SUMMARY OF MARKING SYMPOSIUM

By

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The number of living trees 6 inches and more in d.b.h., basal area and volume marked for removal by each of the nine markers are summarized in table 1. Tree volumes are for peeled wood to a 1-inch top diameter. The conversion to cords is on the basis of 100 cubic feet solid content per cord, the 138-2/3 cubic feet stacked cord of 52-inch peeled wood used by the Armstrong Forest Company.

There are a total of 94 living trees on the half-acre sample plot with a total basal area of 57.48 square feet and a total volume, to a 4-inch top, of 1,460 cubic feet (14.6)cords).

TABLE 1

Summary of Individual Markings
(Figures for half-acre sample plot, exclusive of dead trees)

D.B.H.	Trees	Basal area	Volume 4/	Trees	Basal	Volume 4/	Trees	Basal	Volume 4/
Inches	No.	Sq.ft.	Cu.ft.	No.	Sq.ft.	Cu.ft.	No.	Sq.ft.	Cu.ft.
	A.L.BENNETT			S.O.HEIBERG			A.F.HOUGH		
6	1	0.196	4.8	7	1.372	33.6	7	1.372	33.6
7	3	0.801	20.4	6	1.602	40.8	7	1.869	47.6
8	-	-	-	-	-	-	3	1.047	28.8
9	3	1.326	39.3	6	2.652	78.6	3	1.326	39.3
10	3	1.635	59.4	2	1.090	33.6	3	1.635	50.4
11	3	1.980	63.0	1	0.660	21.0	3	1 980	63.0
12	6	4.710	151.2	5	3.925	126.0	4	3.140	100.8
13	3	2.766	90.0	4	3.688	120.0	3	2.766	90.0
14	4	4.276	139.2	4	4.276	139.2	2	2.138	69.0
15	2	2.454	80.6	1	1.227	40.3	1	1.227	40.3
16	2	2.792	93.6	1	1.396	46.8	2	2.792	93.6
Totals	30	22.936	732.5 (7.33 cds.)	37	21.888	679.9 (6.80 cds.)	38	21.292	657.0 (6.57 cds.)

(Table 1 continued on p.42)

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[4] Volumes taken from an unpublished volume table for Allegheny northern hardwoods prepared by the Northeastern Forest Experiment Station in cooperation with the Armstrong Forest Company and the Allegheny National Forest.

TABLE 1 (continued)

D.B.H.	Trees	Basal area	Volume	Trees	Basal area	Volume	Trees	Basal area	Volume
Inches	No.	Sq.ft.	Cu.ft.	No.	Sq.ft.	Cu.ft.	No.	Sq.ft.	Cu.ft.
	C. HEIMBURGER			J.E.IBBERSON			F. MERGEN		
6	6	1.176	28.8	7	1.372	33.6	6	1.176	28.8
7	7	1.869	47.6	8	2.136	54.4	5	1.335	34.0
8	1	0.349	9.6	3	1.047	28.8	1	0.349	9.6
9	7	3.094	91.7	4	1.768	52.4	7	3.094	91.7
10	3	1.635	50.4	3	1.635	50.4	3	1.635	50.4
11	-	-	-	4	2.640	84.0	3	1.980	63.0
12	4	3.140	100.8	3	2.355	75.6	6	4.710	151.2
13	4	3.688	120.0	3	2.766	90.0	3	2.766	90.0
14	4	4.276	139.2	2	2.138	69.6	1	1.069	34.8
15	2	2.454	80.6	1	1.227	40.3	-	-	-
16	2	2.792	93.6	2	2.792	93.6	1	1.396	46.8
Totals	40	24.473	762.3 (7.62 cds.)	40	21.876	672.7 (6.73 cds.)	36	19.510	600.3 (6.00 cds.)
	D.E. PETERSON			L.E. STOTZ			E.J. SCHREINER		
6	5	0.980	24.0	10	1.960	48.0	6	1.176	28.8
7	4	1.068	27.2	10	2.670	68.0	5	1.335	34.0
8	1	0.349	9.6	2	0.698	19.2	-	-	-
9	6	2.652	78.6	7	3.094	91.7	4	1.768	52.4
10	4	2.180	67.2	3	1.635	50.4	3	1.635	50.4
11	2	1.320	42.0	3	1.980	63.0	4	2.640	84.0
12	4	3.140	100.8	4	3.140	100.8	5	3.925	126.0
13	4	3.688	120.0	1	0.922	30.0	5	4.610	150.0
14	4	4.276	139.2	2	2.138	69.6	2	2.138	69.6
15	2	2.454	80.6	1	1.227	40.3	2	2.454	80.6
16	2	2.792	93.6	1	1.396	46.8	2	2.792	93.6
Totals	38	24.899	782.8 (7.83 cds.)	44	20.860	627.8 (6.28 cds.)	38	24.473	769.4 (7.69 cds.)

