Evaluation of the Use of Acoustic Technology to Identify Low Value Logs

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Objective
The purpose of this service was to evaluate the feasibility and effectiveness of a resonance based acoustic technique for sorting low grade and low value logs from the chip wood mix stems. This work is conducted under a service agreement between the Natural Resources Research Institute (NRRI) at the University of Minnesota Duluth and the Seneca Sawmill Co. in Eugene, Oregon.

Work Scope
Provide testing and consulting services to the Seneca Sawmill Company in Eugene, OR during a log sorting trial. The scope of this service includes the following:

1. Demonstrate the use of the Director HM200, a resonance-based commercial acoustic tool (hand-held), in sorting logs with acoustic concept;

2. Conduct acoustic measurements on randomly selected stems (300 stems from 3 groups), establish acoustic velocity data base for the chip wood mix, determine cut-off acoustic velocities for subsequent log sorting process;

3. Acoustically test stems in the production flow and sort them into acoustic classes using pre-determined cut-off acoustic velocity values;

4. Conduct data analysis on stem acoustic data and lumber grade yield data (the Seneca Sawmill tracks the stems, logs, and the lumber through the mill process and determines lumber grade yield).

5. Prepare a final report for the Seneca Sawmill Co.

Procedure
Two trials were run at Seneca Sawmill in Eugene, Oregon from February to May, 2007. In first trial, field acoustic testing was conducted in two phases:

Phase 1: Establish acoustic velocity database, determine velocity thresholds

1. Randomly select 300 stems from 3 groups/bins, 100 stems from each group/bin;
2. Measure the length and diameters of each stem;
3. Measure acoustic velocity of the stems using a resonance based acoustic tool (Director HM200); Return the stems back to the production flow;
4. Develop statistical distributions of stem acoustic velocity for each group and determine if there is significant differences between groups/bins;
5. Establish acoustic velocity thresholds for sorting stems into 3 grade levels (high, medium, and low);

Phase 2: Sorting stems based on stem acoustic velocity

1. Randomly select 300 new stems from 3 groups/bins, 100 stems from each group/bin;
2. Measure the length and diameters of each stem (both ends);
3. Measure acoustic velocity of the stems using Director HM200 and sort the stems into 3 grade levels based on the velocity thresholds developed in the first phase; paint the ends

of the stems with "Green" (high grade), "Blue" (medium grade), and "Red" (low grade) colors;

4. Segregate the stems into 3 piles based on the colors (green, blue, and red).

After acoustic testing, the stems of 3 different acoustic sorts were sawn into lumber in the mill. The lumber was then visually graded in green condition.

In second trial, 300 grand fir and hemlock stems were acoustically tested and sorted into two acoustic classes using a velocity threshold of 11,000 ft/s. The stems were then processed into lumber in the mill. Lumber was visually graded after kiln drying.

Results Summary

First Trial

The stems tested in the first trial were mixed species which included Douglas fir (80%), grand fir (14%), red cedar (3%), and hemlock (2%). The stem velocity was in the range of 9,000 ft/s to 16,500 ft/s for the mixed species (Fig1-4). Douglas-fir stem is also in the same velocity range. The velocity ranges for grand fir, red cedar, and hemlock were not conclusive due to relative small sample sizes.

Two cut-off velocities that were established in phase 1 were: 1) 11,000 ft/s and 2) 12,000 ft/s. Using 11,000 ft/s can sort out 10% of the low end stems; Using 12,000 ft/s can sort out approximately 25% of the low end stems. It appears that acoustic velocity of red cedar stems is significantly lower than that of Douglas fir. The threshold of 11,000 ft/s probably can sort out some of the red cedar stems, but some can still pass through and get into the processing stream.

Of the stems acoustically tested, seven in phase 1, and three in phase 2 were misidentified as "low quality" stems. The acoustic velocity of those stems should be doubled. This problem can be easily solved by setting a velocity limit in the tool in operation.

The Douglas-fir stems and lumber were tracked through the mill process. The lumber was visually graded in green from. Table 1 and 2 show the lumber grade yield of Douglas fir stems in volume (board feet) and percentage. In general, lumber visual grade yield corresponds to stem velocity positively. Stems that have a high acoustic velocity contain higher proportions of high-grade lumber; Stems that have a low acoustic velocity contain higher proportions of low-grade lumber (Figure 5, 6).

We also conducted a preliminary economic analysis using the Douglas-fir data. The results are shown in Table 3 and 4. The price references used in this analysis were: $250/MBF for Std & Btr and #2 & Btr; $115/MBF for Economy.

- The lumber volume is 58.84 MBF for Red stems, 5.25 for Blue stems, and 2.81 for Green stems;

- The total lumber value is $14,077 for Red stems, $1,279 for Blue stems, and $621 for Red stems;

- The lumber value per stem volume is $21/ft^3 for Red stems, $14/ft^3 for Blue stems, and $12/ft^3 for Green stems.

(Note: The unit lumber value was calculated based on the volume of the stems, in ft^3)

By comparing the unit lumber values, we can see a significant difference between "Green" stems and "Red" (or "Red + Blue") stems.

The results from the first trial were not conclusive, primarily because the sample size in "Red" (low end) stems was not big enough (only 15 "Red" Douglas fir stems, which is 5% of the total stems tested). In addition, the quantity of hem/fir stems in the first trial was not high enough to draw any conclusions for hem/fir production. Therefore, a decision was made to run second trial using hem/fir logs with a more balanced sample sizes between stem acoustic sorts, then follow the lumber through drying process.

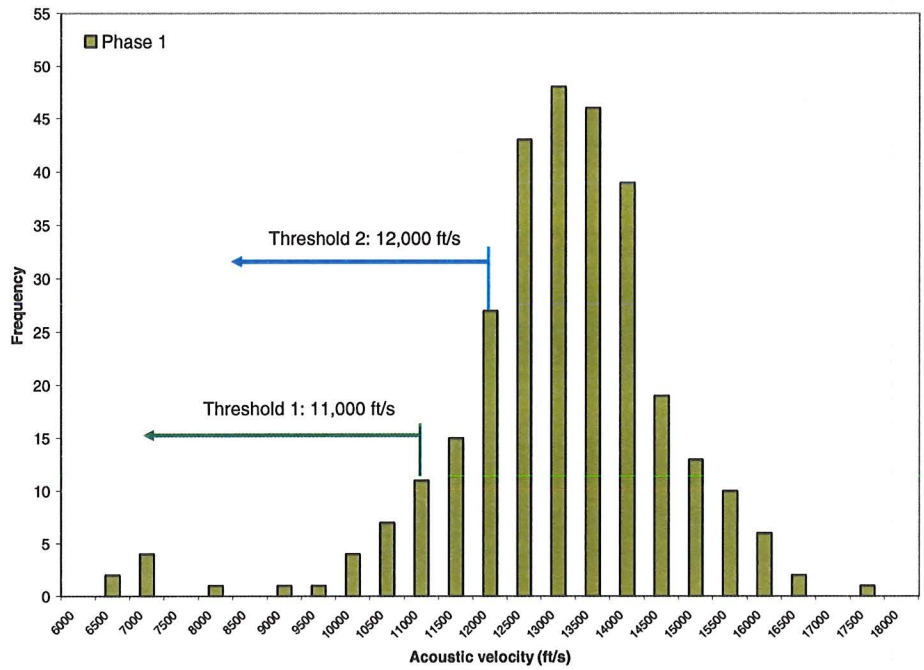


Figure 1. Distribution of acoustic velocity of 300 stems tested in trial 1 - phase 1.

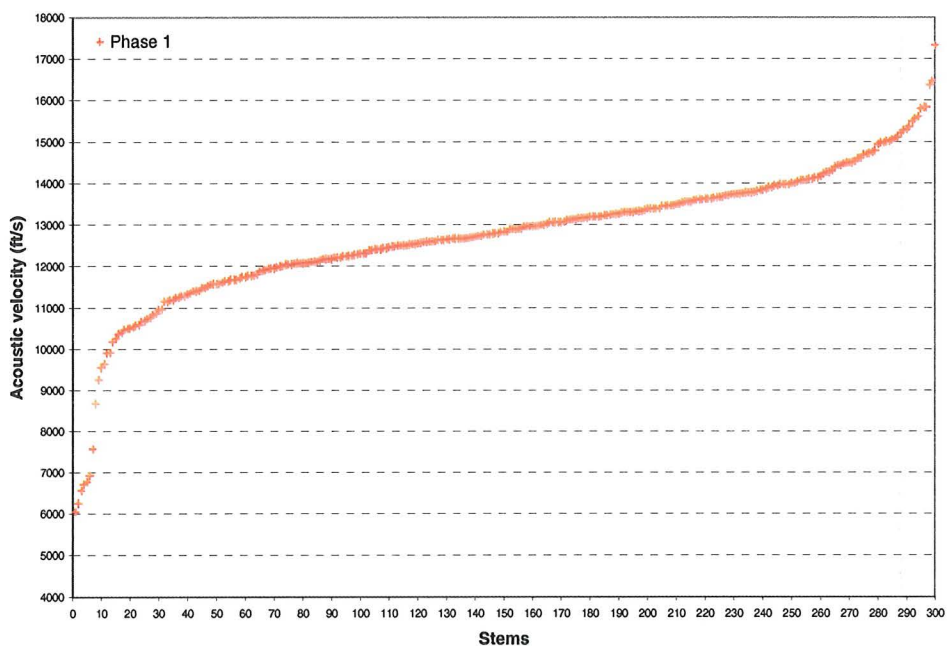


Figure 2. Sorted acoustic velocity of 300 stems tested in trial 1 - phase 1.

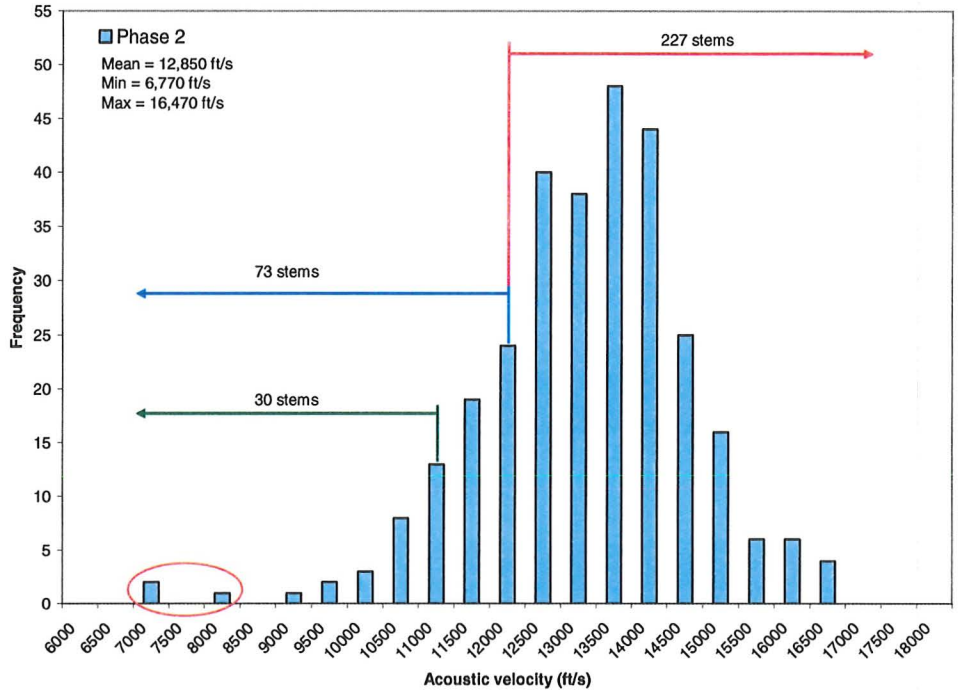


Figure 3. Distribution of acoustic velocity for the 300 stems tested in trial 1- phase 2 (stems processed into lumber)

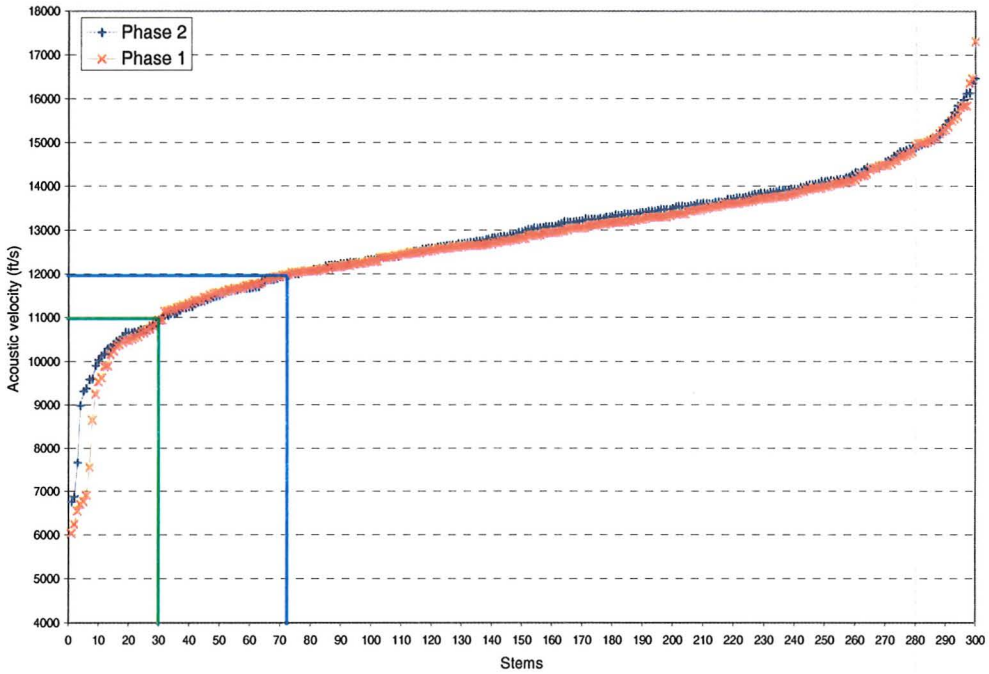


Figure 4. Sorted acoustic velocity of all the stems tested in trial 1 (phase 1 and phase 2).

