Outreach
Warnell School of Forestry & Natural Resources
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Stem Quality Summary for Old-field Planted, Unthinned Longleaf Stands in Georgia

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Introduction

The Georgia Forestry Commission (GFC) was awarded a grant by the USDA Forest Service to survey young (ages 10- through 17-years old), unthinned longleaf planted stands in Georgia. Land use history varied by site and included former cut-over, old-field, pasture, and hay-field conditions. This summary will report on longleaf stem quality from former old-field, pasture and hay-field planted sites.

Background

One of the main objectives of this landscape-level study was to quantify and determine the sawtimber and pole potential of these old-field, pasture, and hay-cutting field planted longleaf sites. While the wildlife benefits of longleaf pine stands are well documented (primarily for natural stands), the productivity and investment potential of this species is relatively unknown. Many forest landowners are interested in the long-term economic value and income potential of longleaf pine after these stands are thinned. Longleaf pine has historically been the favored southern pine for high value sawtimber and poles from naturally regenerated stands that are typically slow growing and of high initial stocking. Old-field sites, on the other hand are highly fertile coupled with the current planting density of 400 to 600 seedlings/acre and no first cycle (generation) genetic improvement, many landowners question long-term longleaf stem quality for sawtimber and poles. If these fast growing longleaf stands have questionable stem quality, will forest landowners keep these stands on the landscape after their CRP contracts expire?

Approximately 20 GFC foresters were trained in July 2013 in four longleaf planted stands by Rick Hatten (retired GFC Head of Forest Management) and David Dickens in Pulaski County. Three 1/20th acre circular plots were established in each stand using a bearing and distance/grid system. Within each plot the GFC foresters measured every living longleaf tree for dbh, total height, height to base of live crown, and document any and all stem defects on each longleaf stem in each stand that the landowner gave permission to measure and tally. Stem defects included; forking, ramicorn branching, excessive sweep (> 3” in any 10 feet run), whorls of four or more branches, and a fusiform rust canker. The height location of each defect was documented to estimate if a given stem was pulpwood (due to any of the above defects in the first 17 feet), or had one clean log (no stem defects in the first 17 feet, but with a stem defect at 17-33 feet), or had two clean logs (no stem defects in the first 33 feet). Stand establishment year, measurement year, planting spacing (and trees/acre planted) and surviving trees/acre (TPA) were also tallied for each landowner's stand. A total of 600 one-twentieth acre longleaf plots (approximately 10000 trees tallied) on 200 forest landowners' properties from 55 counties were tallied by the GFC foresters from the September 2013 through March 2017. The longleaf data presented in this summary paper is from 40 of the 200 longleaf forest landowners (20% subsample size) and 120 one-twentieth acre plots (> 2000 trees).

Landowner Objectives

Every landowner's near- and long-term goals are different. These goals can change with time. So, there is no correct or absolute # of trees/acre to thin back to in a first thinning, rather a range. The common recommendation is to thin back to your larger, best quality trees. Basal area targets after a thinning can range from 40 - 50 square feet for a wildlife emphasis benefit to 65 – 80 square feet per acre for more for a timber production emphasis. Longleaf pine, due to its slower early growth rate, lends itself to longer rotations than loblolly and slash pine to produce higher valued sawtimber and poles. Hence enough quality trees/acre are needed to achieve the higher valued products in a longer rotation and to keep longleaf on the landscape versus being compelled to clearcut the longleaf stand.

Results

The 40 summarized of the 200 sampled longleaf stands had an average planted TPA of 500, an average age of 14.5-years old, an average of 71% survival equating to 355 surviving TPA. There was an average of 30.7% defect in the first log, meaning that just under 1/3 of the stand's living trees would be pulpwood trees and should be removed in the first thinning (Tables 1, 2, and 3). Average defect in the first two logs was 53.5% (0-33 feet height, Table 4). The main longleaf stem defect was forking + ramicorm branching accounting for 89% of all stem defects.

If all trees with a stem defect in the first two logs were removed in the first thinning then the average remaining TPA would be 165 and a basal area of 44 square feet per acre (using a 7 inch average dbh thinned back to). Fourteen of the 40 (35%) landowner's longleaf stands had less than 150 TPA good stem quality trees to thin back to. The 150 TPA threshold can be considered a reasonable number to have as leave trees to allow more than one thinning. The average number good stem quality trees of the lowest 14 sampled longleaf stands was 105 TPA or 28 square feet of basal area per acre (Tables 1, 2 and 3).

