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J. David Lenhart

Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

Jennifer Allen

Stephen F. Austin State University

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...Slash Pine Plantations in East Texas...
..Thinned and Unthinned - Total Wood Flow Comparison..
...A Simulation...



Jennifer Allen
Student Assistant
Arthur Temple College of Forestry, SFASU, Nacogdoches, TX, 75962
and
J. David Lenhart
Professor and ETPPRP Director
Arthur Temple College of Forestry, SFASU, Nacogdoches, TX, 75962

REPORT 51

From
the
East Texas Pine Plantation Research Project
Arthur Temple College of Forestry
SFASU
Nacogdoches, TX 75962

March ... 1997

THE SIMULATION MODEL WAS TRANSLATED INTO AN EXCEL SPREADSHEET MODEL

Four specific EXCEL spreadsheets were designed:

- One for each of the four timing of thinning plantation management schedules.
- An unthinned yield prediction system was incorporated into each spreadsheet for the simulation runs.
- In addition to defining plantation parameters on the spreadsheet, the user specifies percent of wood removed and possible increase in growth rates.

THE SIMULATION RUNS

To encompass a reasonable range of Slash pine plantation parameters, values were set as:

- Site index was defined as 50', 70' & 90'.
- Trees per acre were defined as 300, 500 & 700.
- Percent of fusiform rust infected stems = 50%.
- Only trees with dbh values 4" or more were considered.
- Upper stem dob merchantability limit was 4".

for 9 combinations for the simulation runs of the EXCEL spreadsheets.

In addition, for each timing of thinning situation, percent of wood removed values were set at: 25%, 33%, 50% & 67%.

Finally, hypothetical increases in growth rates were set as: 0%, 10%, 20%, 30% & 40%.

Results are summarized in 9 charts.

CHARTS 1 - 9

The 9 charts are presented on the next 18 pages with 1 chart for each plantation parameter combination.

- Four timings of thinning in each chart.
- Four thinning percent values for each thinning schedule.
- Five growth percent increases for each thinning percent value.

In each of the 80 ellipses on each chart, the difference of
(total wood flow with a thinning) - (total wood flow with no thinning)
is presented.

ANSWER TO THE RESEARCH QUESTION

In East Texas Slash pine plantations, is the combined wood flow from a thinning and a final harvest greater than total wood flow from just a final harvest?

That is, does including one thinning in the rotation have an advantage over no thinning in the production of wood during the rotation?

And the answer in most of the cases examined is no

- A perusal of the charts indicated that the advantage only tended to be with thinning:
 - 1) If the thinning occurred early in the rotation,
 - 2) Less wood was removed in the thinning and
 - 3) A relatively high increase in the residual stand growth rate can be expected.
- The advantage tends to be better on poorer sites with higher number of trees per acre.
- To maximize the production of wood within a 25-30 yr rotation length, it may be argued that a thinning is not needed. One harvest - a final harvest - may be adequate.

Several caveats...

- Study was limited to the situations within the range of specified slash pine plantation parameters.
- Obtaining certain products from thinned trees was not a factor.
- Obtaining certain products from residual trees was not a factor.
- Data on actual response of East Texas slash pine plantations to these types of thinnings are not available.
- Cash flows were not a part of this study.
- The study was a simulation.

A SLASH PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4) ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 12 tons per acre at 25 yrs.
- About 50% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-3	-4	-6	-8
	10%	0	-1	-4	-6
	20%	5	3	-1	-4
	30%	10	8	3	-2
	40%	17	14	8	1

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4) ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 12 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-2	-3	-5
	10%	-1	-2	-3	-4
	20%	0	-1	-2	-4
	30%	1	0	-2	-4
	40%	2	1	-1	-3

**THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 13 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-3	-4	-6
	10%	-1	-2	-4	-5
	20%	0	-1	-3	-5
	30%	1	0	-2	-4
	40%	3	2	-1	-4

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 13 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-1	-2	-2	-3
	10%	-1	-1	-2	-3
	20%	0	-1	-2	-3
	30%	0	0	-1	-3
	40%	1	0	-1	-2

A Few Thoughts...

- *This slash pine plantation is defined as site index 50 base age 25 years and 300 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Simulated total wood flows with and without thinnings were calculated and compared.*

=> In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.

