Forestry

Reference Handbook

by

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IOWA STATE UNIVERSITY
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DNR

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Textural Classification of Soils[10]

Soil texture refers to the relative proportions of sand, silt, and clay particles that make up the soil mass. The chart below shows the percentage of these soil fractions in the basic textural grades.

Three classifications — sandy loam, loam, and silt loam — are common surface soils; they also may occur as subsoils. The rest of the classifications are subsoils.

Sand (Percent)
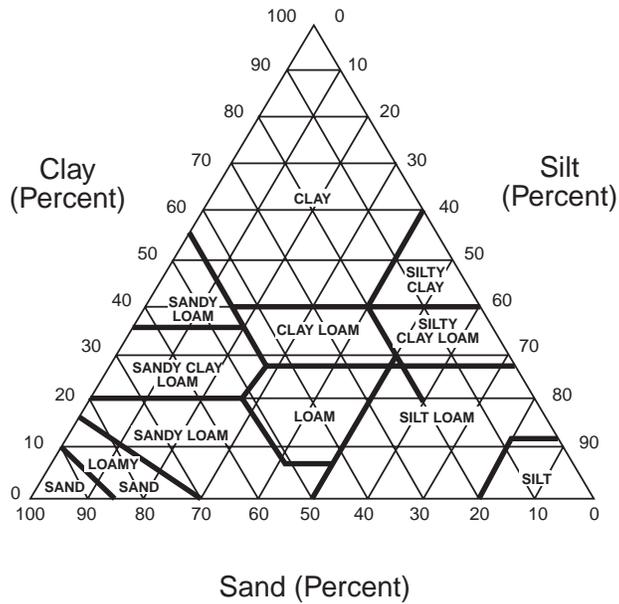
Silvical Characteristics of Common Trees in Iowa

SPECIES	TOLERANCE	GROWTH	LIFE SPAN	REPROD.	SITE*	SOIL*	PESTS	OTHER
Ash, Green	intermediate	fast	medium	easy	B, U	M, W	minor	
Ash, White	tolerant	fast	medium	easy	U	M	ash yellows	
Aspen	very intolerant	fast	short	easy	U	D,MS,W		root sprouts
Basswood	tolerant	fast	medium	medium	U	M,MS		stump sprouter
Birch, River	tolerant	medium	medium	medium	B	MS,W		
Birch, White	intolerant	fast	medium	easy	U	D,MS	Birch Borer	
Black Cherry	intolerant	fast	medium	easy	U	D,M,MS		seed accumulation
Cottonwood	very intolerant	very fast	medium	easy	B	MS,W		
Elm, Red	tolerant	fast	medium	easy	U	MS	Dutch elm	somewhat resistant
Elm, White	intermediate	fast	medium	easy	B, U	MS,W	Dutch elm	most die young
Hackberry	tolerant	medium	medium	easy	B, U	M,MS,W		upland invader
Hickory, Bitternut	very tolerant	fast	short	easy	U	M,MS	borers	often dies at pole size
Hickory, Shagbark	intermediate	slow	medium	easy	U	D,M		
Hybrid Poplar	very intolerant	very fast	short-medium	cuttings	B, U	M,MS		select clones only
Ironwood	very tolerant	slow	medium	easy	U	M,MS		persists understory
Locust, Black	very intolerant	fast	medium	easy	U	M,MS		root sprouts
Locust, Honey	intolerant	fast	medium	easy	B, U	M,MS	locust borer	pasture invader
Maple, Boxelder	tolerant	fast	medium	easy	B, U	M,MS,W		aggressive invader
Maple, Silver (soft)	intermediate	fast	medium	easy	B	MS,W		
Maple, Sugar (hard)	very tolerant	medium	long	easy	U	M,MS		climax species

* B=bottomland sites, U=upland sites
** D=dry sites, M=medium, MS=moist, W=wet

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Silvical Characteristics of Common Trees in Iowa (cont.)

