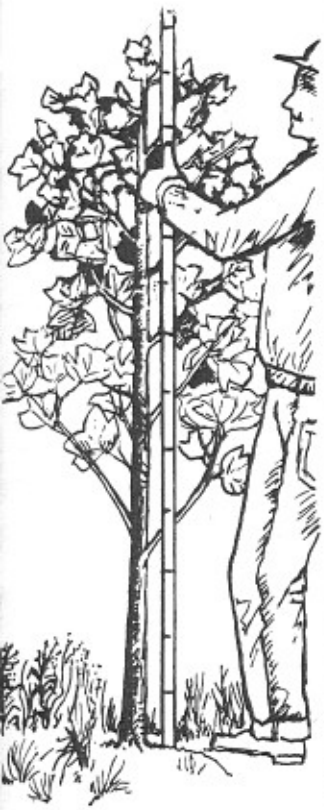

OCCASIONAL REPORT 70 MAY 1986

LOBLOLLY PINE RELEASE STUDY

REPORT NUMBER

6

VIRGINIA DIVISION OF FORESTRY

Department of Conservation and Historic Resources

LOBLOLLY PINE RELEASE
Report #6

by
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Abstract. This study included three treatments: no release, hand-chopping hardwoods close to the ground, and mist-blowing with a tractor-mounted mist-blower. The release was done during the fifth growing season. Hardwood competition was fairly severe when the release was done. At age 22, hand-chopped plots averaged 52 percent more basal area and 63 percent more volume in standard cords than check plots, and mist-blown plots averaged 19 percent more basal area and 17 percent more volume than check plots.

INTRODUCTION

This is the sixth in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This particular study was installed in the central Piedmont of Virginia, on the Appomattox-Buckingham State Forest, in Stand 7 of the Abbitt 9 Management Unit. The previous stand was predominately mixed oaks and other hardwoods, with scattered pine. The timber was clearcut in early 1962. Site preparation consisted of mist-blowing followed by prescribed burning. A Potts mist-blower, mounted on a small crawler tractor, was used to apply two pounds active ingredient of 2,4,5-T per acre, during the summer of 1962. The prescribed burn was done late in the fall of 1962. It was not a hot burn, and hardwood control was marginal. The many residual hardwoods that survived the fire were later frilled and poisoned. Seedlings were planted in the spring of 1963. Although seedling survival was satisfactory, growth during the early years was less than normal, probably because of the inadequate site preparation.

Treatments were applied during the fifth growing season, to swaths ranging from 150 to 350 feet in width and running across the tract, as shown in Figure 1. There were two check swaths, two mist-blown swaths, and three hand-chopped swaths. All hardwoods were cut off close to the ground in the hand-chopped swaths, between July 24 and 28, 1967. Mist-blowing was done on July 27, 1967, with the same equipment, chemical, and rate used for the site preparation spray.

Hardwood competition was moderately severe when release was done. Release provided by the mist-blowing was marginal. Most hardwood sprout clumps were killed back to some extent, but the majority of them resprouted and resumed growth. Hand-chopping did a much better job. All of the hardwoods that were chopped off resprouted vigorously, but many of the pines were able to stay ahead of this regrowth, and it was obvious early in the study that the hand-chopping provided the greater degree of release.

In March of 1968, mil-acre plots were systematically located in all seven swaths. There were 110 plots in the check swaths, 100 in the mist-blown swaths, and 180 in the chopped swaths. Height of each

loblolly pine on every plot was measured to the nearest one-half foot. Estimates of loblolly pine stocking based on this mil-acre sampling are presented in Table 1. The average and range of heights reflect the poor growth of many seedlings in this plantation in its early years. Average heights of only seven feet at age five are considerably less than expected with good initial site preparation. The somewhat shorter seedlings at age five on the mist-blown plots can probably be attributed to spray damage. Some pine seedlings were killed back by the mist-blowing, and on these seedlings height was measured to the uppermost living buds or needles.