The nine markings can be subjected to a wide variety of comparisons and the interpretations of such comparisons are open to even wider diversity of opinion. We are including only a few comparisons that seem pertinent to forest tree improvement [5/] with a minimum of interpretation; we leave further comparisons and interpretations to the reader.

[5/] The senior author takes full responsibility for genetical interpretations.

In table 2, the markings are arranged in the order of the basal area and volume marked for cutting. The range in volume marked for removal is 1.83 cords, 12.5 percent of the total volume (14.6 cords) on the sample plot, and the range in basal area is 5.39 square feet, 9.3 percent of original basal area (57.48 sq. ft.).

The number of trees marked for cutting places the markers in a different sequence. The range in number of trees marked for cutting is 14, 14.9 percent of the 94 living trees on the plot.

TABLE 2

Basal Area, Volume and Number of Living Trees Marked for Cutting

Marker	Basal Area		Volume		Trees	
	Sq.ft.	Percent	Cords	Percent	Number	Percent
Mergen	19.51	34	6.00	41	36	38
Stotz	20.86	36	6.28	43	44	46
Hough	21.29	37	6.57	45	38	40
Ibberson	21.88	38	6.73	46	40	42
Heiberg	21.89	38	6.80	47	37	39
Bennett	22.94	40	7.33	50	30	32
Heimburger	24.48	43	7.62	52	40	42
Schreiner	24.47	43	7.69	53	38	40
Peterson	24.90	43	7.83	54	38	40
Maximum cut	24.90	43	7.83	54	44	46
Minimum cut	19.51	34	6.00	41	30	32
Range	5.39	9	1.83	13	14	14

TABLE 3

Summary of Markings by Occupational Categories

Occupational Category	Marker	Volume		Trees		No. trees
		Cords	Percent	Number	Percent	Per cord
Public service foresters; employed in management of public lands.	Stotz	6.28	43	44	46	7.0
	Ibberson	6.73	46	40	42	5.9
	Averages	6.55	44.5	42.0	44.0	6.45
Silviculturists; employed in research and teaching.	Hough	6.57	45	38	40	5.8
	Heiberg	6.80	47	37	39	5.4
	Averages	6.68	46.0	37.5	39.5	5.60
Forest geneticists; employed in research.	Mergen	6.00	41	36	38	6.0
	Heimburger	7.62	52	40	42	5.2
	Schreiner	7.69	53	38	40	4.9
	Averages	7.10	48.7	38.0	40.0	5.37
Industry foresters; employed in management of private lands.	Bennett	7.33	50	30	32	4.1
	Peterson	7.83	54	38	40	4.9
	Averages	7.65	52.5	33.5	35.5	4.50

One of the objectives of this symposium was to compare the marking of foresters in different occupational categories (table 3). The categories have been arbitrarily based on the present occupation of the markers. Original training, previous employment and experience are undoubtedly of equal (or greater) importance. These have not been considered because they cannot be accurately defined and in any case it would be impossible to assess their influence.

The relationship between volume and size of trees removed is indicated by the number of trees per cord. The average figures show that public service foresters removed the lowest volume but the largest number of trees, thus the largest number of small diameter trees Industry foresters removed the largest volume and the smallest number of trees. The average markings of the silviculturists and the forest geneticists fall between these extremes.

If we keep in mind that silviculture is still essentially an art based on limited scientific (silvical) knowledge, the differences between the average volumes and number of trees marked for removal (on the basis of occupational categories) may be considered relatively small.

Comparisons of Residual Stands

The improvement or deterioration of forest stands managed under any system of intermediate cuttings depends on the residual trees left after each partial cutting. It is therefore of particular interest to compare the residual stands left by the nine markers. The number of identical trees left by a majority (five to nine) of the markers, by seven to nine, and by all markers are compiled in table 4 by species and d.b.h. classes.

TABLE 4

Identical Residual Trees by Species and D.B.H. Classes

	Left by 5 to 9 markers						Left by 7 to 9 markers						Left by all markers					
D.B.H.	C	S M	H M	Y B	B	All sps.	C	S M	H M	Y B	B	All sps.	C	S M	H M	Y B	B	All sps.
6		1	9		4	14		1	8		3	12			5			5
7		2	4	1		7		2	2	1		5		1	2			3
8		4	5		2	11		3	5		2	10		3	3		2	8
9	1		3	2		6	1		2	2		5	1		1			2
10	1					1	1					1	1					1
11	2	1	1	1		5	1	1	1			3	1					1
12	1	6				7		5				5	4					4
13	2	1				3	1					1	1					1
14		2				2		1				1						
15		1				1		1				1						
Totals	7	18	22	4	6	57	4	14	18	3	5	44	4	8	11	0	2	25
No. trees on plot	16	24	27	6	17	90	16	24	27	6	17	90	16	24	27	6	17	90

On the basis of the 90 trees on the sample plot (of the 5 species listed in table 4), five to nine markers left 63 percent identical trees, seven to nine markers left 49 percent and all markers left 28 percent.