Performing a first thinning scenarios

The following are two perspectives on number of quality trees per acre and basal area after a current common thinning method; a fifth row + selection thinning. The first perspective is using the 40 sampled forest landowners' averages. The second perspective is looking at each individual landowner's case and determining if each landowner has at least 150 quality stems per acre or at least 50 square feet of basal area per acre.

Remaining TPA and BA/acre using averages - removing only the stems with a defect in the 1st log

Using the average surviving TPA value of 355 and removing all trees with a stem defect in the first log only would leave 246 TPA, a reasonable TPA to leave. The removed trees would be 109 TPA of defective pulpwood trees. Due to current logging practices of row+selection thinning, some of the good quality (no defect) longleaf stems would also be removed in the row+select thinning operation. The fifth row thin portion of the thinning would remove 20% of the trees without regard to their stem quality or 71 TPA thinned. The breakdown of the 71 TPA removed in the row thinning portion would be 22 TPA pulpwood trees removed and 49 TPA good trees removed. The remaining trees with no defect in the first log would be 197 TPA (246 – 49 removed in the row thin) and 53 square feet of basal area per acre. The selection portion of the thinning that occurs after the first phase of the thinning (row removal) should remove all the defective and small diameter, small crown trees.

Remaining TPA and BA/acre based on post-thin individual stands of 15-years old and greater – removing all trees with a defect in the first 33 feet (first 2 logs)

Discerning old-field longleaf stands on a case by case basis, Tables 1 and 2 have estimates of residual TPA and basal area leaving the no defect (through 33 feet) trees in a 5th row + select thinning for the longleaf stands in the 15 – 17 year old age class (typically the beginning of thinning ages for longleaf on old-field sites) in the far right column. Sixteen of the 27 stands (59%) listed in Tables 1 and 2 had post first thin TPA numbers below 150 of quality stems (0-33 feet of clean wood with no defects). Twelve of the 27 stands (44%) had post first thin basal areas of less than 50 square feet per acre (Tables 1 and 2, far right column). Landowners that have one to five tracts of planted old-field longleaf might be best to look at the probability of their longleaf stand(s) not having enough quality TPA to thin back to using the individual events. Landowners that have many (five to ten or more) old-field planted longleaf stands may be comfortable with using the average TPA of quality trees and basal area, although each stand should be scrutinized for some minimum TPA or basal area value.

Remaining quality trees per acre in the 10 – 14 year old stands

Seven of the 13 longleaf stands (54%) in Table 3 had less than 150 quality trees per acre remaining if we were to impose the same fifth row plus select thinning removing all trees with a stem defect in the first two logs.

Summary

Using the 40 sub-sample landowners of the 200 surveyed and the above fifth row + selection thinning, the following is a summary of the findings: (1) using averages and thinning only the trees with a stem defect in the first 17 feet (first log), there was on average 197 trees per acre (trees with no stem defect + trees with a stem defect in the second log @ 17-33 feet) and 53 square feet of basal area per acre left after the thinning. (2) Looking at each landowner’s case and thinning all the trees with stem defects in the first two logs in the first thinning in the 15 – 17 year old stands, 16 of 27 stands (59%) had less than 150 quality stems per acre and 12 of the same 27 stands (44%) had less than 50 square feet of basal area per acre (Tables 1 and 2). Fifty-four percent (7 of 13) of the younger stands (ages 10 -14 years, Table 3) had less than 150 quality trees per acre (no stem defect in the first two logs; 0-33 feet). Therefore when using a threshold of 150 TPA to thin back to of quality trees with no stem defect in the first two logs over 50% of the landowners surveyed did not meet this criteria. When using the 50 square feet per acre basal area or more criteria, 44% of the 15 – 17 year old stands did not meet that criteria after a fifth row + select thinning.

Recommendations

Based on the analysis of a sub-set (40) of the 200 old-field, unthinned longleaf planted stands in Georgia, the amount of defect in these fast growing stands, and the fact that 89% of stem defect was due to forking + ramicorm branching, the following are recommendations. These recommendations should assist the forest landowners who would like to have residual basal areas of at least 50 square feet and/or greater than 150 TPA after their first thinning, have multiple thinnings, and help keep as many of the longleaf planted acres in longleaf (versus clearcut and convert back to cropland or plant another tree species).