SPECIES	TOLERANCE	GROWTH	LIFE SPAN	REPROD.	SITE*	SOIL*	PESTS	OTHER
Oak, Black	intolerant	fast	long	medium	U	D,M	oak wilt	resprouts well
Oak, Bur	intolerant	slow	very long	medium	U	D,M		Savanna species
Oak, Pin	intolerant	medium	medium	medium	B, U	D,M,MS	oak wilt	
Oak, Red	intolerant	slow	long	difficult	U	M,MS	oak wilt	
Oak, White	intolerant	slow	vert long	difficult	U	D,M,MS		most shade tolerant
Pine, Jack	very intolerant	fast	short		U	D		driest sites
Pine, Red	intolerant	fast	medium		U	D,M,MS	some	
Pine, Scotch	intolerant	medium	medium		U	D,M,MS	several	least deer browse
Pine, White	intermediate	slow	medium	difficult	U	M,MS	blister rust	most deer browse
Spruce, White	tolerant	slow	medium		U	M,MS	mites, cankers	
Spruce, Norway	intermediate	medium	medium		U	M,MS	mites, cankers	
Spruce, Blue	intolerant	slow	medium		U	D,M	mites, cankers	
Walnut, Black	intolerant	fast	long	medium	B, U	M,MS		most valuable
Walnut, White	intolerant	fast	medium	medium	U	M,MS	decline	species will be lost

* B=bottomland sites, U=upland sites
** D=dry sites, M=medium, MS=moist, W=wet

Cottonwood Site Index[14]

Total Height (Feet) vs Total Age (Years). Curves labeled by Site Index: 120, 110, 100, 90, 80.
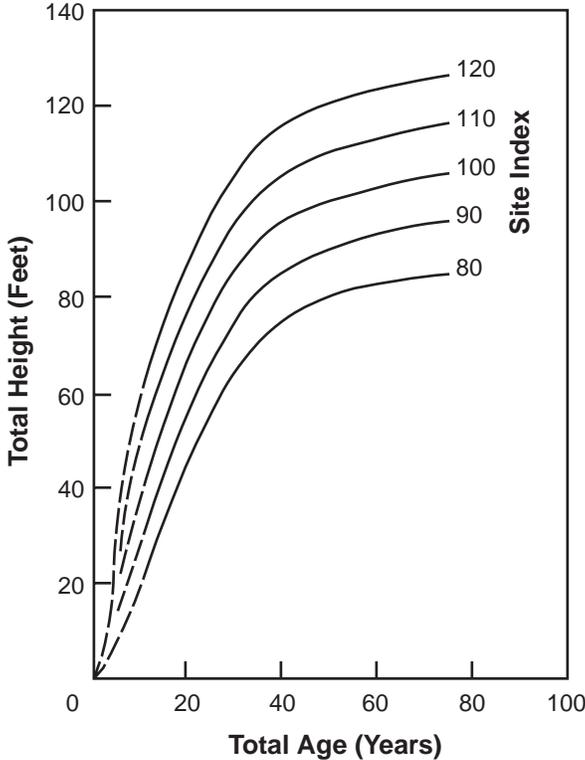
Cottonwood Yield in Board Feet per Acre, International Log Rule, ($\frac{1}{4}$-inch kerf)[14]

Total age, years	Yield per acre by site index				
	80	90	100	110	120
15	200	290	370	455	530
20	1880	2665	3440	4190	4915
25	4800	6805	8790	10695	12550
30	6530	9250	11950	14545	17065
35	7770	11015	14230	17320	20320
40	8635	12240	15810	19245	22575
45	9295	13175	17020	20715	24300
50	9780	13860	17900	21790	25565
55	10135	14365	18555	22585	26495
60	10415	14760	19065	23205	27225
65	10645	15085	19485	23715	27820
70	10770	15265	19715	24000	28155
75	10885	15425	19925	24255	28450

Silver Maple Site Index[14]