=> The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
- Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
- Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.
Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4)

ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 15 tons per acre at 25 yrs.
- About 60% of situations indicate that a thinning tends to increase total wood flow.
- Under these circumstances, a thinning tends to be advantageous.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-4	-5	-7	-10
	10%	2	0	-4	-8
	20%	10	7	1	-4
	30%	21	17	9	1
	40%	36	31	19	8

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4)

ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 15 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-3	-5	-7
	10%	-1	-2	-4	-6
	20%	0	-1	-3	-6
	30%	2	0	-2	-5
	40%	3	2	-1	-4

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 18 tons per acre at 30 yrs.
- About 20% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-3	-4	-6	-8
	10%	-1	-3	-5	-8
	20%	0	-1	-4	-2
	30%	3	1	-3	-6
	40%	5	3	-1	-5

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 18 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-2	-3	-5
	10%	-1	-2	-3	-4
	20%	0	-1	-3	-4
	30%	0	0	-2	-4
	40%	1	0	-2	-3

A Few Thoughts...

- *This slash pine plantation is defined as site index 50 base age 25 years and 500 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

- => In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning with a subsequent final harvest.
- => The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.

Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4)

ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 17 tons per acre at 25 yrs.
- However, about 65% of the situations indicate that a thinning tends to increase total wood flow.
- Under these circumstances, a thinning tends to be advantageous.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-4	-6	-9	-12
	10%	4	1	-3	-8
	20%	16	12	5	-3
	30%	35	29	17	5
	40%	63	54	36	18

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4)

ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 17 tons per acre at 25 yrs.
- About 20% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-3	-4	-6	-8
	10%	-1	-3	-5	-8
	20%	0	-1	-4	-7
	30%	2	1	-3	-6
	40%	5	3	-1	-5

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 21 tons per acre at 30 yrs.
- About 25% of situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-4	-5	-8	-11
	10%	-2	-3	-6	-10
	20%	1	-1	-5	-9
	30%	4	2	-3	-7
	40%	7	5	0	-6

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 21 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-3	-4	-6
	10%	-1	-2	-4	-6
	20%	0	-1	-3	-5
	30%	0	0	-3	-5
	40%	1	0	-2	-4

A Few Thoughts...

- *This slash pine plantation is defined as site index 50 base age 25 years and 700 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

- => In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.
- => The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.

Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4)

ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 38 tons per acre at 25 yrs.
- About 20% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-8	-10	-15	-20
	10%	-3	-6	-12	-18
	20%	2	-1	-8	-16
	30%	8	4	-4	-13
	40%	15	11	0	-10

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4)

ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 38 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-4	-5	-8	-11
	10%	-2	-4	-7	-10
	20%	-1	-2	-6	-9
	30%	1	-1	-5	-9
	40%	3	1	-4	-8

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 41 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-5	-6	-10	-13
	10%	-3	-5	-8	-12
	20%	-1	-3	-7	-11
	30%	1	-1	-5	-10
	40%	4	1	-4	-9

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 41 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by a final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-2	-3	-5	-6
	10%	-2	-2	-4	-6
	20%	-1	-2	-4	-5
	30%	0	-1	-3	-5
	40%	1	0	-2	-5

A Few Thoughts...

- *This slash pine plantation is defined as site index 70 base age 25 years and 300 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

- => In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.
- => The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.

Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4) ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 63 tons per acre at 25 yrs.
- About 30% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-13	-18	-27	-36
	10%	-4	-10	-21	-32
	20%	6	0	-14	-27
	30%	19	11	-5	-22
	40%	33	24	4	-15

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4) ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 63 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-7	-10	-14	-19
	10%	-4	-7	-13	-18
	20%	-1	-4	-11	-17
	30%	2	-1	-8	-15
	40%	5	2	-6	-14

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 69 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-9	-11	-17	-23
	10%	-5	-8	-15	-22
	20%	-1	-5	-12	-20
	30%	3	-1	-10	-18
	40%	7	3	-7	-16

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 69 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-4	-6	-8	-11
	10%	-3	-4	-7	-11
	20%	-1	-3	-6	-10
	30%	0	-2	-5	-9
	40%	2	0	-4	-9

A Few Thoughts...

- *This slash pine plantation is defined as site index 70 base age 25 years and 700 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

- => In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.
- => The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS

- WITH**
- SITE INDEX BASE AGE 25 YRS = 90'
 - TREES PER ACRE @ 5 YRS = 300
 - PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.
 Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4) ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 81 tons per acre at 25 yrs.
- About 25% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-15	-19	-29	-39
	10%	-7	-12	-24	-36
	20%	2	-4	-18	-32
	30%	12	4	-12	-27
	40%	23	14	-4	-23

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4) ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 81 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-7	-10	-15	-20
	10%	-5	-7	-13	-18
	20%	-2	-5	-11	-17
	30%	1	-2	-9	-16
	40%	4	1	-7	-15

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 85 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-8	-11	-16	-22
	10%	-5	-8	-14	-21
	20%	-2	-5	-12	-19
	30%	2	-2	-10	-18
	40%	5	1	-7	-16

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 85 tons per acre at 30 yrs.
- Generally, a thinning at 20 years followed by final harvest 10 years later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-3	-4	-7	-9
	10%	-2	-3	-6	-9
	20%	-1	-2	-5	-8
	30%	0	-1	-5	-8
	40%	1	0	-4	-7

A Few Thoughts...