For current old-field planted longleaf stands that are approaching thinning age (age 15 – 22 years old), have a consulting forester inventory each longleaf stand to include the number of stems/acre with a defect in the 1st log (0-17 feet) and the first 2 logs (0-33 feet) and total trees/acre. Decide in each stand if there are enough "quality" stems/acre to thin back to. This is a judgment call as each landowner will have a minimum number of quality trees/acre to thin back to. Some landowners are removing only the stems with a defect in the 1st log in the first thinning using current thinning practices (row + selection), leaving the best stems and stems with one clean log but a defect in the 2nd log (to be removed in a later thinning) if there are enough quality stems to thin back to in a 2nd or later thinning.

For future old-field plantings of longleaf:

* Allow landowners to plant from 600 to 900+ longleaf seedlings per acre. More tree per acre gives more trees to work with in the first thinning and means an earlier thinning benefiting wildlife when including a prescribed burning regime. Higher densities in the earlier years mimic natural stands that we know develop high-quality stems.
* Procure the best longleaf seedlings that have been proven to have greatly reduced forking on moderate to high fertility sites (former old-field, pasture and hay-field sites). This recommendation is currently being worked on with improved seedlings and progeny testing.
* Plant at more of a square spacing, such as a 7x9 feet (691 TPA) or 6x10 feet (726 TPA) versus a more rectangular spacing (6x12 feet; 605 TPA) to help with the pruning process and possibly aid in reducing wind speed in the stand which may contribute to terminal breakage and forking.
* Although not proven in longleaf, consider broadcast applying 1 lb/ac elemental-boron. Boron is known for improving terminal growth dominance, potentially reducing forking (Dr. Cristian Montes' recommendation).

Table 1. Old-field planted, unthinned longleaf from 24 Counties in Georgia in the 15 – 17 years old age class; Appling through Grady Counties.

County Land-owner	Age (yrs)	% survival	Surviving TPA	1^{st} log defect %	ǂ$1^{st}+2^{nd}$ log defect %	TPA w/ 2^{+} clean logs	Mean dbh (in)	Mean ht (ft)	BA/ac (ft2)	ǂ ǂ **TPA (BA/ac) post thin**
Appling D	16	75	340	15	43	194	8.1	48	124	**155 (70)**
Berrien K	16	81	393	20	40	236	6.4	37	89	**189 (56)**
Brooks J	15	91	440	25	69	136	6.8	45	117	**109 (36)**
Bulloch Co	16	84	407	25	53	191	7.0	45	109	**153 (53)**
Bulloch Cr	15	86	440	35	43	251	6.2	41	96	**201 (57)**
Calhoun P	15	72	373	55	77	86	6.9	45	100	**69 (23)**
Candler S	15	72	373	30	58	157	7.6	42	108	**125 (50)**
Colquitt B	16	78	387	26	39	236	7.3	53	116	**189 (71)**
Decatur S	17	84	407	19	58	171	6.8	45	107	**137 (45)**
Early B	15	60	313	36	50	156	7.2	45	92	**124 (45)**
Early T	16	56	273	60	81	107	7.7	50	93	**97 (40)**
Evans J	15	67	347	16	41	205	7.7	50	126	**191 (79)**
Evans M	15	79	407	20	41	240	6.0	36	84	**192 (51)**
Grady P	15	63	313	33	59	116	8.2	55	113	**90 (42)**

ǂ The main longleaf stem defect was forking + ramicorm branching accounting for 89% of all stem defects

ǂ ǂ Final TPA of no defects in first 33 feet (2 logs) calculated assuming a 5^{th} row thin + select thinning. The 5^{th} row thin removed 20% of the trees (surviving TPA - (0.2 x surviving TPA)) x (1- $1^{st}+2^{nd}$ log defect fraction) x TPA w/ 2^{+} clean logs. BA/acre is calculated by (TPA w/2^{+} clean logs)x((mean dbh+1)^2 x .005454154). Assumes post thin mean dbh is 1” greater than pre-thin dbh

Table 2. Old-field planted, unthinned longleaf from 24 Counties in Georgia in the 15 – 17 years old age class; Irwin through Worth Counties.