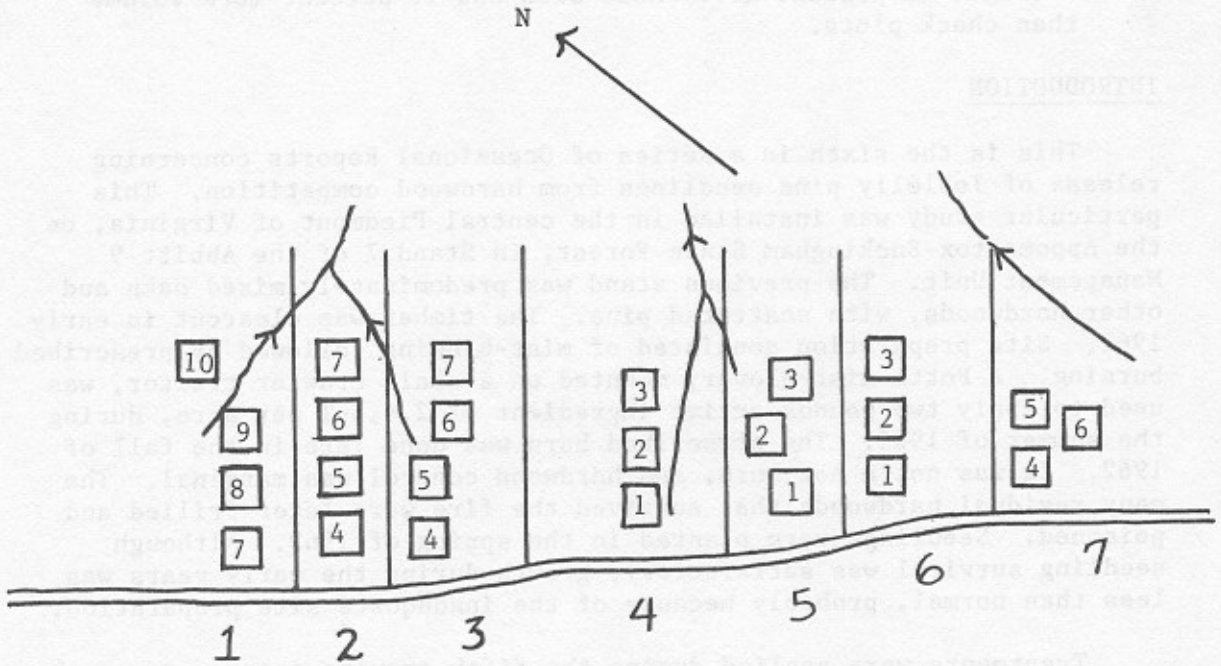

FIGURE 1. Layout of study area and plot locations. Treatment swaths are numbered below the road:

Check:	2 and 5
Mist-blown:	3 and 6
Hand-chopped:	1, 4 and 7

Table 1. Estimated number and height of loblolly pine seedlings after five seasons.

Treatment	Number per Acre	Total Height (feet) Average	Range
Check	491	7.1	1 to 14
Mist-blown	630	6.3	½ to 12½
Hand-chopped	628	7.3	1½ to 14

PLOT INSTALLATION

Permanent growth plots were installed in November, 1972 and January, 1973, ten growing seasons after planting. A total of 24 one-tenth acre growth plots were installed, 7 in the two check swaths, 7 in the two mist-blown swaths, and 10 in the three hand-chopped swaths (Figure 1). All volunteer pines, mostly Virginia pine, were cut down when the plots were installed.

Measurements were taken at age 10 when plots were installed, and again at ages 14, 18 and 22. Diameter at breast height of each loblolly pine was measured to the nearest inch. For a sample of trees in each diameter, total height to the nearest foot was also measured, noting which trees were dominant or codominant. For the final measurement at age 22, all hardwoods over .5 inch DBH were tallied by species, DBH, and crown class. Total height to the nearest foot of about two-thirds of the dominant and codominant hardwoods were measured.

DAMAGE FROM ICE STORMS

Severe ice storms occurred on the Buckingham State Forest during the winters of 1978-79 and 1979-80, between the age 14 and 18 measurements. Some trees were killed by being uprooted or broken off below the live crown. Many trees had their tips broken out, but survived. Less severe ice storms occurred during the winters of 1983-84 and 1984-85, killing a few trees and causing top breakage in others.

RESULTS AND DISCUSSION

A summary of loblolly pine data for the four measurements is presented in Table 2, and individual plot data for each measurement in Appendix A. At age 22, mist-blown plots averaged 2.2 standard cords more, and hand-chopped plots 8.2 standard cords more than the check plots[1/]. Table 3 presents stand tables for loblolly pine at age 22. Differences due to release increased with time as illustrated in Table 4.