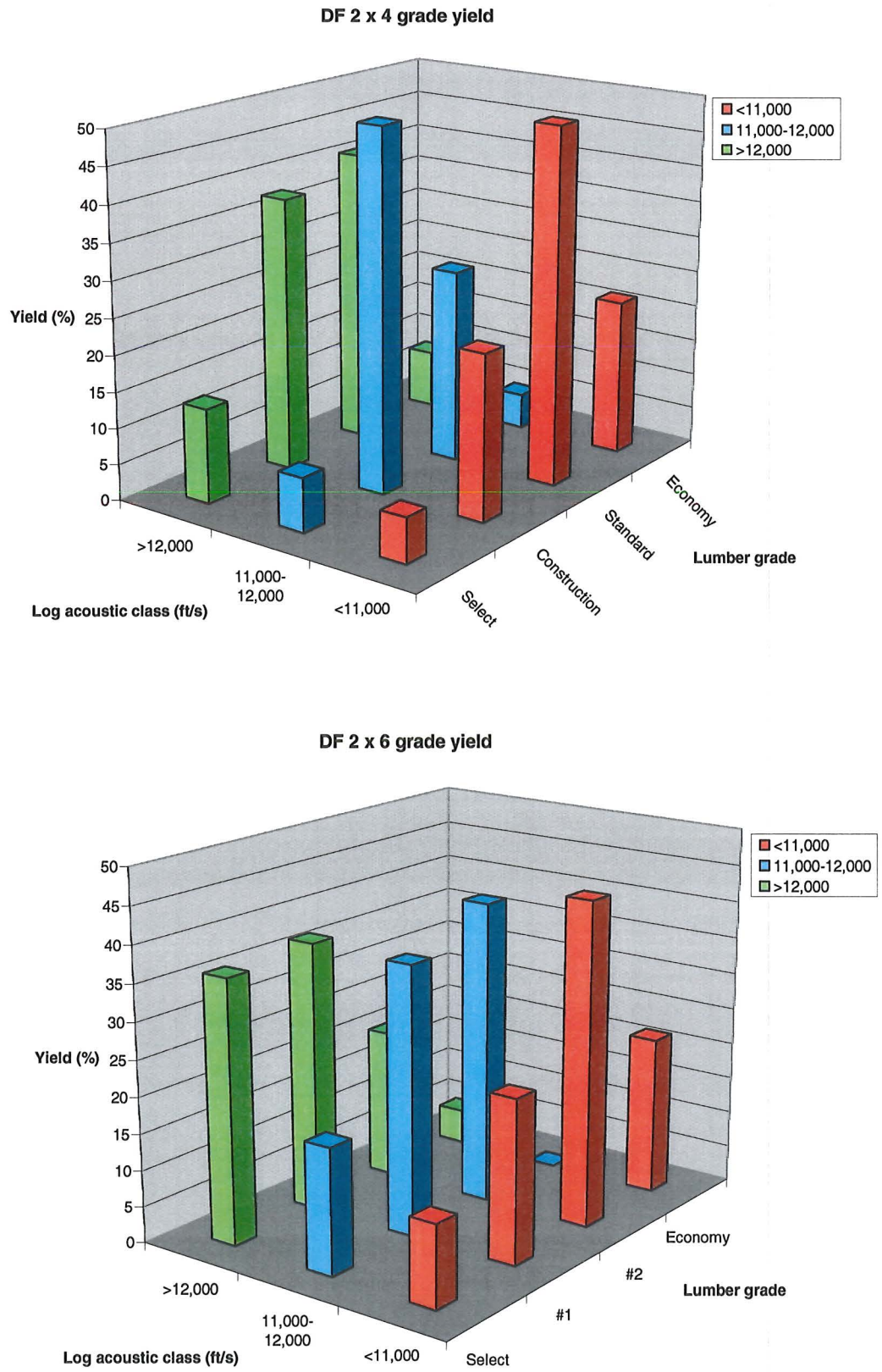
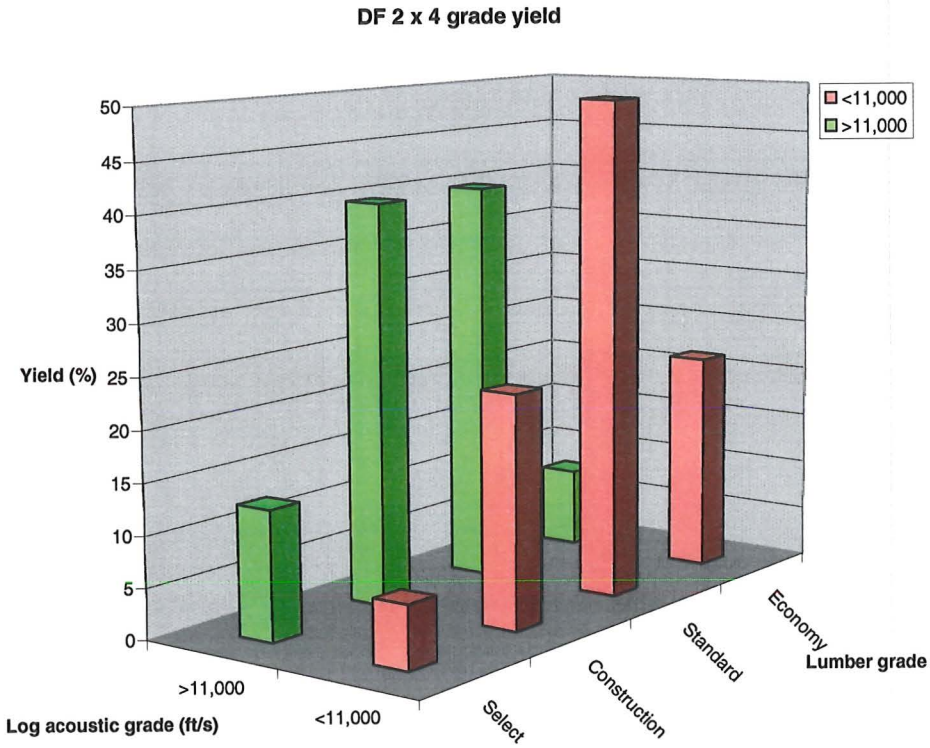


Figure 5. Lumber grade distribution of three acoustic sorts (Douglas-fir).



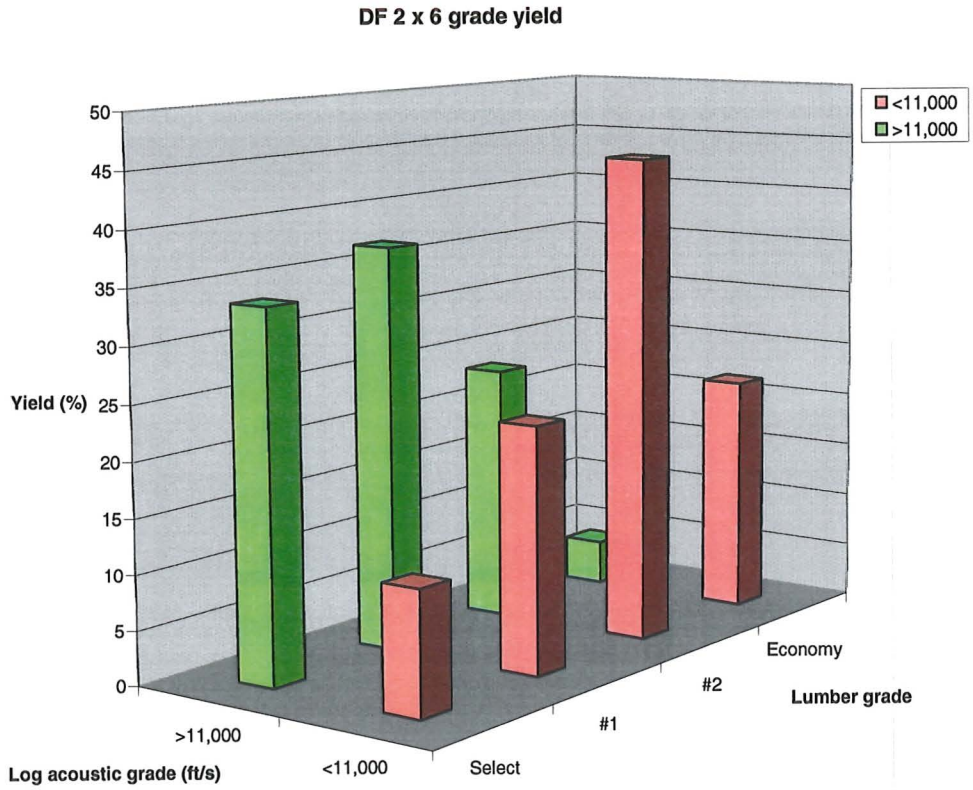


Figure 6. Lumber grade comparison of two acoustic sorts (sorting threshold: 11,000 ft/s)

Table 1. Lumber grade yield of Douglas-fir stems Unit: board feet

Size	Grade	3 sorts			2 sorts	
		>12,000	11,000-12,000	<11,000	>11,000	<11,000
		Green	Blue	Red	Green+blue	Red
2 x 4	Select	7561	380	165	7941	165
	Construction	21788	3052	612	24840	612
	Standard	23523	1358	1325	24879	1325
	Economy	4629	248	579	4877	579
	Short	0	19	0	19	0
	Total	**57501**	**5055**	**2681**	**62556**	**2681**
2 x 6	Select	398	31	8	429	8
	#1	409	66	16	475	16
	#2	228	75	32	303	32
	Economy	53	0	16	53	16
	Short	16	8	0	23	0
	Total	**1103**	**179**	**71**	**1282**	**71**

Table 2. Lumber grade yield of Douglas-fir stems Unit: %

Size	Grade	3 sorts			2 sorts	
		>12,000	11,000-12,000	<11,000	>11,000	<11,000
		Green	Blue	Red	Green+blue	Red
2 x 4	Select	13.1	7.5	6.2	12.7	6.2
	Construction	37.9	60.6	22.8	39.7	22.8
	Standard	40.9	26.9	49.4	39.8	49.4
	Economy	8.1	4.9	21.6	7.8	21.6
	Short	0	0.4	0	0	0
	Total	**100**	**100**	**100**	**100**	**100**
2 x 6	Select	36.1	17.3	11.3	33.5	11.3
	#1	37.1	36.9	22.5	37	22.5
	#2	20.7	41.6	44.4	23.6	44.4
	Economy	4.8	0	21.8	4.1	21.8
	Short	1.4	4.2	0	1.8	0
	Total	**100**	**100**	**100**	**100**	**100**

Table 3. Grade yields and lumber values of different acoustic sorts (Douglas-fir stems)

Stem	Velocity range	Standard & Btr		Economy		Total value
Acoustic sorts	(ft/s)	Volume (MBF)	Value (US$)[1]	Volume (MBF)	Value (US$)[2]	(US$)
Red	>12,000	54.16	$13,539	4.68	$538	$14,077
Blue	11,000-12,000	5.00	$1,250	0.25	$29	$1,279
Green	<11,000	2.21	$552	0.60	$69	$621

[1] Price reference: $250/MBF for Std & Btr and #2 & Btr.

[2] Price reference: $115/MBF for Economy.

Table 4. Value comparison of different acoustic sorts (Douglas-fir stems)

Stem	Velocity range	Total stem volume	Total lumber value	Stem value
acoustic sorts	(ft/s)	(ft^3)	($)	($/ft^3$)
Green	>12,000	663	$14,077	$21
Blue	11,000-12,000	94	$1,279	$14
Red	<11,000	53	$621	$12

Second Trial

The purpose of second trial was to test hem/fir stems only, follow the lumber through kiln drying process and see if improvement can be made on lumber grade yield through log sorting. In this trial, 300 stems (263 Grand-fir and 37 Hemlock) were acoustically tested in the log yard and sorted into two acoustic classes using a threshold of 11,000 ft/s. Each stem was painted with the appropriate color as they were tested ("Green": ≥11,000 ft/s; "Red": <11,000 ft/s. Note: the color code for the second trial was different from that in the first trial).

Figure 7 shows the distribution of acoustic velocity for the hem-fir stems tested. After acoustic testing, 12 defected Grand-fir stems with a velocity of over 16,000 ft/s were removed due to possible false readings. Production reports indicated a total of 285 stems were processed into lumber, 178 stems in "Green" class (≥11,000 ft/s), 107 stems in "Red" class (<11,000 ft/s).

