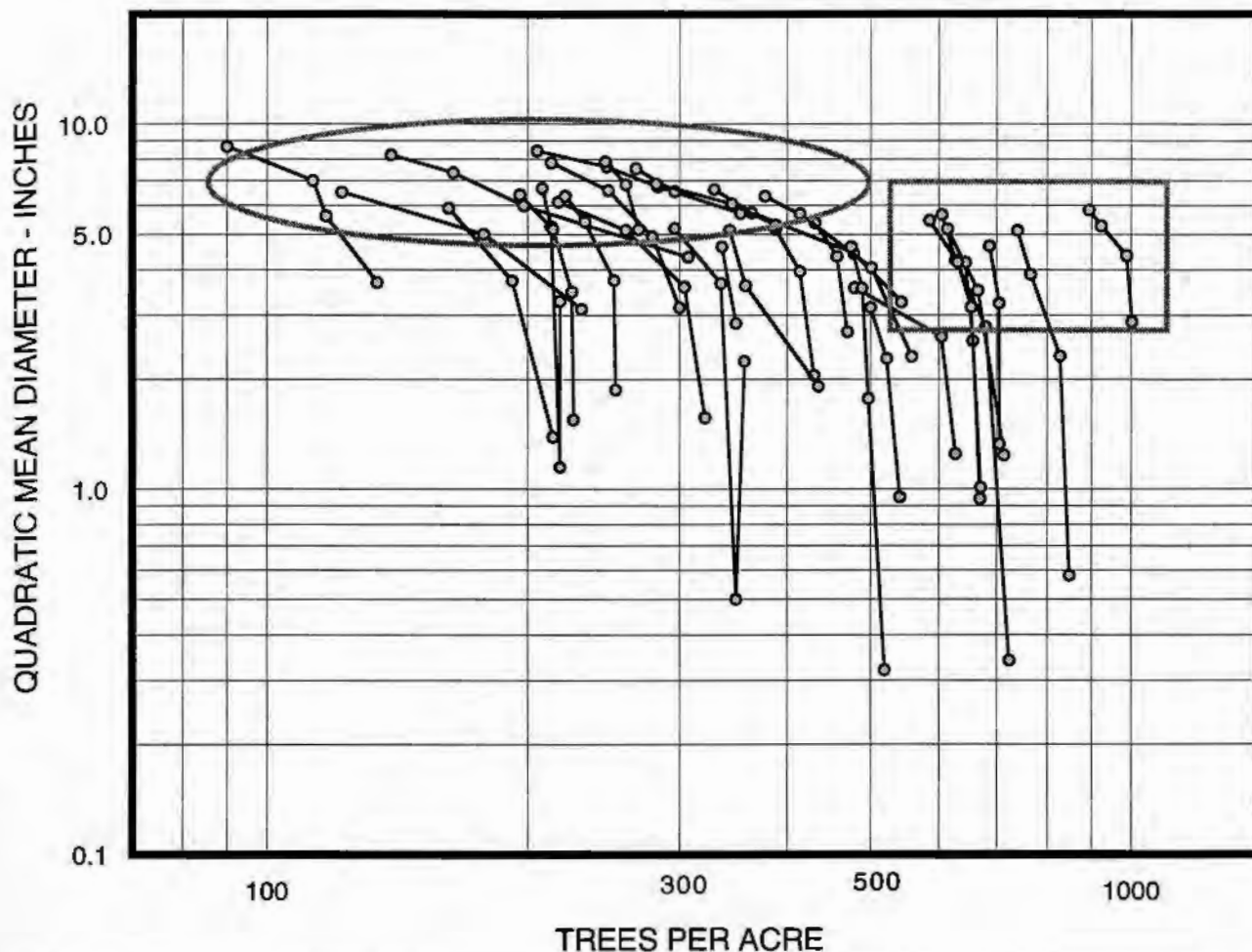
Perhaps the incidence of fusiform rust with increased mortality is affecting three of the four paths.

However, the lack of data precludes suggesting a course of action.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING IN EAST TEXAS SLASH PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) ... 70 FEET



RECOMMENDATION:

In slash pine plantations situated on these mid-level productivity sites, the ellipse indicates an area of definite reduced survival and diameter growth, while the rectangle indicates an area of modest reduction in growth and survival.