Chart: Silver Maple Site Index[14]. X-axis: Total Age (Years), ranging from 0 to 100. Y-axis: Total Height (Feet), ranging from 0 to 120. Curves labeled by Site Index: 100, 90, 80, 70, 60.
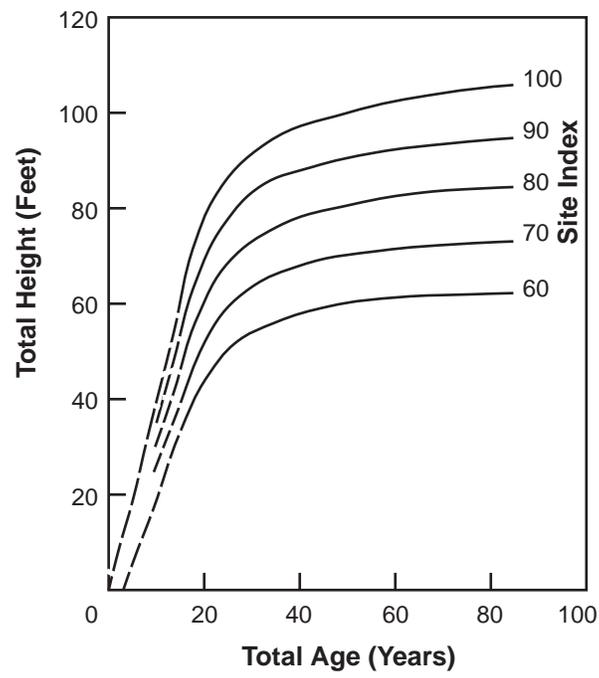
Silver Maple Yield in Board Feet per Acre, International Log Rule, ($\frac{1}{4}$-inch kerf)[14]

Total age, years	Yield per acre by site index classes				
	60	70	80	90	100
20	770	1200	1620	2050	2480
25	1455	2260	3055	3870	4675
30	2140	3320	4485	5685	6870
35	2780	4315	5830	7585	8920
40	3395	5275	7125	9025	10905
45	3945	6130	8280	10490	12675
50	4480	6960	9400	11910	14385
55	4975	7725	10435	13220	15970
60	5335	8290	11195	14180	17135
65	5600	8700	11750	14885	17985
70	5820	9040	12210	15470	18690
75	6005	9330	12660	15965	19285
80	6175	9590	12950	16410	19825
85	6285	9760	13180	16700	20180

Oak Site Index[14]
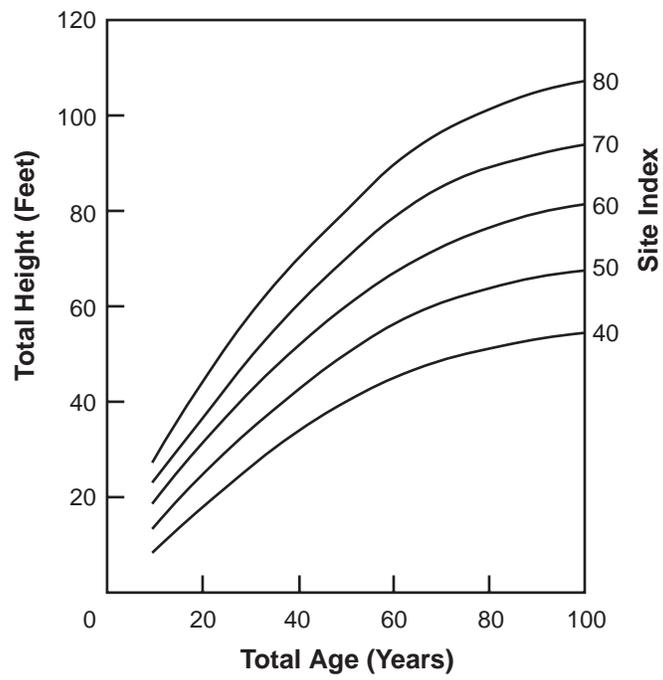
Oak Yield in Board Feet per Acre,
International Log Rule, (¹⁄₄-inch kerf)[14]