After sawing, all 2x4s and 2x6s were kiln dried, planed, and visually graded. 1x4s, 1x6s, and 2x3s were tallied in green from and sold the same way. The lumber, although heavy to Grand-fir, were sold all as hemlock.

Table 5 and 6 shows the lumber yield in board feet and percentage versus log acoustic grade. The "Green" stems (≥ 11,000 ft/s) yielded more 2x4 stud than the "Red" stems; however, the trend for 2x6 stud was reversed, the "Red" stems (<11,000 ft/s) produced more 2x6 studs than the "Green" stems. There were no significant difference in economy and short lumber between two stem classes. This indicted that no distinctive relationships existed between lumber visual grade and log acoustic grade.

Table 7 listed the corresponding lumber values based on the price table provided by Seneca Sawmill Company (Table 9). Table 8 summarizes stem and lumber data for a direct comparison between stem classes. Even though no apparent correlation was found between lumber visual grade and log acoustic grade, the economic analysis indicated a positive trend between the board value per stem volume and log acoustic grade – the board value of "Green" stems (≥ 11,000 ft/s) was 43% higher than that of "Red" stems (<11,000 ft/s) on a per volume basis. This may suggest that log acoustic grade do have a positive relationship with the lumber visual grade in terms of visual characteristics, but is not readily recognizable in terms of lumber yield.

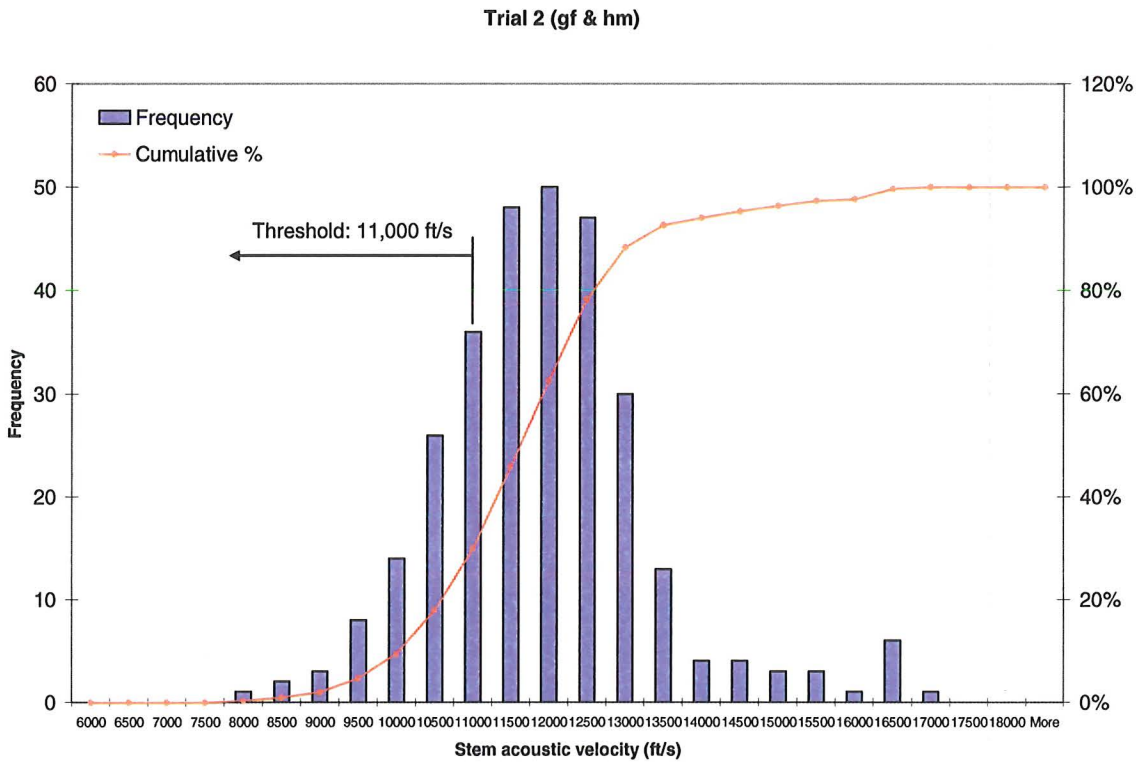
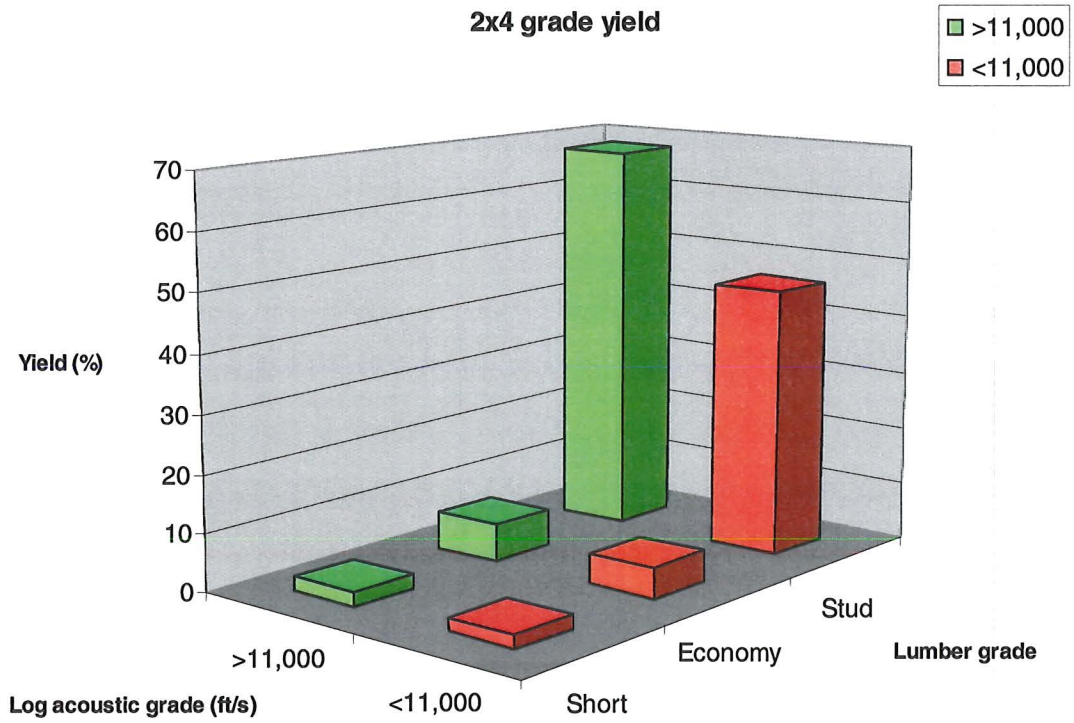


Figure 7. Distribution of acoustic velocity of 300 stems tested in trial 2



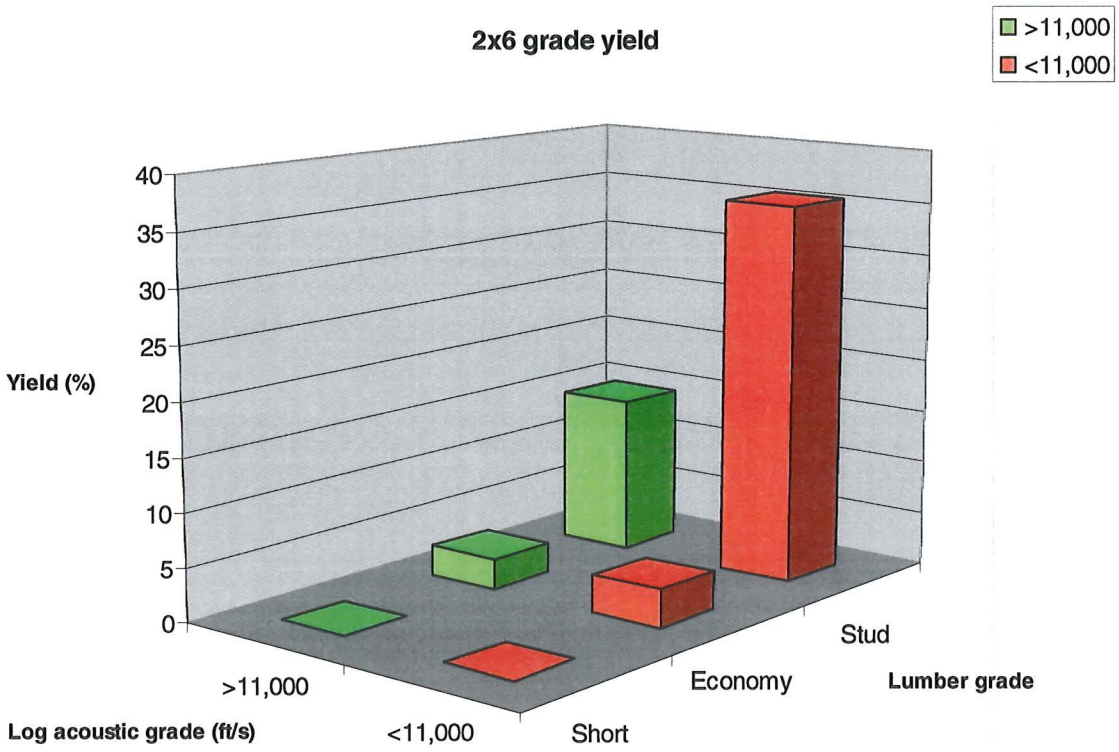


Figure 8. Lumber grade distribution of two acoustic classes.

Table 5. Lumber grade yield (Trial 2) Unit: board feet

Size	Grade	Stem class		
		All stems	>11,000 Green	<11,000 Red
1x4, 1x6, 2x3 (Rough)	**Total**	**520**	**286**	**234**
2 x 4 (Finished)	Stud	4904	3425	1479
	Economy	486	323	163
	Shorts	200	126	74
	Total	**5590**	**3874**	**1716**
2 x 6 (Finished)	Stud	1881	744	1137
	Economy	259	147	112
	Shorts	0	0	0
	Total	**2140**	**891**	**1249**
Total		**8250**	**5051**	**3199**

Table 6. Lumber grade yield (Trial 2) Unit: %

Size	Grade	Stem class		
		All stems	>11,000 Green	<11,000 Red
1x4, 1x6, 2x3 (Rough)	**Total**	**6.30%**	**5.66%**	**7.31%**
2 x 4 (Finished)	Stud	59.4%	67.8%	46.2%
	Economy	5.9%	6.4%	5.1%
	Shorts	2.4%	2.5%	2.3%
	Total	**67.8%**	**76.7%**	**53.6%**
2 x 6 (Finished)	Stud	22.8%	14.7%	35.5%
	Economy	3.1%	2.9%	3.5%
	Shorts	0.0%	0.0%	0.0%
	Total	**25.9%**	**17.6%**	**39.0%**
Total		**100%**	**100%**	**100%**

Table 7. Lumber value (Trial 2) Unit: $

Size	Grade	Stem class		
		All stems	>11,000 Green	<11,000 Red
1x4, 1x6, 2x3 (Rough)	**Total**	**$84.26**	**$46.48**	**$37.78**
2 x 4	Stud	$1,291.72	$902.13	$389.59
	Economy	$73.15	$50.49	$22.66
	Shorts	$51.94	$32.80	$19.14
	Total	**$1,416.81**	**$985.42**	**$431.39**
2 x 6	Stud	$485.63	$192.17	$293.46
	Economy	$31.08	$17.64	$13.44
	Shorts	$209.81	$209.81	$0.00
	Total	**$726.52**	**$419.62**	**$306.90**
Total		**$2,227.59**	**$1,451.52**	**$776.07**

Table 8. Data summay (Trial 2)

	Stem class		
Hem fir & grand fir	All	>11,000 Green	<11,000 Red
Stem			
Stem number	285	178	107
Average Dia. IN.		5.1	5.8
Average Length FT		19.3	19.3
Scribner BF	5400	3140	2260
Cubic ft^3	1033.9	585.5	448.4
Lineal ft	5491.8	3429.3	2062.5
Finished lumber			
Board yield BF	7730	4765	2965
Board yield %	93.70%	57.76%	35.94%
Board value $	$2,143.69	$1,405.40	$738.29
Board yield per stem volume (bf/ft^3)		8.1	6.6
Board value per stem volume ($\$/ft^3$)		$2.40	$1.65
Rough lumber			
Board yield BF	520	286	234
Board yield %	6.30%	3.47%	2.84%
Board value $	$84.26	$46.48	$37.78
Rough & finished lumber			
Board yield BF	8250	5051	3199
Board yield (%)	100.00%	61.22%	38.78%
Board value $	$2,227.95	$1,451.88	$776.07
Board yield per stem volume (bf/ft^3)	8.0	8.6	7.1
Board value per stem volume ($\$/ft^3$)	$2.15	$2.48	$1.73

Table 9. Lumber price for Hemlock (price as of 6/19/2007)

Size	Length	Price $/MBF (green)
1x4	7'	
	8'	160
	9'	160
	10'	160
1x6	7'	
	8'	135
	9'	135
	10'	135
2x3	7'	
	8'	165
	9'	165
	10'	165

Size	Length	Price $MBF (kiln dried)
2x4 Stud	72"	$170
	84"	$170
	88 5/8"	$190
	92 5/8"	$265
	104 5/8"	$275
	116 5/8"	$270
2x4 Economy	72"	
	84"	
	88 5/8"	$165
	92 5/8"	$165
	104 5/8"	$165
	116 5/8"	$165
2x4 Shorts	72"	$170
	84"	$170
	88 5/8"	$190
	92 5/8"	$265
	104 5/8"	$275
	116 5/8"	$270
2x6 Stud	72"	
	84"	
	88 5/8"	$185
	92 5/8"	$255
	104 5/8"	$280
	116 5/8"	$265
2x6 Economy	72"	
	84"	
	88 5/8"	$120
	92 5/8"	$120
	104 5/8"	$120
	116 5/8"	$120
2x6 Shorts	72"	
	84"	
	88 5/8"	$185
	92 5/8"	$255
	104 5/8"	$280
	116 5/8"	$265

APPENDIX A. PHOTOES: STEM ACOUSTIC SORTING PROCESS

Piles of stems

Acoustic measurement on stems.