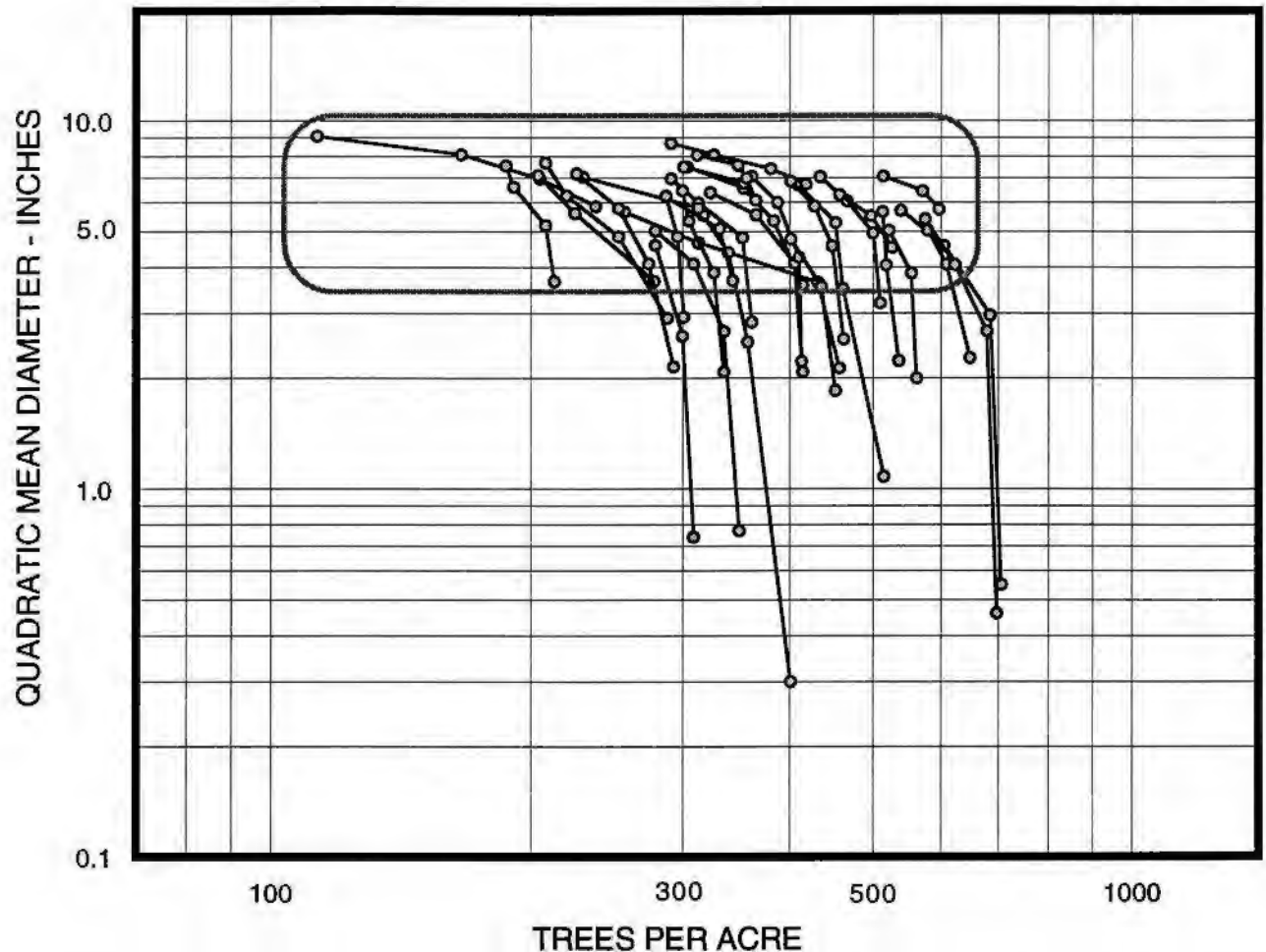
If a combination of diameter and trees per acre for a plantation occurs within or close to the ellipse, it might be best to remove all trees. If not, severe fusiform rust influenced mortality may continue to occur.

If a combination of diameter and trees per acre occurs within or close to the rectangle, a feasible course of action might be to remove rust-infected trees.

For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING
IN
EAST TEXAS SLASH PINE PLANTATIONS
SITE INDEX CLASS (BASE AGE 25 YEARS) ... 80 FEET



RECOMMENDATION:

In slash pine plantations situated on sites with this level of productivity, the rounded rectangle indicates an area of reduced survival and diameter growth.

If a combination of diameter and trees per acre for a plantation occurs within or close to the area, the removal of all trees might be appropriate. The reason for this recommendation is the threat of possibly severe fusiform rust influenced mortality.