Computed on the basis of the nine markings, the average number of trees left in the residual stand is 56. The 25 identical trees left by all markers therefore represent 45 percent of the trees in the average residual stand. In the opinion of the authors this is unexpectedly good agreement.

Improvement of naturally regenerated stands through genetical mass selection depends on retaining the best phenotypes for seed trees. A comparison of the markings on the basis of the quality of the trees left in the residual stand is presented in table 5. The quality ratings are those assigned by Bennett and Armstrong (p.11).

TABLE 5

Identical Residual Trees by Species and Quality Rating

Species	Quality rating[6]	Trees on plot	Identical trees left by: All markers	3 geneticists	7-9 markers	5-9 markers
		No.	No.	No.	No.	No.
Cherry (C)	VG	3	2	2	2	3
	G	5	2	2	2	2
	F	3	-	-	-	1
	P	2	-	-	-	1
	VP	3	-	-	-	-
	Totals	16	4	4	4	7
Red maple (Soft maple) (SM)	VG	13	6	9	10	13
	G	5	1	3	3	3
	F	5	1	2	1	2
	P	-	-	-	-	-
	VP	1	-	-	-	-
	Totals	24	8	14	14	18
Sugar Maple (Hard Maple) (HM)	VG	14	7	9	13	14
	G	3	3	3	3	3
	F	6	1	2	2	5
	P	3	-	-	-	-
	VP	1	-	-	-	-
	Totals	27	11	14	18	22
Yellow Birch (YB)	VG	3	-	3	3	3
	G	1	-	-	-	1
	F	1	-	-	-	-
	P	-	-	-	-	-
	VP	1	-	-	-	-
	Totals	6	0	3	3	4
Beech (B)	VG	2	2	2	2	2
	G	3	-	-	1	1
	F	2	-	1	1	2
	P	3	-	1	1	1
	VP	7	-	-	-	-
	Totals	17	2	4	5	6
Totals, all species		90	25	39	44	57

[6] VG = very good; G = good; Fair = fair; Poor = poor; VP = very poor.

The following tabulation summarizes the number of identical residual trees of all species by quality ratings (from table 5):

	Very good		Good		Fair		Poor		Very poor	
	No.	%	No.	%	No.	%	No.	%	No.	%
Trees on plot	35	100	17	100	17	100	8	100	13	100
Identical trees left by:										
All Markers	17	49	6	35	2	12	-	0	-	0
Geneticists	25	71	8	47	5	29	1	12	-	0
7 to 9 markers	30	86	9	53	4	23	1	12	-	0
5 to 9 markers	35	100	10	59	10	59	2	25	-	0

The fact that a majority (five to nine) of the markers left all (100 percent) of the trees rated as "very good" by Bennett and Armstrong indicates a majority agreement on the best trees on this plot. The number of identical trees marked by the three geneticists, whose major interest in marking was to preserve the best phenotypes, were intermediate between the markings by all nine and by seven to nine of the markers Since spacing requirements make it impossible to leave all of the best phenotypes in the residual stand, the 71 percent agreement by the three geneticists on the "very good" quality rating probably indicates their general agreement with the majority evaluation of tree quality.

Our last comparison, presented in the following tabulation, shows practically no difference between the average phenotypic rating of "very good" and "good" trees left in the residual stand by foresters in the four occupational categories:

Occupational category	Marker	Very Good	Good
		Number	Number
Public service foresters; employed in management of public lands.	Stotz	32	10
	Ibberson	33	13
	Averages	32.5	11.5
Silviculturists; employed in research and teaching	Hough	32	13
	Heiberg	33	10
	Averages	32.5	11.5
Forest geneticists; employed in research	Mergen	35	11
	Heimburger	27	11
	Schreiner	33	11
	Averages	31.7	11.0
Industry foresters; employed in management of private lands	Bennett	30	14
	Peterson	33	9
	Averages	31.5	11.5

Many more comparisons are possible, but from the comparisons presented in this summary it appears that genetical mass selection cannot go beyond a good silvicultural marking at the present time It is also apparent that "genetical markings" will be possible only when forest genetics research has provided much more precise information on the mode of inheritance in our important forest tree species. Sound criteria for genotypic, rather than phenotypic excellence are required for a truly genetical marking.