Average numbers of pine seedlings initially present were probably similar for the mist-blown and hand-chopped plots, but there were apparently fewer seedlings present on the check plots (see Table 1). Seedling density was estimated from samples taken over the entire study area after five seasons, but permanent growth plots were not installed until age 10. These early estimates based on mil acre sampling were not very precise. For example, for the hand-chopped plots at age 10, there was an average of 671 loblolly pine seedlings per acre, whereas the estimate at age 5 was only 628 per acre. If indeed there was a difference in average stocking initially, as suggested by Table 1, then part of the yield advantage of the treated plots over the check plots is due to this initial difference. No adjustments for differences in initial stocking can be made, however, because permanent, one-tenth acre plots

1/ Standard cords at age 22 were subjected to an analysis of variance. Differences between treatment means were tested using Duncan's New Multiple Range Test. Yields on mist-blown plots were not significantly greater than yields on check plots, but yields on hand-chopped plots were significantly greater than yields on both mist-blown and check plots at the .01 level.

Table 2. Summary of loblolly data at each of four measurements: number of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees at ages 10, 14, 18, and 22.

Treatment	Age	Number	DBH	Basal Area	Std. Cords	Height
Check	10	474	2.65	22.0	-	21.0
	14	457	3.96	46.2	4.0	33.6
	18	414	4.78	58.5	6.8	36.6
	22	397	5.59	76.0	13.0	45.3
Mist-blown	10	503	2.86	25.5	-	20.8
	14	477	4.40	55.6	5.5	33.6
	18	443	5.23	71.6	8.7	36.3
	22	420	6.04	90.1	15.2	45.3
Hand-chopped	10	671	3.21	43.6	-	22.8
	14	660	4.52	82.4	8.6	35.8
	18	589	5.25	97.0	13.2	39.1
	22	554	5.92	115.2	21.2	47.5

Table 3. Average number of loblolly pines per acre by DBH class at age 22.

DBH	Check Plots	Mist-blown Plots	Hand-chopped Plots
1	3		4
2	26	10	16
3	34	32	39
4	47	53	65
5	70	71	89
6	74	86	134
7	80	71	103
8	47	56	65
9	9	37	27
10	7	3	11
11		1	1
Totals	397	420	554

Table 4. Average differences between released plots and check plots at each measurement, for basal area per acre and standard cords per acre.

Age	Mist-blown minus Check		Hand-chopped minus Check	
	Basal Area	Std. Cds.	Basal Area	Std. Cds.
10	3.5	-	21.6	-
14	9.4	1.5	36.2	4.6
18	13.1	1.9	38.5	6.4
22	14.1	2.2	39.2	8.2

were not put in until age 10, after considerable mortality had occurred on the check plots.

Ice damage was related to treatments. The greatest damage occurred on hand-chopped plots and the least on check plots, with mist-blown plots intermediate (Table 5). Ten times as many pine trees were killed on hand-chopped plots as on check plots. (In Release Report #1, we reported that an ice storm one year after release caused far greater damage to hand-chopped plots than to check plots.) Top breakage was related to tree size, since a higher percentage of the larger trees lost their tops. At the age 18 measurement, which occurred one or two seasons after the two worst ice storms, it was difficult on the hand-chopped plots to find enough large trees to measure for total height. When a loblolly pine loses its top, one of the larger lateral branches below the break bends up under the action of compression wood to replace the lost leader. By the age 22 measurement, the larger trees that had lost their tops at age 16 or 17 had recovered fairly well, and measurement of total height was possible on many of them. Average heights, however, are less than they would have been had these ice storms not occurred. When a lateral branch bends up to replace a broken leader, the "recovered" height is less than it would have been had the leader not been lost. Without storm damage, the difference in yields between the hand-chopped plots and the check plots would have been even greater. The damage was so great on hand-chopped plot #10, for example, that basal area was less at the 18 year measurement than it was at the 14 year measurement (Appendix A).

Table 5. Number of trees per acre over 4.5 inches DBH that were killed by ice storms, and percent of surviving trees with tops broken.

	Check		Mist-blown		Hand-chopped	
Plot	Number Killed	% Broken	Number Killed	% Broken	Number Killed	% Broken
1	0	24	10	35	20	19
2	0	14	0	40	50	30
3	0	10	10	22	20	25
4	0	24	10	30	0	30
5	0	20	20	16	10	29
6	20	29	20	17	10	39
7	0	18	0	29	0	23
8					0	30
9					50	37
10	—	—	—	—	140	36
Means	3	20	10	27	30	30

The height growth pattern of dominant and codominant loblolly pines was distorted by the severe ice storms which occurred at ages 16 and 17, as illustrated in Table 6. Height growth from age 14 to 18 was considerably less than it would have been without ice damage.