Paint stems with different colors based on acoustic velocity.

Stems sorted into acoustic classes

APPENDIX B. ACOUSTIC DATA OF FIRST TRIAL

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
1	hm	20	9	14993	15026	15026	15015		1
2	df	21	2	13156	13156	13156	13156		1
3	hm	21	10	11516	11549	11516	11527		1
4	gf	21	4	12762	12762	12762	12762		1
5	gf	20	5	12238	12238	12238	12238	be	1
6	gf	21	2	15026	15026	15026	15026		1
7	df	21	0	12894	12894	12894	12894		1
8	df	21	5	13386	13386	13386	13386		1
9	df	21	1	13944	13944	13944	13944		1
10	df	21	2	13976	13976	13976	13976		1
11	gf	21	7	12205	12205	12205	12205		1
12	df	21	2	13353	13287	13287	13309		1
13	df	21	5	12270	12270	12270	12270		1
14	rc	21	10	10499	10499	10499	10499	ae	1
15	df	20	9	12172	12172	12172	12172		1
16	df	19	9	12205	12205	6299	12205	ae	1
17	df	21	2	13648	13681	13681	13670	ae	1
18	gf	21	4	11745	11745	11745	11745		1
19	df	21	4	7316	14534	14534	14534	ae	1
20	df	21	3	6660	7087	7021	6923	ae	1
21	hm	21	0	11778	11778	11778	11778		1
22	rc	20	9	10564	10564	10564	10564	cull	1
23	rc	20	9	9908	9908	9908	9908	cull	1
24	gf	21	0	11483	11483	11483	11483		1
25	gf	21	3	11614	11614	11614	11614		1
26	gf	21	5	6037	6037	6070	6048		1
27	df	21	2	13386	13386	13386	13386		1
28	gf	20	7	11286	11286	11286	11286		1
29	gf	21	8	11975	11975	11975	11975		1
30	df	20	11	7546	7612	7546	7568	ae	1
31	df	21	2	12369	12402	12369	12380	cull	1
32	gf	20	11	12664	12664	12664	12664		1
33	df	21	9	10958	10958	10958	10958		1
34	df	21	2	13287	13287	13287	13287		1
35	df	21	1	13878	13976	13845	13900		1
36	df	21	0	11680	11680	11680	11680		1
37	gf	21	2	13091	13091	13550	13244		1
38	df	21	2	13386	13386	13386	13386		1
39	df	20	3	14436	14436	14436	14436	ae	1
40	df	20	9	14600	14600	14633	14611		1
41	df	21	2	13517	13517	13451	13495	be	1
42	df	20	9	14501	14501	14501	14501	ae	1
43	df	19	10	14403	14403	14403	14403	ae	1
44	df	21	4	12992	13058	13353	13134	ae	1
45	gf	21	6	7251	14108	14108	14108	14108 ae	1
46	gf	20	11	11188	11188	11188	11188		1
47	df	20	8	13222	13222	13222	13222		1
48	gf	20	11	12205	12270	12270	12248		1
49	df	20	9	12894	12894	12894	12894		1
50	df	21	7	14009	14009	14009	14009		1

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1 (Cont.)

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
51	df	21	6	11778	11778	11778	11778		1
52	df	20	0	10171	10171	10171	10171		1
53	gf	21	1	12762	12762	12762	12762	ae	1
54	df	20	5	13976	13976	13976	13976		1
55	rc	21	7	9252	9252	9252	9252	ae	1
56	hm	21	1	15617	15617	15617	15617		1
57	gf	21	6	12795	12795	12795	12795		1
58	df	20	11	12664	12664	12697	12675		1
59	hm	21	5	10531	10531	10531	10531		1
60	gf	21	2	12959	12959	12959	12959		1
61	df	21	9	12073	12073	12073	12073		1
62	rc	21	9	11352	11319	11319	11330	ae	1
63	gf	20	10	12402	12402	12402	12402		1
64	hm	21	5	10499	10499	10499	10499		1
65	gf	21	11	12533	12533	12533	12533		1
66	gf	21	3	13780	13780	13780	13780		1
67	df	21	0	13976	13976	13976	13976		1
68	df	21	0	12664	12664	12664	12664		1
69	gf	20	7	13123	13123	13123	13123		1
70	df	20	4	13255	13255	13255	13255		1
71	gf	21	4	13451	13451	13484	13462	ae	1
72	hm	21	10	12500	12500	12500	12500		1
73	gf	20	5	12434	12434	12434	12434		1
74	df	20	11	12664	12664	12664	12664	ae	1
75	df	20	4	12861	12861	12762	12828	ae	1
76	df	20	4	14108	14108	14009	14075		1
77	gf	20	8	12795	12795	12795	12795		1
78	gf	20	10	15125	15125	15125	15125		1
79	gf	20	10	13780	13780	13780	13780		1
80	gf	21	2	13583	13583	13648	13605		1
81	df	20	5	14173	14173	14173	14173	ae	1
82	df	20	2	13911	13911	13911	13911	ae	1
83	gf	20	5	16371	16371	16371	16371		1
84	df	19	9	12205	12205	12205	12205		1
85	gf	20	5	14436	14436	14436	14436		1
86	gf	19	0	15846	15846	15846	15846		1
87	df	20	2	12959	12959	12959	12959	ae	1
88	df	20	4	13156	13156	13156	13156		1
89	gf	21	8	13747	13812	13812	13790		1
90	df	21	5	14304	14304	14304	14304		1
91	df	20	2	12762	12762	12762	12762	ae	1
92	df	20	11	13714	13714	13714	13714	ae	1
93	df	20	10	13615	13615	13615	13615	ae	1
94	gf	20	9	15354	15420	15354	15376		1
95	gf	20	10	11417	11385	11417	11406		1
96	df	20	5	11286	11286	11286	11286		1
97	gf	20	11	16470	16470	16470	16470		1
98	df	20	4	12664	12664	12664	12664	ae	1
99	gf	18	11	14731	14731	14731	14731	ae	1
100	df	19	6	13156	13156	13156	13156	ae	1

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1 (Cont.)

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
101	df	17	1	15223	15223	15223	15223		2
102	df	17	0	12270	12270	12205	12248		2
103	df	16	11	14272	14272	14272	14272		2
104	df	16	9	14206	14304	14206	14239		2
105	df	17	1	15289	15289	15289	15289		2
106	df	16	10	12467	12631	12533	12544		2
107	df	17	0	11549	11483	11647	11560		2
108	df	17	0	14501	14501	14501	14501		2
109	df	16	11	13091	13091	12992	13058		2
110	df	22	6	13550	13550	13550	13550		2
111	df	19	2	14928	14928	14993	14950		2
112	df	20	1	12992	12922	12992	12969		2
113	df	17	2	13517	13517	14173	13736		2
114	df	19	1	11975	11909	11975	11953		2
115	df	17	1	14501	14501	14501	14501		2
116	df	19	8	13353	13353	13353	13353		2
117	df	19	8	13550	13550	13550	13550		2
118	df	21	1	12139	12139	12139	12139	ae	2
119	df	20	5	11385	11385	11286	11352	ae	2
120	df	21	7	13517	13550	13550	13539	crook	2
121	df	23	0	14862	14567	14862	14764	be/ae	2
122	df	21	2	12500	12467	12205	12391		2
123	df	22	10	12730	12697	12697	12708		2
124	df	19	2	12664	12566	12664	12631		2
125	df	19	11	13812	13812	13813	13812		2
126	df	22	6	12697	12697	12664	12686		2
127	df	21	1	13484	13451	13484	13473	ae	2
128	df	21	3	11909	11909	11909	11909		2
129	df	22	6	12500	12434	12434	12456		2
130	df	22	9	12369	12369	13025	12588		2
131	df	25	0	14600	15354	15354	15103		2
132	df	22	1	12073	12434	12008	12172		2
133	df	15	9	13944	13944	13944	13944		2
134	df	23	0	13320	13320	13320	13320		2
135	df	18	6	12402	12402	12402	12402		2
136	df	21	0		13845	13845	13845	ae	2
137	df	22	10	14993	14993	15026	15004		2
138	df	20	9	12008	12008	12106	12041		2
139	df	22	0	15354	15354	15223	15310		2
140	df	20	10	13583	13681	13615	13626		2
141	df	24	0	12303	12270	12303	12292	ae	2
142	df	23	8	13156	13189	13156	13167		2
143	df	22	3	12894	12894	12894	12894		2
144	df	25	10	13386	13386	13386	13386		2
145	df	17	7	12106	12041	12106	12084		2
146	df	24	2	14501	14501	14436	14479		2
147	df	21	11	12992	12992	12992	12992	ae	2
148	df	25	9	13747	13747	13747	13747		2
149	df	19	3	15781	15879	15879	15846		2
150	df	20	10	13222	13222	13123	13189		2

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1 (Cont.)

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
151	df	20	9	14108	14108	14108	14108		2
152	df	20	1	14206	14304	14304	14271	ae	2
153	df	24	5	13615	13615	13615	13615	ae	2
154	df	23	9	14797	14797	14797	14797	crook	2
155	df	19	4	17320	17320	17320	17320	ae	2
156	df	21	1	14665	14731	14731	14709	ae	2
157	df	21	1	15814	15814	15814	15814	ae	2
158	df	23	8	13628	13628	13628	13628		2
159	df	22	1	15059	15059	15059	15059	bt	2
160	df	18	5	13222	13287	13222	13244		2
161	df	18	3	13091	13091	12992	13058		2
162	df	23	0	12992	12992	12992	12992		2
163	df	25	3	13681	13681	13681	13681		2
164	df	18	10	12631	12533	12631	12598		2
165	df	21	9	11877	11942	11877	11899		2
166	df	21	6	13714	13714	13714	13714		2
167	df	18	9	8530	5807	5807	6715	bt	2
168	df	20	1	13353	13287	13287	13309		2
169	df	20	2	12106	12106	12008	12073	ae	2
170	hm	20	7	13517	13878	13878	13758		2
171	df	22	11	10860	10860	10860	10860		2
172	df	28	4	12566	12566	12631	12588		2
173	df	27	1	13780	13714	13714	13736		2
174	df	25	10	12959	12959	12959	12959	crook	2
175	df	22	6	13353	13353	13222	13309		2
176	df	20	10	13156	13222	13222	13200		2
177	df	20	7	11188	11188	11188	11188		2
178	df	19	10	13484	13484	13423	13464		2
179	df	19	4	13156	13058	13156	13123		2
180	df	22	11	14600	14600	14600	14600		2
181	df	23	4	15518	15518	15486	15507		2
182	df	21	1	13189	13189	13189	13189		2
183	df	22	2	13714	13615	13648	13659	om	2
184	df	23	4	11877	12238	11877	11997		2
185	df	17	8	12106	11909	12106	12040		2
186	df	19	3	12172	12172	12172	12172		2
187	df	25	0	12992	12959	12894	12948		2
188	df	25	3	12828	12828	12828	12828		2
189	df	20	1	12041	12041	12041	12041		2
190	df	23	11	10761	10761	10761	10761		2
191	df	21	1	13287	13287	13353	13309		2
192	df	21	0	14140	14140	14140	14140	crook	2
193	df	27	1	13320	13320	13320	13320		2
194	df	22	1	13648	13648	13648	13648		2
195	df	25	1	12566	12566	12566	12566		2
196	df	21	2	13484	13484	13550	13506		2
197	df	19	9		14993	14993	14993		2
198	df	27	0	12533	12598	12598	12576		2
199	df	20	10	11220	11286	11220	11242		2
200	df	27	9	13189	13189	13189	13189		2

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1 (Cont.)