- *This slash pine plantation is defined as site index 90 base age 25 years and 300 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

=> In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.

=> The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.

Unshaded ellipses indicate situations where thinning may not be advantageous.

A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4)

ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 112 tons per acre at 25 yrs.
- About 25% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-20	-27	-41	-55
	10%	-9	-17	-33	-50
	20%	3	-6	-25	-44
	30%	17	7	-16	-38
	40%	33	21	-5	-31

ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4)

ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS

Comments:

- Total wood flow without a thinning = 112 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-10	-14	-21	-28
	10%	-6	-10	-18	-26
	20%	-2	-7	-15	-24
	30%	2	-3	-13	-22
	40%	6	1	-10	-20

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 117 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-12	-15	-23	-31
	10%	-7	-11	-20	-29
	20%	-2	-7	-17	-27
	30%	2	-3	-14	-25
	40%	7	2	-10	-23

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 117 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-5	-6	-10	-13
	10%	-3	-5	-8	-12
	20%	-2	-3	-7	-11
	30%	0	-2	-6	-11
	40%	2	-1	-5	-10

A Few Thoughts...

- *This slash pine plantation is defined as site index 90 base age 25 years and 500 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

- => In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.
- => The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.

A SLASH PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 50%

Simulated thinned total wood flow per acre relative to unthinned total wood flow per acre in tons.

- Four combinations of timing thinning/final harvest.
 - Four thinning percent values: 25%, 33%, 50% or 67% of tons per acre removed.
 - Five growth response increases after thinning: 0%, 10%, 20%, 30% or 40%.

Values within ellipses = { total wood flow with a thinning } - { total wood flow without a thinning }.

Shaded ellipses indicate situations where thinning may be advantageous.
 Unshaded ellipses indicate situations where thinning may not be advantageous.

**A PLANTATION TIMBER MANAGEMENT PLAN (1 OF 4)
 ESTABLISH...GROW...THIN AT 10 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS**

Comments:

- Total wood flow without a thinning = 139 tons per acre at 25 yrs.
- About 25% of the situations indicate that a thinning tends to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-26	-34	-51	-68
	10%	-11	-21	-42	-62
	20%	4	-7	-31	-53
	30%	22	9	-19	-47
	40%	42	27	-6	-39

**ANOTHER POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (2 OF 4)
 ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 25 YRS**

Comments:

- Total wood flow without a thinning = 139 tons per acre at 25 yrs.
- Generally, a thinning at 15 yrs followed by a final harvest 10 yrs later does not tend to be advantageous.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-13	-17	-26	-34
	10%	-8	-15	-23	-32
	20%	-3	-8	-19	-30
	30%	2	-4	-16	-28
	40%	8	1	-12	-25

**A THIRD POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (3 OF 4)
ESTABLISH...GROW...THIN AT 15 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 145 tons per acre at 30 yrs.
- Generally, a thinning at 15 yrs followed by final harvest 15 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-14	-19	-29	-39
	10%	-9	-14	-25	-36
	20%	-3	-9	-21	-34
	30%	3	-3	-17	-31
	40%	9	2	-13	-28

**AND A FOURTH POSSIBLE PLANTATION TIMBER MANAGEMENT PLAN (4 OF 4)
ESTABLISH...GROW...THIN AT 20 YRS ...GROW RESIDUAL...FINAL HARVEST AT 30 YRS**

Comments:

- Total wood flow without a thinning = 145 tons per acre at 30 yrs.
- Generally, a thinning at 20 yrs followed by final harvest 10 yrs later does not tend to increase total wood flow.

		..... Percent removed at thinning			
		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-6	-8	-12	-16
	10%	-4	-6	-11	-15
	20%	-2	-4	-9	-14
	30%	0	-3	-8	-13
	40%	2	-1	-7	-13

A Few Thoughts...

- *This slash pine plantation is defined as site index 90 base age 25 years and 700 trees per acre at 5 yrs.*
- *Forester wants to maximize total wood flow during the rotation ... to thin or not to thin?*
- *Total wood flows with and without thinnings were calculated and compared.*

=> In general, total wood flow at final harvest with no thinning exceeds a total wood flow consisting of a thinning and a final harvest.

=> The few exceptions tend to have earlier timing of thinning, less tons removed at thinning and higher anticipated increases in residual growth rate following the thinning.