Table 6. Average height growth of dominant and codominant loblolly pines by four-year periods.

Period	4-Year Height Growth (feet)		
	Check Plots	Mist-blown Plots	Hand-chopped Plots
age 10 to 14	12.6	12.8	13.0
age 14 to 18	3.0	2.7	3.3
age 18 to 22	8.7	9.0	8.4

A summary of hardwood data from the final measurement at age 22 is presented in Tables 7 and 8. Total numbers of hardwoods per acre were similar for the three treatments, however, there were many more large hardwoods on the check plots. Mist-blown plots had 17 percent less hardwood basal area and hand-chopped plots 38 percent less than check plots. Hardwood basal area in intermediate, codominant and dominant trees, averaged 10.8, 6.5, and 1.3 square feet on the check, mist-blown and hand-chopped plots respectively.

Cordwood yields at age 22 are related to the amount of hardwood present at age 22. Figure 2 shows the relationship between pine cordwood yields and basal area in dominant, codominant and intermediate hardwoods at age 22, for the 24 plots. A simple linear regression fitted to these data accounted for 75 percent of the variation in cordwood yields[2/]. A regression of yields over total hardwood basal area (all trees greater than one-half inch DBH) accounted for 64 percent of the variation in yields.

At age 22 there were 30, 17, and 3 dominant and codominant hardwoods per acre on the check, mist-blown and hand-chopped plots respectively. Over 90 percent of these were oaks. Table 9 compares the average heights of dominant and codominant loblolly pines and hardwoods at age 22. The hardwoods averaged about seven feet shorter than the pines. This large difference suggests that many of these hardwoods will eventually drop down in crown class.

2/ Estimated standard cords = 21.75 - .825 (hardwood basal area), r^2 = .751.

Table 7. Average numbers of hardwoods per acre by species and DBH class at age 22.

Check Plots

Species	DBH 1	2	3	4	5	6	Totals
Chestnut Oak	296	74	37	17	3	3	430
White Oak	276	56	20	10			362
Red Oak	441	200	106	33	10		790
Red Maple	299	110	43	4	1		457
Black Gum	119	1					120
Hickory	11	1					12
Yellow Poplar	3						3
Dogwood	16	3	1	3			23
Miscellaneous	19	1					20
Totals	1,480	446	207	67	14	3	2,217

Mist-blown Plots

Species	DBH 1	2	3	4	5	6	Totals
Chestnut Oak	279	69	39	20	7		414
White Oak	287	53	13	3			356
Red Oak	393	223	87	4	1	1	709
Red Maple	389	101	26	6			522
Black Gum	40						40
Hickory	29	3					32
Yellow Poplar	1	1					2
Dogwood	19	10					29
Miscellaneous	9	3					12
Totals	1,446	463	165	33	8	1	2,116

Hand-chopped Plots

Species	DBH 1	2	3	4	5	6	Totals
Chestnut Oak	258	51	7	6		1	323
White Oak	505	68	8	3			584
Red Oak	576	123	12	4			715
Red Maple	459	94	5				558
Black Gum	133						133
Hickory	56	5					61
Yellow Poplar	14						14
Dogwood	85	25					110
Miscellaneous	34	4	1				39
Totals	2,120	370	33	13		1	2,537

Table 8. Average numbers of hardwoods per acre by DBH class and crown class, and basal area by crown class, at age 22.

DBH	Over-topped	Intermediate	Codominant	Dominant	Totals
		Check Plots			
1	1,480				1,480
2	443	3			446
3	140	64	3		207
4	10	44	13		67
5		3	7	4	14
6				3	3
Totals	2,073	114	23	7	2,217
B.A.	25.5	7.5	2.2	1.1	36.3
		Mist-blown Plots			
1	1,446				1,446
2	459	4			463
3	116	49			165
4	1	23	9		33
5		1	7		8
6			1		1
Totals	2,022	77	17		2,116
B.A.	23.7	4.6	1.9		30.2
		Hand-chopped Plots			
1	2,120				2,120
2	370				370
3	32	1			33
4	1	10	2		13
5					
6				1	1
Totals	2,523	11	2	1	2,537
B.A.	21.3	.9	.2	.2	22.6

Table 9. Average height in feet of dominant and codominant pines and hardwoods at age 22.