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
201	df	22	4	12730	12730	12730	12730		3
202	gf	22	3	11253	11253	11253	11253		3
203	df	19	4	13320	13320	13320	13320		3
204	df	18	10	6168	6430	6168	6255		3
205	df	19	6	11713	11713	11713	11713		3
206	df	22	8	11647	11647	11647	11647	cull	3
207	df	22	10		13976	13976	13976		3
208	df	21	7	12238	12238	13451	12642		3
209	gf	19	3	12467	12467	12467	12467		3
210	df	20	8	13845	13845	13911	13867		3
211	df	23	8	10925	10925	10991	10947		3
212	df	21	9	11417	11417	11417	11417		3
213	df	20	4	13255	13255	13255	13255		3
214	df	20	9	12795	12730	12795	12773		3
215	df	21	3	13583	13648	13648	13626		3
216	df	23	4	11581	11581	11581	11581		3
217	df	21	10	12041	12073	12073	12062		3
218	df	20	4	14108	14009	14009	14042		3
219	df	23	2	11581	11581	11581	11581		3
220	df	20	10	12631	12631	12631	12631		3
221	df	20	4	13451	13451	13451	13451		3
222	df	19	11	10466	10466	10466	10466		3
223	df	20	3	13189	13189	13189	13189		3
224	df	20	7		13222	13222	13222	crook	3
225	df	20	10	12500	12500	12500	12500	rocker brands	3
226	df	20	10	12303	12303	12303	12303		3
227	df	19	7	14698	14698	14698	14698		3
228	df	21	7	10367	10367	10367	10367		3
229	df	20	3	14140	14140	14140	14140		3
230	gf	22	5	10827	10827	10827	10827		3
231	df	20	5	14075	14075	14075	14075		3
232	df	20	9	13583	13583	13583	13583		3
233	df	20	10	12073	12073	12073	12073		3
234	df	20	8	12697	12697	12697	12697		3
235	df	20	6	12303	12303	12303	12303		3
236	df	22	3	13025	13091	13091	13069		3
237	df	21	7	13550	13550	13550	13550		3
238	df	20	8	12730	12730	12730	12730		3
239	df	20	8	11680	11680	11680	11680		3
240	df	18	10	12533	12533	12533	12533		3
241	df	27	6	10630	10564	10564	10586		3
242	df	19	10	12073	12073	12073	12073		3
243	df	21	4	12894	12894	12894	12894		3
244	df	22	2	11647	11647	11647	11647		3
245	df	22	1	13451	13451	13451	13451		3
246	df	21	5	13058	13058	13058	13058		3
247	df	23	5	12402	12402	12402	12402		3
248	df	24	0	12106	12106	12106	12106		3
249	df	21	3	12959	12959	12959	12959		3
250	df	17	6	11155	11155	11155	11155		3

Appendix B1. Acoustic measurement of 300 stems in first trial - phase 1 (Cont.)

stem#	species	Length		Reading 1	Reading 2	Reading 3	Average	Note	Group
		feet	inches	(ft/s)	(ft/s)	(ft/s)	(ft/s)		
251	df	20	11	11909	11975	11975	11953		3
252	df	20	4	12664	12664	12664	12664		3
253	df	19	5	11745	11745	11745	11745		3
254	df	23	3	12631	12631	12631	12631		3
255	df	22	5	13780	13780	13780	13780		3
256	df	22	9	12598	12598	12598	12598		3
257	df	20	10	11417	11417	11385	11406		3
258	df	20	11	13025	13025	13025	13025		3
259	sp	19	11	8694	8596	8694	8661	crook	3
260	df	22	7	13747	13747	13747	13747		3
261	df	20	11	12467	12467	12468	12467		3
262	df	18	0	13156	13845	13156	13386		3
263	df	20	4	11909	12008	11909	11942		3
264	sp	27	2	9613	9613	9678	9635		3
265	df	22	6	12008	12008	11975	11997		3
266	df	21	4	14009	14009	14009	14009		3
267	df	22	3	14156	14156	13189	13834		3
268	gf	22	9	10663	10663	10663	10663	cull	3
269	df	22	1	9941	9875	9875	9897		3
270	df	23	4	10663	10761	10761	10728		3
271	df	19	4	12402	12763	12763	12643		3
272	df	22	8	9678	10531	10564	10258	be	3
273	df	22	2	12041	12205	12106	12117		3
274	df	19	5	12566	12467	12467	12500		3
275	df	20	10	10400	10367	10433	10400		3
276	df	20	1	12434	12434	12434	12434		3
277	df	21	2	12861	12959	12894	12905		3
278	df	21	3	9547	9547	9547	9547		3
279	df	20	6	13058	13058	13058	13058		3
280	df	22	7	6562	6562	6562	6562		3
281	df	21	10	13091	13156	13091	13113		3
282	df	21	1	12172	12172	12172	12172		3
283	df	20	5	12533	12434	12533	12500		3
284	df	22	6	12500	12566	12500	12522		3
285	df	19	11	11483	11483	11483	11483		3
286	df	21	5	10696	10696	10630	10674		3
287	df	20	0	12270	12172	12467	12303		3
288	df	21	7	12106	12106	12106	12106		3
289	df	20	10	12795	12828	12828	12817	crook	3
290	df	24	10	11581	11581	11581	11581		3
291	df	21	9	11713	11713	11614	11680		3
292	df	21	8	6791	6759	6791	6780		3
293	df	20	2	10958	11253	11253	11155		3
294	df	20	0	11713	12008	11713	11811	crook	3
295	df	23	10	13058	13058	13058	13058		3
296	df	18	11	12139	12238	12336	12238		3
297	df	27	4	11778	11778	11778	11778		3
298	df	18	11	11877	11877	11877	11877		3
299	gf	21	8	15551	15584	15551	15562		3
300	gf	21	9	14075	14075	14108	14086		3

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
1	gf	20	7	10.5	8.5	14469	14469	14469	14469	43.9	R	1
2	gf	17	6	6.5	3.5	11647	11647	11647	11647		B	1
3	df	19	3	6	3.75	12106	12106	12000	12071		R	1
4	gf	21	2	7.25	6	15715	15682	15682	15693		R	1
5	df	19	9	6.25	4.75	13615	13615	13615	13615		R	1
6	df	21	1	5.5	3.5	12270	12270	12270	12270		R	1
7	gf	18	4	5.75	3.75	10728	10728	10728	10728		G	1
8	df	21	0	5.5	4.25	13091	13091	13091	13091		R	1
9	df	19	0	3.75	3.25	13615	13615	13615	13615		R	1
10	df	19	6	7.5	4.75	12073	12073	12073	12073	42.9 crook	R	1
11	df	16	6	6.25	3.5	11680	11680	11680	11680		B	1
12	df	20	7	5.25	4.5	11975	12073	11975	12008	crook	B	1
13	df	19	5	6.25	4.5	12828	12828	12828	12828		R	1
14	df	20	7	6.5	5.25	12730	12730	12730	12730		R	1
15	gf	21	1	6.25	3.75	11844	11811	11844	11833		B	1
16	gf	20	8	6.5	3.5	10663	10663	10663	10663		G	1
17	df	20	6	5.75	3.5	11450	11450	11450	11450		B	1
18	gf	17	0	10.5	6.5	11713	11713	11713	11713		B	1
19	df	25	6	5.5	3.25	14042	14042	14042	14042		R	1
20	df	21	1	6.5	5.5	13091	13091	13091	13091	43.1	R	1
21	df	19	10	5	4.25	8924	5938	8169	7677	6037-7448-7448	G	1
22	df	21	3	6.75	4.25	11844	11844	11844	11844		B	1
23	df	20	9	5.75	3.75	12402	12402	12369	12391		R	1
24	df	21	1	5	4	13648	13648	13648	13648		R	1
25	df	19	7	6.25	5.25	12861	12861	12861	12861		R	1
26	gf	20	10	7.25	5.7	14206	14272	14206	14228		R	1
27	df	19	7	6.25	4.25	11942	12041	11942	11975		B	1
28	df	21	1	7.25	4	11352	11352	11352	11352		B	1
29	df	19	11	8.5	5.5	12500	12590	12598	12563	crook	R	1
30	gf	20	5	6.75	5	16175	16175	16076	16142	16076-8005-8005- 45.7	R	1
31	gf	20	7	6.25	4.5	10892	10794	10892	10859		G	1
32	df	22	11	6.75	5.5	13648	13648	13648	13648		R	1
33	gf	20	10	8.5	6.5	16470	16470	16470	16470	16470-8005-8005	R	1
34	rc	20	7	7.75	4.5	10039	10039	10039	10039	crook	G	1
35	df	21	1	6.25	5.25	13189	13189	13189	13189		R	1
36	df	20	11	5.5	3.75	12270	12270	12270	12270		R	1
37	df	20	8	6	4.25	13550	13550	13550	13550		R	1
38	df	20	9	6	4.25	14436	14436	14436	14436		R	1
39	df	20	3	5.75	3.5	10326	10326	10326	10326		G	1
40	gf	21	7	7	5.25	15518	15518	15518	15518	39.9	R	1

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
41	df	21	5	6.25	3.75	13287	13287	13287	13287	crook	R	1
42	gf	21	5	6.5	4.25	12205	12205	12205	12205	crook	R	1
43	df	21	1	7.25	4.5	10720	10720	10761	10734		G	1
44	rc	20	6	9.25	4	10171	10171	10171	10171		G	1
45	df	17	11	5.5	4.25	11417	11417	11417	11417		B	1
46	df	21	7	5.75	3	12533	12598	12598	12576		R	1
47	df	21	1	5	3.5	12861	12861	12861	12861		R	1
48	gf	19	4	9.5	9	15420	15420	15420	15420		R	1
49	df	20	8	4.5	4	13451	13451	13451	13451		R	1
50	df	20	6	5.5	5	13451	13451	13451	13451	45.3	R	1
51	gf	22	6	9	6.5	14698	14698	14698	14698		R	1
52	gf	20	8	5.5	4.5	12106	12172	12106	12128		R	1
53	df	21	8	7	4.5	12861	12861	13878	13200		R	1
54	gf	20	9	14.25	12.75	14600	14600	14698	14633		R	1
55	gf	15	1	13	9	12795	12795	12795	12795		R	1
56	df	20	6	6	4.25	6824	7119	6726	6890	4528-13648-4528	G	1
57	df	20	3	5	3	12894	13681	13583	13386		R	1
58	df	20	6	5.25	3.75	13550	13550	13550	13550		R	1
59	df	21	0	5.5	6	13550	13550	13550	13550		R	1
60	gf	20	8	4.5	2.25	5413	7448	7448	6770	7448-5413-5873	G	1
61	df	19	2	6	4.5	13125	6660	12927	10904	13025-13025-12927	R	1
62	df	20	7	5	3.75	13419	13419	13419	13419		R	1
63	df	16	11	7	4.5	12515	12533	12533	12527		R	1
64	df	20	1	5	3.25	13091	13091	13091	13091		R	1
65	df	19	9	6.5	4.75	12762	12762	12762	12762		R	1
66	df	18	10	5.25	4.25	13944	13944	14042	13977		R	1
67	gf	20	11	6	4.25	15190	15190	15190	15190	ae	R	1
68	df	19	10	5.25	3.75	14140	14140	14140	14140		R	1
69	df	19	7	5.25	3.25	11942	11942	11942	11942		B	1
70	df	21	0	4.25	2.5	13457	13386	13386	13410	47.4	R	1
71	gf	22	3	11	8.25	13353	13353	13353	13353		R	1
72	gf	18	1	11	12	15584	15584	15584	15584		R	1
73	df	19	7	5.75	3.5	13123	13222	13222	13189		R	1
74	df	19	5	7.5	3.75	9908	9908	9908	9908		G	1
75	df	20	5	6	3.75	11877	11877	11877	11877		B	1
76	df	20	10	5.25	3.75	13386	13386	13386	13386		R	1
77	df	20	10	5.5	4.25	12172	12172	12205	12183		R	1
78	gf	21	2	8.5	7.5	15978	15978	15978	15978		R	1
79	df	20	0	5	3.5	13222	13222	13222	13222		R	1
80	df	20	7	5.75	4.75	13220	13222	13222	13221	46.6	R	1

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
81	df	20	10	6.75	5.5	14173	14173	14173	14173		R	1
82	df	21	0	7	4.5	11483	11483	11483	11483		B	1
83	df	21	0	6.25	5.25	13484	13484	13484	13484		R	1
84	df	21	1	5.25	4	12697	12697	12697	12697		R	1
85	df	20	6	6	5.25	13747	13747	13747	13747		R	1
86	df	21	0	6.75	5.25	14140	14140	14173	14151		R	1
87	df	17	8	5.5	5.25	12664	12598	12664	12642		R	1
88	gf	19	1	6.5	4.5	11624	11624	11624	11624		B	1
89	df	19	11	6.25	5.25	14108	14108	14108	14108		R	1
90	rc	21	6	6	3.5	11680	11680	11745	11702	48.1	B	1
91	gf	21	2	9.25	7.75	16109	16176	16109	16131	16076-16109-16109	R	1
92	df	20	6	6	2.5	11352	11450	11352	11385		B	1
93	df	20	3	7.5	4.25	11877	11877	11877	11877		B	1
94	gf	21	2	6.25	4.5	12106	12106	12106	12106		R	1
95	df	20	7	7	5.25	12232	12232	12232	12232		R	1
96	gf	21	2	9.75	7.5	15289	15289	15289	15289		R	1
97	df	20	5	6.75	3	11877	11877	11877	11877		B	2
98	df	21	4	6	3.5	12205	12205	12205	12205		R	2
99	gf	19	11	6	4.25	12697	12238	12238	12391	be	R	2
100	gf	16	8	6.75	4.5	10466	10466	10466	10466		G	2
101	df	16	11	5.25	3.75	13944	13944	13878	13922	52.3	R	2
102	df	16	9	7	5.25	12106	12106	12106	12106		R	2
103	df	21	4	5.75	5	12967	12762	12762	12830	ae	R	2
104	df	23	6	6	3.5	12336	12336	12336	12336		R	2
105	df	21	0	6.25	4.75	12598	12566	12598	12587	be	R	2
106	df	17	1	7.75	6.75	14829	14829	14731	14796		R	2
107	df	20	9	6.5	5.5	13714	13714	13714	13714		R	2
108	df	17	0	8	6.25	13944	13944	13944	13944		R	2
109	df	16	11	6.75	4.5	14501	14501	14501	14501		R	2
110	df	18	2	8.75	7.5	12270	12270	12270	12270	be	R	2
111	df	16	11	6.75	5.5	13714	13714	13714	13714		R	2
112	df	17	0	6.25	4.5	13615	13615	13615	13615		R	2
113	df	16	10	8.25	6	11909	11909	11909	11909		B	2
114	df	16	11	6.25	5.5	14042	14042	14042	14042		R	2
115	df	23	0	7	5.5	15092	15092	15092	15092	be	R	2
116	df	16	9	6.25	5.5	13648	13648	13648	13648		R	2
117	df	16	10	5.75	4.25	12467	12467	12467	12467		R	2
118	df	22	11	6.75	4.25	10696	10696	11122	10838	be	G	2
119	df	17	0	6.5	5	15059	15059	15157	15092		R	2
120	df	17	1	6.75	5.25	13944	14009	14009	13987	54.7	R	2