Total age, years	Yield per acre by site index				
	40	50	60	70	80
15	0	0	0	0	50
20	0	0	0	150	350
25	0	0	300	700	1450
30	100	350	850	1750	3350
35	300	800	1900	3550	5950
40	600	1400	3200	5500	8600
45	950	2250	4700	7650	11200
50	1400	3250	6300	9750	13750
55	2000	4350	8000	11850	16250
60	2700	5600	9700	13900	18600
65	3450	6900	11300	15800	20900
70	4250	8150	12800	17700	23100
75	5100	9300	14200	19500	25200
80	5900	10450	15650	21200	27250
85	6750	11550	17000	22900	29150
90	7600	12600	18300	24500	30950
95	8350	13800	19600	26100	32700
100	9200	14700	20900	27650	34400

Sugar Maple Site Index[10]

Chart: X-axis labeled "Total Age (Years)" ranging 0 to 80; Y-axis labeled "Total Height (Feet)" ranging 20 to 120. Five curves labeled 80, 70, 60, 50, 40 at right.
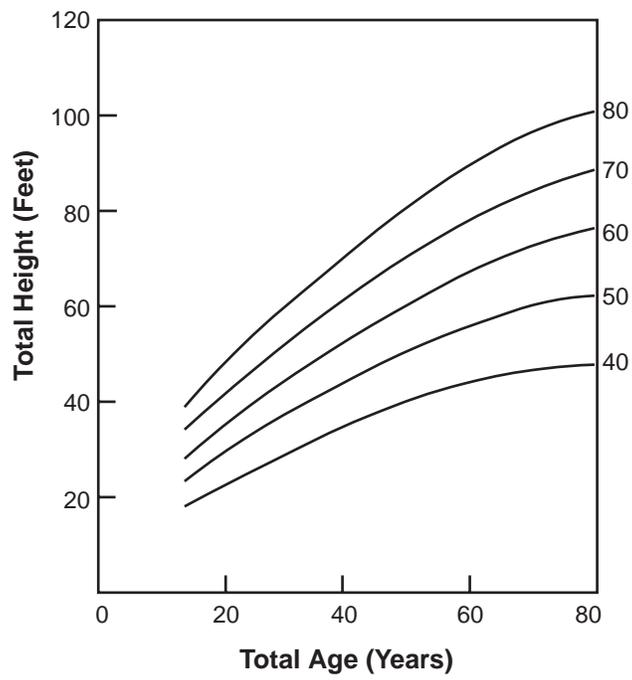
Black Cherry Site Index[10]

Figure axes: Total Height (Feet) vs. Total Age (Years), with site index curves labeled 110, 100, 90, 80, 70, 60, 50, 40.

White Pine Site Index[10]