Treatment	Loblolly		Hardwoods	
	Mean	Range	Mean	Range
Check	45.3	37 to 54	38.1	35 to 44
Mist-blown	45.3	37 to 52	38.0	35 to 40
Hand-chopped	47.5	42 to 53	41.0	39 to 43

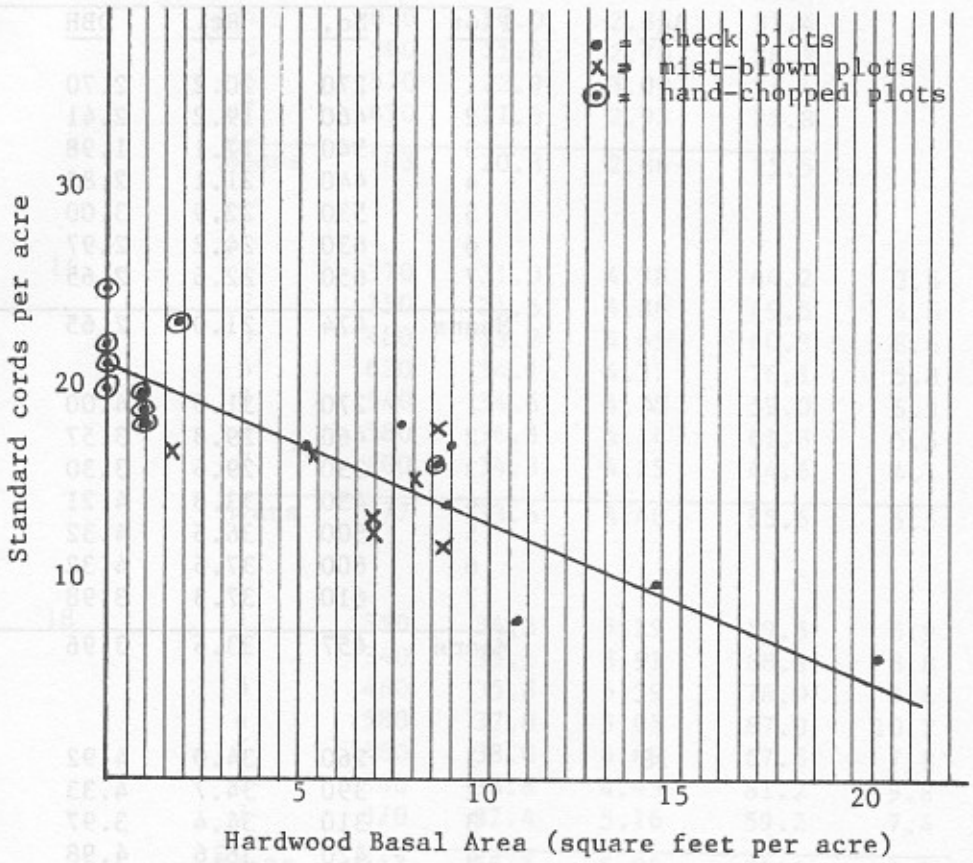

FIGURE 2. Pine cordwood yields at age 22 relative to basal area of intermediate, codominant and dominant hardwood trees.

APPENDIX A. Summary of loblolly pine data for each plot at ages 10, 14, 18, and 22: number of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees.

CHECK PLOTS

Age	Plot	No.	Ht.	DBH	B.A.	Cords
10	1	270	20.2	2.70	12.4	
	2	460	19.2	2.41	16.3	
	3	340	17.1	1.98	8.4	
	4	440	21.1	2.82	21.6	
	5	530	22.9	3.00	30.6	
	6	630	24.2	2.97	35.0	
	7	650	22.6	2.65	29.4	
	Means	474	21.0	2.65	22.0	
14	1	270	31.0	4.00	27.4	2.3
	2	460	29.8	3.57	36.4	2.0
	3	330	29.6	3.30	22.6	.8
	4	430	33.8	4.21	46.4	3.9
	5	500	36.5	4.32	59.9	6.2
	6	600	37.5	4.32	69.3	6.9
	7	610	37.3	3.98	61.2	5.9
	Means	457	33.6	3.96	46.2	4.0
18	1	260	34.0	4.92	38.8	4.2
	2	390	34.7	4.33	45.4	3.9
	3	310	34.4	3.97	31.1	2.4
	4	420	36.6	4.98	62.3	7.4
	5	400	41.5	5.50	70.4	10.2
	6	560	37.5	4.95	83.1	10.1
	7	560	37.6	4.80	78.6	9.3
	Means	414	36.6	4.78	58.5	6.8
22	1	250	43.0	5.84	53.4	9.0
	2	350	41.4	5.23	59.1	8.2
	3	290	44.4	5.07	46.2	6.5
	4	420	45.0	5.64	80.6	14.4
	5	400	49.2	6.12	88.2	17.3
	6	520	45.7	5.77	102.3	18.4
	7	550	48.4	5.47	102.4	17.3
	Means	397	45.3	5.59	76.0	13.0