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
121	df	17	0	7.25	6	13747	13747	13747	13747		R	2
122	df	18	11	6.25	4	13386	13386	13386	13386		R	2
123	df	17	0	7.25	6.25	14009	14009	14173	14064		R	2
124	df	18	7	8.5	6.25	14108	14108	14108	14108	be 7316-7316-7316	R	2
125	df	17	0	6.25	5	12762	12762	12762	12762		R	2
126	df	17	0	6.75	5.25	13615	13615	13615	13615		R	2
127	df	19	8	6.5	6.5	12533	12533	12533	12533	be	R	2
128	df	16	9	5.25	3.5	13255	13255	13255	13255		R	2
129	df	22	10	6.25	5	14009	13812	13812	13878	be	R	2
130	df	17	0	7.25	6	14993	14993	14993	14993	52.7	R	2
131	df	18	7	8	6	14797	14797	14797	14797		R	2
132	df	17	1	10.5	8.25	12730	12730	12730	12730		R	2
133	df	16	11	6.5	5	13255	13255	13255	13255		R	2
134	df	17	0	5.25	4.25	12270	12270	12270	12270		R	2
135	df	17	0	7.75	6.25	12500	12500	12500	12500	be	R	2
136	df	19	0	10	6	12303	12303	12303	12303		R	2
137	df	16	11	7.75	6.25	13484	13484	13484	13484	be	R	2
138	df	16	0	7.5	4.75	12008	12008	12008	12008		R	2
139	df	20	4	7	5.25	12664	12664	12664	12664		R	2
140	df	17	0	7.25	6.25	14567	14567	14567	14567	52.7	R	2
141	df	16	10	5.25	4.25	13583	13583	13583	13583		R	2
142	df	17	0	7.25	6.25	14436	14436	14436	14436	be	R	2
143	df	21	3	6.25	5	13451	13451	13484	13462		R	2
144	df	17	0	5.75	3.75	12664	12664	12664	12664		R	2
145	df	17	0	8	7.25	14272	14272	14272	14272	be	R	2
146	df	16	5	6.5	5	14862	14862	14862	14862		R	2
147	df	16	11	7	6	13320	13320	13320	13320		R	2
148	df	16	10	6.75	5.25	13255	13255	13255	13255		R	2
149	df	17	0	6.75	5	13615	13615	13615	13615		R	2
150	df	17	1	5.5	4.5	14403	14403	14403	14403	54.7	R	2
151	df	17	0	7	5.5	13386	13386	13386	13386		R	2
152	df	17	1	7	5.25	12402	12402	12402	12402		R	2
153	df	16	10	7.25	5.75	13484	13583	13583	13550		R	2
154	df	18	8	7.75	6.25	14436	14436	14436	14436		R	2
155	df	16	11	8.5	7	13156	13156	13156	13156		R	2
156	df	16	11	7.25	6.25	14436	14436	14436	14436		R	2
157	df	16	11	6.5	5.25	14206	14206	14206	14206	be	R	2
158	df	18	11	6.75	4.75	14731	14731	14731	14731		R	2
159	df	16	11	6.25	5	13320	13320	13320	13320		R	2
160	df	16	10	6	5.5	14140	14140	14140	14140	56.6	R	2

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
161	df	17	0	7.25	6.5	14995	14995	14995	14995		R	2
162	df	17	1	6	5	14173	14173	14173	14173		R	2
163	df	17	0	6.75	5.75	13451	13451	13451	13451		R	2
164	df	17	0	5.75	4.75	13550	13550	13550	13550		R	2
165	df	16	11	5.75	4	13255	13255	13255	13255		R	2
166	df	17	0	9	6	14337	14337	14272	14315		R	2
167	df	17	0	7	5.5	15125	15125	15125	15125	be	R	2
168	df	19	7	7.75	5.5	13484	13484	13484	13484	BE	R	2
169	df	17	0	7	5.75	13780	13780	13780	13780		R	2
170	df	18	4	7	5.5	13911	13911	13911	13911	be 53.8	R	2
171	df	19	9	5.75	5	14895	14895	14993	14928	BE	R	2
172	df	17	0	7	6	14829	14829	14829	14829		R	2
173	df	17	1	7	5.5	13944	13944	13944	13944	BE	R	2
174	df	20	5	6.75	5.25	14075	14075	14075	14075		R	2
175	df	17	0	5.5	4.25	14895	14895	14895	14895		R	2
176	df	19	1	6.25	4.5	12533	12533	12533	12533		R	2
177	df	16	10	7.75	6.5	13320	13320	13419	13353		R	2
178	df	19	1	8.5	6.5	14862	14862	14862	14862		R	2
179	df	17	0	6.5	5.75	13878	13878	13878	13878		R	2
180	df	17	0	6.75	5.5	13058	13058	13058	13058	56.3	R	2
181	df	16	11	5.5	4.5	13091	13091	13091	13091		R	2
182	df	21	2	6.75	4.75	13845	13845	13845	13845		R	2
183	df	16	9	6.25	4.25	13747	13747	13747	13747	be	R	2
184	df	19	8	6.25	4	12072	12072	12072	12072	be	R	2
185	df	16	9	5.75	4.5	13812	13812	13812	13812	be	R	2
186	df	17	0	7.5	6.25	13944	13944	13944	13944		R	2
187	df	21	0	10.5	7.25	11680	11680	11680	11680		B	2
188	df	17	5	5.75	4.25	14042	14042	14862	14315	BE	R	2
189	df	21	2	9	5.25	11745	11253	11745	11581	be	B	2
190	df	18	1	7	5.75	13648	13648	13648	13648		R	2
191	df	24	1	8.5	6.25	16371	16371	16371	16371	be	R	2
192	gf	16	10	6.75	4.75	12073	12073	12073	12073	be	R	2
193	df	16	11	7.25	6.25	13648	13550	13648	13615		R	2
194	df	20	11	8.5	5.5	11188	11220	11286	11231		B	2
195	df	17	1	6.5	5	14961	14961	14961	14961		R	2
196	df	17	2	7	6	14337	14337	14337	14337		R	2
197	df	19	4	7.5	5.75	12402	12336	12402	12380	be	R	2
198	df	20	9	6.75	5	12927	12927	12927	12927	be	R	2
199	df	17	1	6.75	5.5	13845	13845	13845	13845		R	2
200	df	16	11	7	6.25	13484	13550	13484	13506		R	2

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
201	rc	22	7	7.5	5.5	11056	11122	11122	11100	61.9	B	3
202	gf	21	0	6	3.7	10794	10827	10827	10816		G	3
203	df	20	10	6.5	5.25	12303	12303	12369	12325		R	3
204	rc	20	10	6	5	12402	12402	12402	12402		R	3
205	df	22	3	5.5	3.5	12992	12992	12927	12970		R	3
206	df	18	8	9.5	5.5	10663	10663	10663	10663		G	3
207	rc	20	9	7	3.5	9383	9383	9383	9383		G	3
208	gf	20	3	5.75	3.5	12992	12992	12992	12992		R	3
209	gf	21	0	5.5	4.75	12894	12894	12894	12894		R	3
210	df	20	11	7	5.25	13878	13812	13812	13834	55.8	R	3
211	df	21	0	6.75	4.5	12467	12369	12402	12413		R	3
212	gf	18	8	8.5	5.75	9613	9613	9613	9613		G	3
213	df	20	9	5.25	5	13944	13911	13944	13933		R	3
214	df	20	11	4.75	3.5	13484	13484	13484	13484		R	3
215	df	21	0	5.75	5	13747	13681	13747	13725		R	3
216	df	21	0	6	4.25	13353	13353	13353	13353		R	3
217	gf	17	11	8.5	7.5	11680	11680	11680	11680		B	3
218	gf	20	11	7	5.25	15846	15879	15879	15868		R	3
219	df	20	7	4.5	3.5	12238	12238	12236	12237		R	3
220	gf	19	1	6	3.5	12336	12336	12336	12336	52.3	R	3
221	df	21	2	5	4	13287	13287	13287	13287		R	3
222	rc	17	6	4.75	2.5	10925	10925	10991	10947		G	3
223	df	20	10	7	5.25	12697	12697	12697	12697		R	3
224	df	20	9	8	6	12598	12631	12631	12620		R	3
225	df	21	0	5.5	4.5	11417	12205	12205	11942		B	3
226	df	21	4	7	3.5	10696	10696	10696	10696		G	3
227	rc	19	0	7	3.5	8990	8990	8990	8990		G	3
228	hm	17	1	7.25	6.5	11122	11122	11122	11122		B	3
229	df	20	6	5.5	4.25	12598	12598	12598	12598		R	3
230	df	17	8	6.25	5	12434	11909	12434	12259	54.1	R	3
231	rc	17	3	6	3.25	12369	12369	12369	12369		R	3
232	gf	21	4	6.75	5.25	13255	13255	13255	13255		R	3
233	df	21	6	6.75	5.25	13747	13747	13780	13758		R	3
234	df	16	3	4.5	3.5	14009	13878	13780	13889		R	3
235	rc	21	1	6	2.75	12106	12172	12106	12128		R	3
236	gf	22	0	6.25	3	11286	11122	11122	11177		B	3
237	hm	22	5	9	5.75	13550	13615	13550	13572	be	R	3
238	df	17	6	5.5	3.75	12730	12730	12795	12752		R	3
239	gf	20	5	6.25	4.5	10531	10531	10433	10498		G	3
240	rc	20	8	6.75	4.75	11253	11253	11253	11253	56.8	B	3

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
241	df	20	10	6.5	4.25	13386	13386	13386	13386		R	3
242	df	23	11	7.25	3.5	11385	11385	11385	11385		B	3
243	df	21	11	5	3.25	11056	11056	11056	11056		B	3
244	rc	22	3	6	2.5	11220	11220	11253	11231		B	3
245	gf	27	0	10	6.75	11516	11516	11516	11516		B	3
246	df	18	0	4.5	3	11549	11549	11549	11549		B	3
247	df	19	10	5	3.5	12631	12631	12631	12631		R	3
248	df	16	11	7.25	5.5	12205	12205	12205	12205		R	3
249	df	17	1	4.25	3	15846	15846	15846	15846		R	3
250	gf	22	9	5.75	3	11450	11516	11516	11494	55.3	B	3
251	df	21	5	5	4	12762	12697	12697	12719		R	3
252	df	20	6	5.75	4.25	12697	12697	12697	12697		R	3
253	rc	18	4	6.5	3.25	9547	9613	9613	9591		G	3
254	df	21	0	6.75	5.75	12795	12795	12795	12795		R	3
255	rc	19	6	5.75	4.5	11319	11319	11319	11319		B	3
256	gf	21	8	5.25	4.5	13189	13189	13189	13189		R	3
257	df	20	9	5.75	4.5	12598	12598	12598	12598		R	3
258	rc	18	9	11	6.75	10105	10105	10203	10138		G	3
259	df	17	1	7	5.25	13845	13845	13845	13845		R	3
260	gf	20	4	7.25	5.5	12664	12664	12664	12664	CROOK	R	3
261	df	20	9	5	3	11188	11188	11385	11254	53.7	B	3
262	df	20	11	6.75	5	12402	12369	12402	12391		R	3
263	df	21	3	6	4.75	12861	12795	12861	12839		R	3
264	df	20	6	5.5	3.5	12008	12008	12008	12008		R	3
265	df	21	0	7.5	4.75	11614	11680	11713	11669		B	3
266	df	21	0	5	4	14567	14633	14567	14589		R	3
267	df	21	1	5.5	4.5	12697	12664	12598	12653		R	3
268	df	21	0	6	5.25	13976	14042	14042	14020		R	3
269	df	20	6	8	4.25	9318	9318	9318	9318		G	3
270	df	21	7	5.5	4	11975	11975	11942	11964	52.6	B	3
271	df	23	4	6.25	2.75	10761	10597	10663	10674		G	3
272	df	21	0	6.25	2.75	11024	10991	11024	11013		B	3
273	df	21	0	6.75	3.75	10728	10728	10728	10728		G	3
274	df	21	0	6.5	5.75	13845	13386	15125	14119		R	3
275	df	21	0	6	5	13681	14337	13747	13922		R	3
276	df	18	4	4.25	3.5	12467	12467	12467	12467		R	3
277	df	18	3	5.25	2.25	10433	10696	10597	10575		G	3
278	df	21	2	5.75	3.75	13845	13845	13780	13823		R	3
279	df	20	11	7	5.25	13320	13123	13123	13189		R	3
280	df	21	0	4.75	3.25	11614	11614	11680	11636	49.5	B	3

Appendix B2. Acoustic measurement of 300 stems in first trial - phase 2 (Cont.)