County Land-owner	Age (yrs)	% survival	Surviving TPA	ǂ 1st log defect %	1st+2nd log defect %	TPA w/ 2+ clean logs	Mean dbh (in)	Mean ht (ft)	BA/ac (ft2)	ǂ ǂ **TPA (BA/ac) post thin**
Irwin G	16	47	213	44	63	79	8.3	45	73	**73 (34)**
Jeff Davis B	15	72	347	18	20	278	5.5	34	62	**222 (51)**
Jenkins C	15	66	340	26	63	126	7.2	41	99	**79 (29)**
Lowndes T	15	82	371	35	44	208	7.4	49	102	**166 (64)**
Miller B	16	65	313	25	72	88	7.4	43	98	**63 (24)**
Mitchell H	16	73	353	24	50	172	7.4	55	109	**136 (52)**
Montgomery B	16	80	387	21	49	197	7.8	47	128	**158 (67)**
Pulaski P	15	55	285	32	42	165	8.0	42	101	**132 (58)**
Screven R	15	78	387	56	63	132	7.0	35	110	**103 (36)**
Seminole D	15	75	340	31	51	167	7.3	49	104	**134 (50)**
Stewart H	16	65	313	40	62	119	7.4	49	99	**95 (37)**
Sumter P	16	48	247	41	70	74	8.5	47	94	**59 (29)**
Wilcox B	16	74	460	21	52	221	6.8	42	129	**177 (59)**

ǂ The main longleaf stem defect was forking + ramicorm branching accounting for 89% of all stem defects

ǂ ǂ Final TPA of no defects in first 33 feet (2 logs) calculated assuming a 5th row thin + select thinning. The 5th row thin removed 20% of the trees (surviving TPA - (0.2 x surviving TPA)) x (1- 1st+2nd log defect fraction) x TPA w/ 2+ clean logs. BA/acre is calculated by (TPA w/2+ clean logs)x((mean dbh+1)^2 x .005454154). Assumes post thin mean dbh is 1" greater than pre-thin dbh.

Table 3. Old-field planted, unthinned longleaf from 24 Counties in Georgia in the 10 – 14 years old age class; Atkinson through Worth Counties.

County Land-owner	Age (yrs)	% survival	Surviving TPA	1st log defect %	ǂ1st+2nd log defect %	TPA w/ 2+ clean logs	Mean dbh (in)	Mean ht (ft)	BA/ac (ft2)	ǂ ǂ **TPA (BA/ac) post thin**
Atkinson M	12	80	387	21	38	240	7.0	47	98	**192 (67)**
Bacon L	12	41	247	12	22	193	5.8	34	48	**154 (39)**
Burke H	14	78	387	23	45	213	6.8	37	98	**171 (57)**
Clay B	14	88	427	24	48	222	6.9	50	115	**178 (61)**
Coffee M	13	65	293	20	33	196	7.4	41	90	**157 (60)**
Crisp H	11	61	333	45	60	133	7.0	44	94	**106 (37)**
Dodge C	13	81	393	21	60	157	6.3	37	87	**126 (37)**
Emanuel M	14	79	380	26	54	171	7.3	44	111	**136 (51)**
Liberty H	14	88	433	28	50	217	7.5	46	137	**174 (69)**
Schley H	11	72	373	71	85	56	4.4	22	49	**45 (6)**
Screven T	11	72	347	35	53	163	6.3	36	102	**130 (38)**
Terrell S	10	52	287	30	62	109	7.7	43	97	**73 (30)**
Worth A	14	65	313	44	77	110	7.2	46	88	**96 (35)**

ǂ The main longleaf stem defect was forking + ramicorm branching accounting for 89% of all stem defects

ǂ ǂ Final TPA of no defects in first 33 feet (2 logs) calculated assuming a 5th row thin + select thinning. The 5th row thin removed 20% of the trees (surviving TPA - (0.2 x surviving TPA)) x (1- 1st+2nd log defect fraction) x TPA w/ 2+ clean logs. BA/acre is calculated by (TPA w/2+ clean logs)x((mean dbh+1)^2 x .005454154). Assumes post thin mean dbh is 1” greater than pre-thin dbh.

Table 4. Mean longleaf growth parameters from the 40 landowner old-field longleaf planted sites in Georgia.

Age (yrs)	MAI	Dbh(in)	Ht (ft)	BA/ac (ft^2)	TPA planted	Survival	1^{st} log defect	$1^{st}+2^{nd}$ log defect
14.5	3.9	7.1	43.6	100	500	71%	30.7%	53.5%

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