MIST-BLOWN PLOTS

Age	Plot	No.	Ht.	DBH	B.A.	Cords
10	1	410	20.1	2.71	19.9	
	2	360	19.0	2.96	19.5	
	3	490	19.7	2.94	25.4	
	4	670	21.0	2.78	31.4	
	5	590	21.4	2.70	28.2	
	6	570	22.9	3.00	31.4	
	7	430	21.6	2.93	22.8	
	Means	503	20.8	2.86	25.5	
14	1	370	31.0	4.38	44.2	3.5
	2	350	31.6	4.86	49.5	4.6
	3	480	33.2	4.65	60.3	8.6
	4	620	34.1	4.37	70.1	5.8
	5	540	34.6	4.15	59.0	6.5
	6	580	36.3	4.14	61.8	5.5
	7	400	34.3	4.25	44.6	4.1
	Means	477	33.6	4.40	55.6	5.5
18	1	350	34.3	5.29	59.5	6.9
	2	340	35.1	5.91	68.9	8.8
	3	460	35.8	5.39	78.0	9.4
	4	580	37.0	5.05	87.0	10.7
	5	460	38.0	4.89	67.6	7.8
	6	540	36.8	4.93	81.2	9.8
	7	370	37.4	5.16	59.2	7.4
	Means	443	36.3	5.23	71.6	8.7
22	1	340	42.3	6.18	77.6	12.1
	2	350	46.5	6.80	95.0	18.3
	3	450	44.1	6.13	99.3	17.0
	4	560	44.8	5.55	102.7	17.0
	5	430	45.6	5.74	85.8	13.6
	6	460	47.4	5.80	93.4	15.7
	7	350	46.1	6.06	76.8	13.0
	Means	420	45.3	6.04	90.1	15.2

HAND-CHOPPED PLOTS

Age	Plot	No.	Ht.	DBH	B.A.	Cords
10	1	660	24.5	3.08	38.1	
	2	790	24.7	3.43	56.7	
	3	610	23.9	3.53	47.5	
	4	470	20.3	2.63	21.0	
	5	550	20.5	2.73	26.0	
	6	560	21.6	3.15	33.2	
	7	820	21.9	3.30	53.4	
	8	710	23.2	3.18	45.1	
	9	660	22.3	3.44	47.2	
	10	880	25.1	3.66	68.0	
	Means	671	22.8	3.21	43.6	
14	1	650	35.0	4.46	78.5	7.5
	2	750	36.8	4.69	101.9	11.4
	3	610	39.4	4.76	86.8	11.5
	4	450	32.7	4.40	53.1	4.4
	5	530	32.0	4.36	61.9	5.2
	6	560	33.2	4.56	69.8	6.1
	7	820	36.5	4.34	93.7	9.1
	8	710	37.3	4.27	81.0	8.9
	9	650	35.3	4.77	88.6	9.3
	10	870	39.4	4.62	109.0	12.3
	Means	660	35.8	4.52	82.4	8.6
18	1	550	37.0	5.24	90.8	11.2
	2	660	39.4	5.33	112.5	16.3
	3	530	41.7	5.57	100.4	15.6
	4	430	37.0	5.28	72.4	9.2
	5	530	36.9	5.26	89.0	10.9
	6	550	37.6	5.36	92.8	11.9
	7	790	40.5	4.87	113.2	15.4
	8	640	40.4	5.05	99.3	13.6
	9	560	39.1	5.45	98.3	13.9
	10	650	41.4	5.12	101.8	14.4
	Means	589	39.1	5.25	97.0	13.2
22	1	530	46.3	5.87	109.0	18.4
	2	630	48.3	5.87	131.3	25.3
	3	530	49.0	6.08	122.2	23.8
	4	400	46.8	6.18	90.0	16.3
	5	510	45.6	6.00	110.7	20.0
	6	510	46.6	6.02	107.2	19.2
	7	700	48.4	5.71	134.1	25.0
	8	610	47.9	5.67	117.0	21.6
	9	510	47.4	6.31	119.3	22.5
	10	610	48.8	5.51	111.2	20.2
	Means	554	47.5	5.92	115.2	21.2