Stem #	Species	Length		Diameter (in.)		Accoustic Measurement(ft/s)				Note	color	group
		ft	in	Butt	Top	Reading 1	Reading 2	Reading 3	Average			
281	df	20	8	10.25	4.75	10400	10400	10400	10400		G	3
282	df	22	0	5	4	13058	13058	13058	13058		R	3
283	df	21	0	6.5	5	12959	12959	12959	12959		R	3
284	df	21	0	6.5	4.25	11089	11089	11089	11089		B	3
285	df	21	0	8.5	4.5	10302	10302	10302	10302	be	G	3
286	df	21	4	5.25	3.25	11647	11713	11713	11691		B	3
287	df	19	1	7.5	5	13058	13058	13058	13058		R	3
288	df	20	11	7	5.75	13320	13320	13320	13320		R	3
289	df	20	9	5.25	4	13123	13123	13123	13123		R	3
290	df	18	6	7.5	3.25	10663	10663	10663	10663	53.1	G	3
291	df	20	0	7.75	5.5	13025	13025	13025	13025		R	3
292	df	21	0	6.25	5.5	13386	13386	13451	13408		R	3
293	df	21	9	6	3	11056	11056	11056	11056		B	3
294	df	21	0	6.25	5.25	13058	13058	13091	13069		R	3
295	df	21	0	9.75	5.5	12270	12270	12270	12270	BE	R	3
296	df	19	9	5.75	4.5	12500	12500	12500	12500		R	3
297	df	21	0	5.5	3.5	12205	12205	12205	12205		R	3
298	df	20	4	6.5	4.75	12861	12861	12861	12861		R	3
299	df	20	9	7.5	4.25	11614	11614	11614	11614		B	3
300	df	19	2	6	4.5	12861	12861	12927	12883	56.4	R	3

APPENDIX C. ACOUSTIC DATA OF SECOND TRIAL

Appendix C. Acoustic measurement of 300 stems in second trial

Stem #	Species	Avg velocity (ft/s)	Length (ft)	Length (in)	Butt dia (in)	Top dia (in)	Comment
1	gf	11286	17	7	5.5	4	
2	gf	11483	19	7	8	6	
3	gf	12205	21	6	8	3.5	
4	gf	12927	23	0	6	3	
5	gf	13353	15	8	7	1	
6	gf	16109	20	4	6	4.5	
7	gf	14765	19	11	8.5	8	
8	gf	9646	21	8	8.5	4	
9	gf	12238	21	5	7.5	4.5	
10	gf	11385	20	3	7	4	
11	gf	11713	19	6	6.5	4	
12	gf	12041	21	1	7	4	
13	gf	12762	20	4	6.5	4	
14	gf	11450	18	6	7	4.5	
15	gf	11155	17	9	9	6	
16	gf	12959	21	7	6.5	3	
17	gf	10769	17	0	9	6	
18	gf	11614	21	9	7	3	
19	gf	11115	21	3	6.5	4	
20	gf	10761	16	5	6.5	5	
21	gf	11877	15	11	7.5	6	
22	gf	11056	20	6	7	4	
23	gf	11877	21	6	6	4	
24	gf	11188	17	10	6	4	
25	gf	10860	21	3	9	6	
26	gf	12467	22	0	7	4	
27	gf	11680	19	11	6.5	5	
28	gf	12861	21	3	6.5	5.5	
29	gf	12041	19	11	7	5	
30	gf	8333	18	6	7	3.5	
31	gf	14337	21	3	9	8	
32	gf	11155	21	5	9	5	
33	gf	10269	21	1	9	2.5	
34	gf	16470	21	2	8	7.5	
35	gf	11056	20	4	9	5	
36	gf	11942	21	3	7.5	5	Broken
37	gf	10827	19	9	6.5	4	
38	gf	10433	18	10	7	4.5	
39	gf	14501	19	1	11.5	8	Cull
40	gf	11417	18	9	7	3.5	
41	gf	15322	21	1	8	7.5	Cull
42	gf	10925	20	5	9	6.5	
43	gf	12270	16	8	6	3.5	
44	gf	12303	20	8	7	4	

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

45	gf	12927	22	1	7.5	5.5	
46	gf	12336	23	1	6	3	
47	gf	10105	18	11	7	4.5	
48	gf	10007	18	9	9	6	
49	gf	11909	21	0	7	4	
50	gf	11909	24	0	5.5	4	
51	gf	10784	20	0	9	5	
52	gf	16207	20	7	6	4	
53	gf	11778	20	11	7	5	
54	gf	9974	18	10	5.5	2.5	
55	gf	11745	21	3	7	4	
56	hm	9219	19	6	8.5	5.5	
57	gf	12894	21	2	6	3.5	cull
58	gf	13878	19	1	10	7.5	
59	gf	11450	19	3	6	5	cull
60	gf	16109	20	0	7.5	6.5	
61	gf	11811	21	4	5.5	3.5	
62	gf	11417	21	2	6.5	4.5	
63	hm	11188	21	6	8.5	6	
64	gf	12303	21	2	7	4	
65	hm	10597	20	0	9	7.5	
66	gf	16176	20	11	5	4	cull
67	gf	12270	21	1	6.5	3	
68	gf	11286	18	8	8	4.5	Broken End
69	gf	10597	19	8	7	4	
71	gf	12861	21	4	7	4.5	
72	hm	12139	21	3	6	5	
73	gf	10827	23	7	6	3.5	
74	hm	11680	23	1	6.5	5	
76	gf	10367	18	0	7	5	
77	hm	11745	14	11	8	6.5	
78	gf	11811	21	9	7	4	
79	gf	11647	21	1	6	4.5	
80	gf	12894	22	11	6	4.5	
81	gf	11549	19	5	7	5	
82	gf	10236	19	4	8	5	
83	hm	11647	17	0	7	5	
84	gf	10794	18	7	7	4	
85	gf	11417	21	0	7	4.5	
86	gf	11483	17	6	7.5	5	
87	hm	9055	21	6	9	5	
88	hm	9941	17	1	7.5	5.5	
89	gf	10335	21	7	7.5	4.5	
90	gf	11647	23	5	6.5	4.5	
91	gf	13484	21	0	6	5	
92	gf	12476	17	6	6	5.5	

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

93	gf	11913	22	2	6.5	3.5	
94	gf	14461	19	6	9	6	Cull
95	gf	9318	17	11	7.5	3	
96	gf	11253	19	4	7	4	
97	gf	11713	21	2	7	5.5	
98	gf	12402	21	6	6	5	
99	gf	10925	19	3	6.5	4	
100	hm	9843	19	5	9	6.5	
101	gf	12861	21	3	6	5	
102	gf	8924	18	8	7.5	4.5	
103	hm	10531	20	10	7	5.5	
104	gf	11942	23	10	6.5	4	
105	hm	9383	17	5	8	4.5	
106	gf	10499	20	11	7.5	3.5	
107	gf	10367	20	10	7	4	
108	gf	11942	21	1	7	4.5	
109	hm	9957	16	11	9.5	6.5	
110	hm	10761	17	3	8	5	
111	gf	11417	22	2	6.5	5	
112	hm	9154	17	5	6	3	
113	gf	11581	19	0	7	5	
114	gf	10302	22	0	7	4	
115	gf	11319	19	6	6.5	4	
116	gf	10958	19	4	7.5	5.5	
117	gf	10630	18	5	8	5	
118	gf	11483	22	3	6	3	
119	gf	11253	21	3	6	4	
120	gf	11680	23	1	6.5	4	
121	gf	7710	19	10	6	3	Broken
122	gf	12697	19	1	6.5	5	
123	gf	9547	18	8	6	3	
125	gf	11319	21	7	7	4	
126	gf	15354	13	9	6	4.5	
127	gf	12795	22	11	6.5	4.5	
128	gf	11024	19	9	6	4.5	
129	gf	11352	21	10	7	4	
130	gf	11385	20	5	7	4	
131	gf	10367	19	7	6	2.5	
132	gf	10981	18	11	6	4.5	
133	gf	11581	17	5	6.5	3.5	Broken End
134	hm	9744	21	5	8	7.5	
135	gf	10892	19	11	10	7	
136	gf	10892	21	11	8.5	3	
137	hm	8465	20	9	9.5	5	
138	gf	12205	21	4	7	6	
139	gf	12533	20	9	5	4	

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

140	gf	16043	18	6	8	6	Cull
141	gf	11089	19	1	8.5	5.5	
142	gf	10072	18	6	7	5	
143	hm	8596	14	0	7.5	6.5	Broken End
144	gf	12664	15	3	8	5.5	Cull and broken end
145	hm	11680	19	0	7	6.5	
146	gf	10827	20	3	8	5.5	
147	gf	13222	18	5	6	4.5	
148	gf	10171	17	1	7.5	4	
149	gf	13058	21	1	7.5	8	
150	gf	13182	20	7	10	7.5	Cull
151	hm	9744	22	10	8	5	
152	gf	8727	19	2	8	6	
153	gf	12235	18	11	6	4.5	
154	gf	16586	22	8	9	7.5	Cull
156	hm	11188	20	11	6.5	4.5	
157	gf	12697	24	0	5	3	
158	gf	12500	22	7	5	3.5	
159	gf	10597	19	2	6	3.5	
160	gf	11352	22	0	6	3	
161	gf	10958	22	6	7	3	
162	gf	12369	20	9	8	5.5	
163	gf	10236	18	10	9	5	
164	gf	11024	21	9	6.5	4.5	
165	gf	10761	17	11	8	5	Broken End
166	gf	10499	20	9	8	5.5	Broken End
167	gf	12533	20	3	7	5	
168	gf	12762	19	9	7	6	
169	gf	11909	22	11	6	4.5	
170	gf	12500	21	6	5	3.5	
171	gf	12697	18	8	5.5	3.5	Broken End
172	gf	12500	21	0	6.5	4	
173	gf	15420	20	5	6.5	5	Broken
174	gf	11483	18	0	7.5	5	
175	gf	12697	13	9	7	5.5	Broken End
176	gf	11220	17	0	6.5	5	
177	gf	10236	22	1	6	3.5	
178	gf	12106	22	3	6	4.5	
179	gf	10499	21	9	8	4.5	
180	gf	12828	21	11	6	3.5	
181	gf	12598	21	6	7	3	
182	gf	11745	19	9	7	4.5	
183	gf	13091	21	10	6.5	5.5	
184	hm	12303	21	8	7	5.5	
185	gf	10892	22	4	8	4.5	
186	gf	13419	20	9	6.5	5	split

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

187	gf	11483	22	11	7.5	5	
188	gf	10696	20	9	6	3	
189	gf	10892	20	9	7.5	3	
190	gf	14239	22	10	8.5	7	Cull
191	gf	12402	18	11	7.5	5.5	
192	gf	11581	21	8	6	4.5	
193	gf	12402	16	5	8	6	
194	gf	12467	18	7	6.5	4	
195	hm	11549	21	3	7	5	
196	gf	11385	17	0	7.5	5.5	
197	hm	9416	20	11	8	5	
198	gf	11483	19	9	7.5	7.5	
199	gf	12172	21	1	6.5	4.5	
200	gf	13386	18	8	6.5	4	
201	gf	11614	20	6	8	6.5	
202	gf	12672	18	8	7	5.5	
203	gf	11680	18	9	8	5	Broken End
204	gf	11188	22	9	7	4	
205	gf	11877	20	5	7	5.5	
206	gf	12139	19	9	5.5	3.5	
207	gf	12467	20	2	7	5.5	
208	gf	12041	17	4	7	5.5	
209	gf	11844	17	1	7	5	
210	gf	10367	19	5	9	7	Broken End
211	gf	11122	20	3	6.5	5	
212	gf	13615	18	10	7	6	Broken End
213	gf	11844	19	10	7	5	
214	hm	10105	21	6	8	6	Broken End
215	gf	12172	20	7	6	5.5	
216	gf	10335	21	5	11	6	
217	gf	10072	19	11	8	4	
218	gf	11844	15	6	8	7.5	
219	gf	10355	20	5	5.5	3.5	
220	hm	11220	23	0	7	4	
221	gf	9843	18	9	7.5	4.5	
222	gf	12073	19	8	8.5	6	
223	hm	10138	18	8	7	4	Broken End
224	gf	11056	21	3	7	4.5	
225	gf	11155	19	10	7	5	
227	gf	10794	20	9	6.5	4.5	
229	gf	12238	20	3	6	4.5	
230	gf	15715	14	6	8	7.5	Cull
231	hm	10203	21	4	8	6	Broken End
232	gf	12270	19	3	6.5	5	
233	gf	11942	19	7	7	5.5	
234	gf	13189	21	2	6	5	