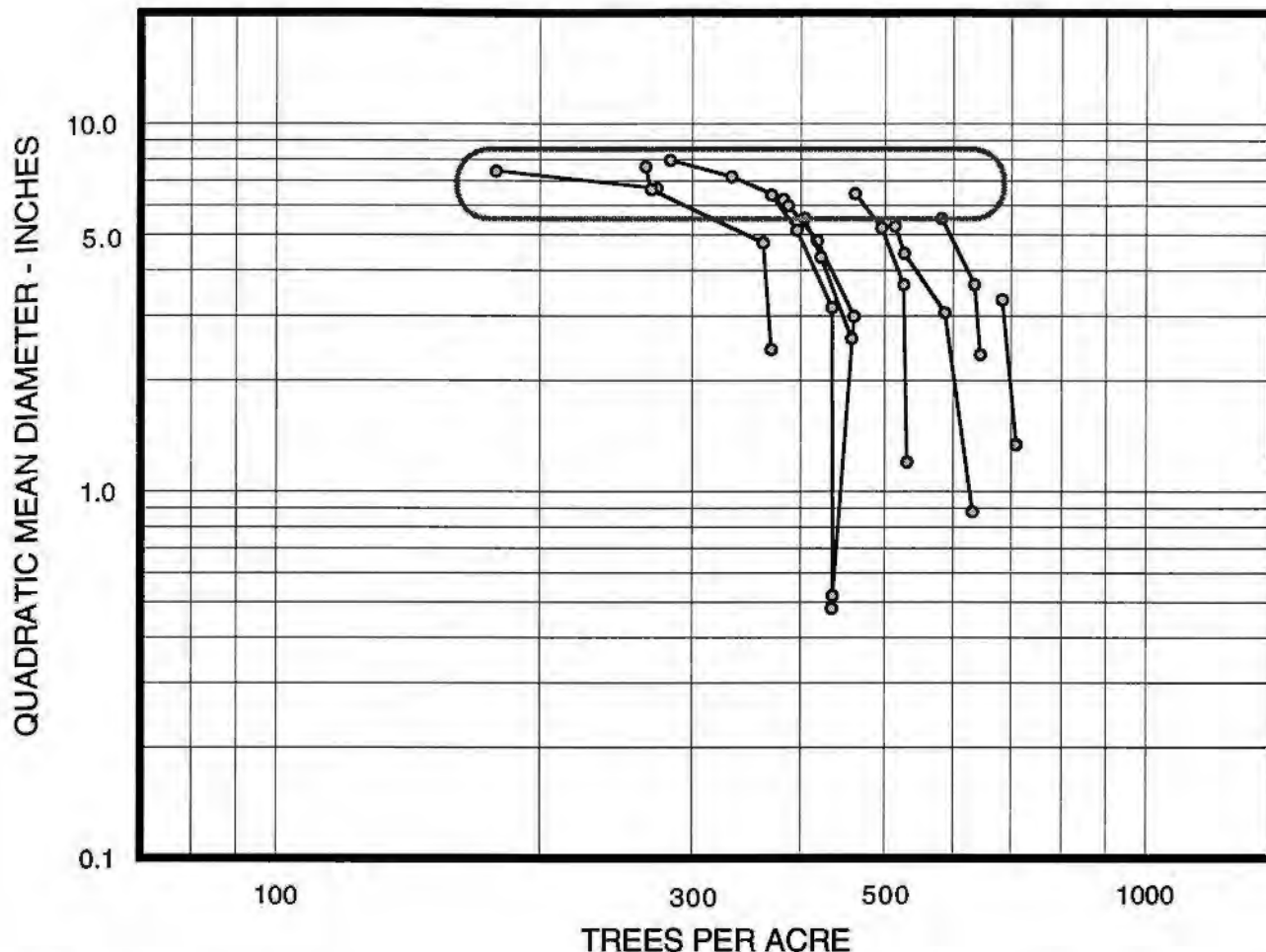
An alternative recommendation might be to remove only trees with infected stems, and, perhaps, the residual trees will remain free of rust until next harvest.

For other plantations, no immediate harvests may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.

A GUIDE FOR INITIAL TIMBER HARVESTING IN EAST TEXAS SLASH PINE PLANTATIONS

SITE INDEX CLASS (BASE AGE 25 YEARS) .. ≥ 90 FEET



RECOMMENDATION:

In slash pine plantations situated on these relatively high productivity sites, the rounded rectangle indicates an area of reduced survival and diameter growth.

If a combination of diameter and trees per acre for a plantation occurs within or close to the area, the removal of all trees might be appropriate. The primary reason for this decision is the threat of possibly severe fusiform rust influenced mortality.

However, an alternative decision to remove only rust-infected trees might be practical, if the residual trees remain clear of rust until next harvest.

For other plantations, no immediate harvest may be necessary.

NOTE: Economic, non-economic or product considerations may result in different plantation management decisions.