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

235	hm	9810	25	3	7	3	
236	gf	11877	21	8	7.5	4	
237	gf	10597	19	10	7	5	
238	gf	11417	19	2	6	3.5	
239	gf	11352	22	0	6.5	4	
240	gf	13000	19	3	5	3	
241	gf	13386	16	7	7.5	6.5	
242	gf	11778	22	5	7.5	5.5	
243	gf	12434	21	5	6	4	
244	gf	10663	18	4	7	3.5	
245	gf	13419	22	11	7	5.5	
246	gf	14337	21	3	6	5	
247	gf	11680	20	1	6	5	
248	gf	12336	17	0	6	4.5	
249	gf	9941	16	4	8	5.5	Broken End
250	gf	12238	20	5	6	4	
251	gf	12828	20	7	6	5.5	
252	gf	14600	20	1	7	4	
253	gf	11549	19	3	7	4	
254	hm	12795	21	0	10	7	
255	gf	13944	16	11	5.5	3	Broken End
256	gf	10892	21	6	7	5	
257	gf	12106	20	10	8	6	
258	gf	12664	19	7	7	6	
259	gf	11680	20	7	9	6	
260	hm	10892	18	11	7	5.5	Broken End
261	gf	9941	19	3	7	4	
262	gf	12467	11	8	6	5	
263	gf	11713	20	8	7	4.5	
264	gf	12270	22	7	8	5.5	
265	gf	12303	19	0	5	3	
266	gf	12664	19	2	6	5.5	
267	hm	13484	20	10	6.5	5.5	
268	gf	10663	18	8	6	3.5	
269	gf	11319	18	8	7.5	6	
270	gf	12927	18	2	11	6.5	
272	gf	13878	22	7	7	5	
273	gf	12828	22	1	7.5	4.5	
274	gf	11581	17	2	6.5	4.5	
275	gf	12041	19	9	7.5	5	
276	gf	11122	16	6	7	5	
277	gf	11680	17	8	7	6	
278	gf	10860	17	5	7.5	5.5	
279	gf	9055	21	3	8	3	
280	gf	11680	19	9	7.5	5.5	
281	gf	12041	19	11	6	5	

Appendix C. Acoustic measurement of 300 stems in second trial (Cont.)

282	gf	11562	20	10	6	4	
283	gf	11581	21	8	7	4	
284	gf	13255	19	3	7	5	
285	gf	12598	21	2	7.5	6.5	
286	gf	11286	19	3	7	4	
287	gf	10925	20	1	8	6.5	
288	gf	12238	16	5	7	5	
289	hm	10367	21	3	10	7	
290	hm	11286	19	1	7	5.5	
291	hm	12402	18	9	6	5	
292	hm	9843	25	0	9.5	7	
293	gf	10663	16	9	8	5	
294	gf	11549	20	4	7	5	
295	gf	9088	18	10	9	5.5	
296	gf	9678	18	9	6	4.5	
297	gf	12205	18	1	7	5.5	
298	gf	11352	16	10	7	6	
299	gf	10761	21	1	8	5.5	
300	gf	10499	16	10	9	6.5	
301	hm	11713	19	1	6.5	5	
302	gf	12041	17	0	7	5.5	
303	gf	12106	19	0	5.5	4	
304	gf	11450	20	2	7	5	
305	gf	12270	20	11	7	4.5	
306	gf	10630	18	0	8	5	
307	gf	12730	21	9	6	5	

APPENDIX D. PRODUCTION REPORT OF SECOND TRIAL

HEWSAW MERCHANDISER

06:50:37 Tuesday, April 17, 2007

Rec - Hem/Fir

HEM:

ALL LOGS	TOTAL	HEM MKT	STUD MILL	HEWSAW	CHIP>=2'	LILY PADS
LOGS/PCS	107	0	0	202	51	163
SCRIBNER BF	2260	0	0	1820		
CUBIC ft3	448.4=	0.0	0.0	386.0	27.8	34.6
LINEAL ft	2062.5=	0.0	0.0	1779.3	192.0	91.2

AVG. DIAMETER = 5.8 in.

AVG. LENGTH = 19.3 ft.

TOO SMALL REJECTS 0

HEWSAW INPUT TALLY

LENGTH 24FT AND LESS

DIA.	STEMS	FT3	DOL	vs.	CHIPS		DIFF
4"	12	48039.99	122067.54	-	65761.94	=	56305.60
5"	38	64922.09	183483.26	-	88871.84	=	94611.42
6"	28	47244.25	140055.15	-	64672.65	=	75382.50
7"	22	26771.98	79681.48	-	36648.17	=	43033.31
8"	7	11493.42	33171.36	-	15733.34	=	17438.02

LENGTH GREATER THAN 24FT

DIA.	STEMS	FT3	DOL	vs.	CHIPS		DIFF

SIZES:

1 In.Thick	0.875	8 Ft.Length	94.0"
2 In.Thick	1.600	10 Ft.Length	118.0"
2 In.Width	1.600	12 Ft.Length	147.0"
3 In.Width	2.600	14 Ft.Length	170.0"
4 In.Width	3.600	16 Ft.Length	195.0"
6 In.Width	5.675	18 Ft.Length	219.0"
8 In.Width	7.560	20 Ft.Length	243.0"
10 In.Width	9.560	22 Ft.Length	268.0"
12 In.Width	11.560	24 Ft.Length	291.0"
14 In.Width	13.560	26 Ft.Length	315.0"
		28 Ft.Length	340.0"

WANE RULES:

1 In.Stud Edge	75	1 In. Stud Face	75
1 In.Dim. Edge	75	1 In. Dim. Face	75
2 In.Stud Edge	33	2 In. Stud Face	33
2 In.Dim. Edge	33	2 In. Dim. Face	33

PRICES:

STUD MILL PRICES :

		6'	7'	97"	94"	9'	10'
1x4x8	$/MBF	0	100	160	160	160	160
1x6x8	$/MBF	0	0	0	0	0	0
2x4	$/MBF	0	100	210	210	235	220
2x6	$/MBF	0	100	100	215	270	255

PRICES:

HEWSAW PRICES :

		6'	7'	97"	94"	9'	10'
1x2x8	$/MBF	0	0	0	0	0	0
1x3x8	$/MBF	2	0	115	115	115	115
1x4x8	$/MBF	0	0	160	160	160	160
1x6x8	$/MBF	0	0	135	135	135	135
2x2	$/MBF	0	0	0	0	0	0
2x3	$/MBF	0	0	165	165	165	165
2x4	$/MBF	0	0	280	270	300	280
2x6	$/MBF	0	0	0	265	305	280

CHIP VALUE:

$117.00/BDU

SENECA

General report

Tuesday, April 17, 2007, Day shift

Start: Tuesday, April 17, 2007 05:00:00
End: Tuesday, April 17, 2007 09:25:26
Print: Tuesday, April 17, 2007 09:25:27

Production Summary

Valid	177	100	9.8483 m³	100
Rejects	0	0		
Too long	0	0		
Too big	0	0		
	177		9.8483 m³	

Hourly summary

	Start	End	Logs
1	00h00	00h00	177

Average

Selection diameter	5.943 "
Length	106.2 "
Volume (m3)	0.0556
Taper ("/8')	1.2
Top diameter	5.943 "
Butt diameter	7.040 "
Average diameter	6.528 "

Productivity

Conveyor usage	25 %	
Running time	20 %	16 m
Downtime	80 %	65 m

Red

Seneca Sawmill Hewsaw Sorter

Day Shift: 4/17/2007 7:48:42 AM to In progress *Sorter Report*

ReRun: No

Hemlock		6	7	8	9	10	Total
1" X 4"	Count:	.	1	15	12	8	36
	Bdft	.	2	40	36	27	105
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%
2" X 3"	Count:	.	1	7	10	6	24
	Bdft	.	4	28	45	30	107
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%
2" X 4"	Count:	.	2	67	161	60	290
	Bdft	.	9	357	966	400	1733
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%
2" X 6"	Count:	.	2	20	62	9	93
	Bdft	.	14	160	558	90	822
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%
Hemlock **Totals:**	Count:	.	6	109	245	83	443
	Bdft	.	29	585	1605	547	2766
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%
Report Total	Count:	.	6	109	245	83	443
	Bdft	.	29	585	1605	547	2766
	%:	.	1.1%	21.2%	58.0%	19.8%	100.0%

1x6
1x4

Report Printed 9:10:40 AM on 4/17/2007

HEWSAW MERCHANDISER

07:45:59 Tuesday, April 17, 2007

Green GF/HF

HEM:

ALL LOGS	TOTAL	HEM MKT	STUD MILL	HEWSAW	CHIP>=2'	LILY PADS
LOGS/PCS	178	0	0	329	79	277
SCRIBNER BF	3140	0	0	2890		
CUBIC ft3	585.5=	0.0	0.0	500.6	41.0	44.0
LINEAL ft	3429.3=	0.0	0.0	2957.2	303.0	169.1

AVG. DIAMETER = 5.1 in.

AVG. LENGTH = 19.3 ft.

TOO SMALL REJECTS 0

HEWSAW INPUT TALLY

LENGTH 24FT AND LESS

DIA.	STEMS	FT3	DOL	vs.	CHIPS		DIFF
3"	1	14633.04	29201.99	-	20031.17	=	9170.82
4"	40	48039.99	122067.54	-	65761.94	=	56305.60
5"	94	64922.09	183483.26	-	88871.84	=	94611.42
6"	31	47244.25	140055.15	-	64672.65	=	75382.50
7"	11	26771.90	79681.48	-	36648.17	=	43033.31
8"	1	11493.42	33171.36	-	15733.34	=	17438.02

LENGTH GREATER THAN 24FT

DIA.	STEMS	FT3	DOL	vs.	CHIPS	DIFF

SIZES:

1 In.Thick	0.875	8 Ft.Length	94.0"
2 In.Thick	1.600	10 Ft.Length	118.0"
2 In.Width	1.600	12 Ft.Length	147.0"
3 In.Width	2.600	14 Ft.Length	170.0"
4 In.Width	3.600	16 Ft.Length	195.0"
6 In.Width	5.675	18 Ft.Length	219.0"
8 In.Width	7.560	20 Ft.Length	243.0"
10 In.Width	9.560	22 Ft.Length	268.0"
12 In.Width	11.560	24 Ft.Length	291.0"
14 In.Width	13.560	26 Ft.Length	315.0"
		28 Ft.Length	340.0"

WANE RULES:

1 In.Stud Edge	75	1 In. Stud Face	75
1 In.Dim. Edge	75	1 In. Dim. Face	75
2 In.Stud Edge	33	2 In. Stud Face	33
2 In.Dim. Edge	33	2 In. Dim. Face	33

PRICES:

STUD MILL PRICES :

	6'	7'	97"	94"	9'	10'
1x4x8 $/MBF	0	100	160	160	160	160
1x6x8 $/MBF	0	0	0	0	0	0
2x4 $/MBF	0	100	190	210	235	220
2x6 $/MBF	0	100	100	215	270	255

PRICES:

HEWSAW PRICES :

	6'	7'	97"	94"	9'	10'
1x2x8 $/MBF	0	0	0	0	0	0
1x3x8 $/MBF	2	0	115	115	115	115
1x4x8 $/MBF	0	0	160	160	160	160
1x6x8 $/MBF	0	0	135	135	135	135
2x2 $/MBF	0	0	0	0	0	0
2x3 $/MBF	0	0	165	165	165	165
2x4 $/MBF	0	0	280	270	300	280
2x6 $/MBF	0	0	0	265	305	280

CHIP VALUE:

$117.00/BDU

General report

Tuesday, April 17, 2007, Day shift

Green

Start: Tuesday, April 17, 2007 05:00:00
End: Tuesday, April 17, 2007 10:11:20
Print: Tuesday, April 17, 2007 10:11:22

Production Summary

Valid	215	100	9.8561 m³	100
Rejects	0	0		
Too long	0	0		
Too big	0	0		
	215		9.8561 m³	

Hourly summary

	Start	End	Logs
1	00h00	00h00	215

Average

Selection diameter	5.475 "
Length	109.2 "
Volume (m3)	0.0458
Taper ("/8')	0.8
Top diameter	5.475 "
Butt diameter	6.216 "
Average diameter	5.842 "

Productivity

Conveyor usage	32 %	
Running time	81 %	16 m
Downtime	19 %	4 m

Green

Seneca Sawmill Hewsaw Sorter

Day Shift: 4/17/2007 9:13:00 AM to In progress *Sorter Report*

ReRun: No

Hemlock		6	7	8	9	10	Total
1" X 4"	Count:	.	.	14	30	18	62
	Bdft	.	.	37	90	60	187
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%
2" X 3"	Count:	.	.	9	17	6	32
	Bdft	.	.	36	77	30	143
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%
2" X 4"	Count:	.	1	130	318	210	659
	Bdft	.	5	693	1908	1400	4006
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%
2" X 6"	Count:	.	.	20	67	17	104
	Bdft	.	.	160	603	170	933
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%
Hemlock *Totals:*	Count:	.	1	173	432	251	857
	Bdft	.	5	927	2678	1660	5269
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%
Report Total	Count:	.	1	173	432	251	857
	Bdft	.	5	927	2678	1660	5269
	%:	.	0.1%	17.6%	50.8%	31.5%	100.0%

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