Chart with axes: Total Height (Feet) on the y-axis ranging from 20 to 120; Total Age (Years) on the x-axis ranging from 20 to 120; Site Index on the right y-axis. Curves labeled 80, 70, 60, 50, 40.
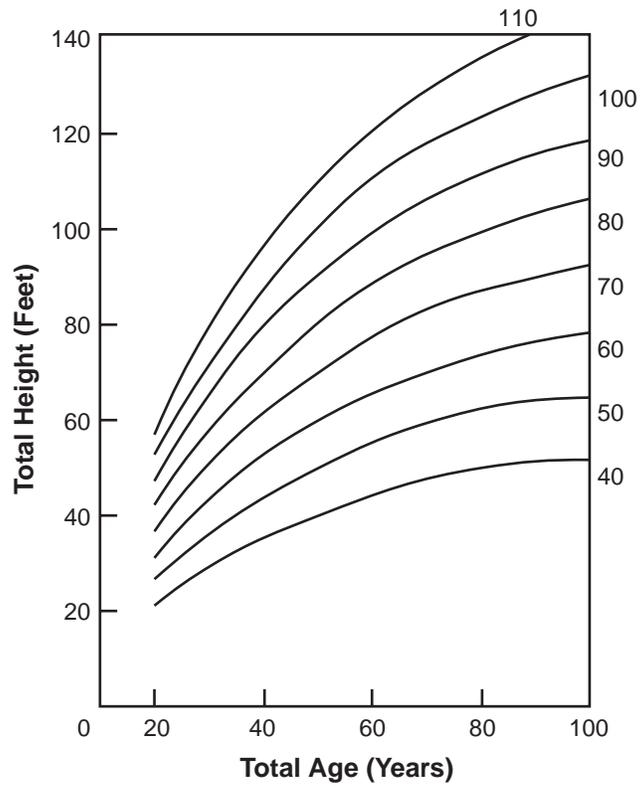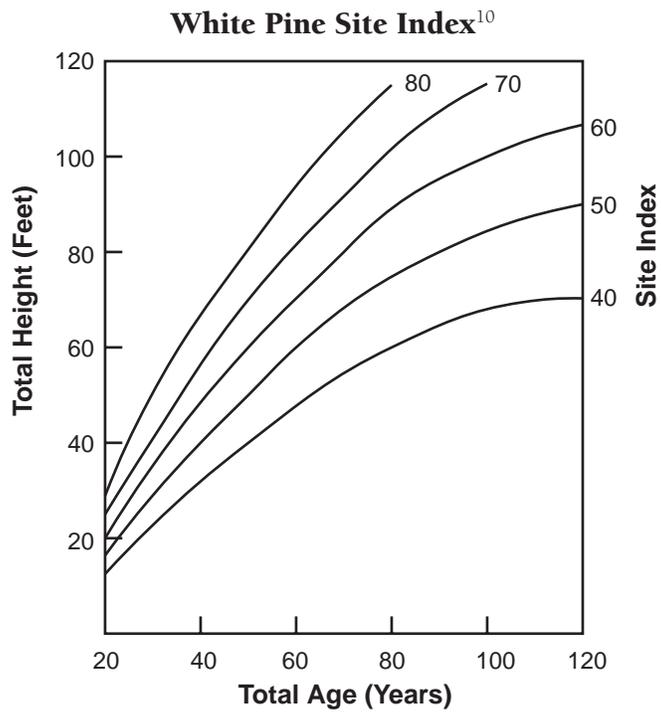
Eastern Red Cedar Site Index[1]
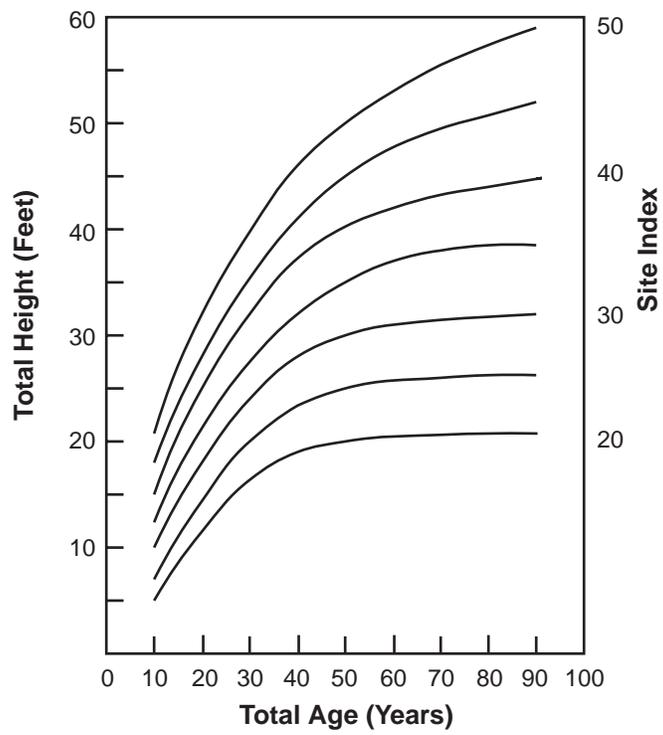
**Diameter at Breast Height and
Stump Diameter Relationship**[a, 5]

Stump[b] diameter (inches)	Diameter breast height	
	Softwoods	Hardwoods
4.0	3	3
5.0	4	4
6.0	5	5
7.0	6	6
8.0	6	7
9.0	7	7
10.0	8	8
11.0	9	9
12.0	10	10
13.0	11	11
14.0	12	12
15.0	13	13
16.0	14	14
17.0	15	14
18.0	15	15
19.0	16	16
20.0	17	17
21.0	18	18
22.0	19	19
23.0	20	20
24.0	21	21
25.0	22	21
26.0	23	22
27.0	23	23
28.0	24	24
29.0	25	25
30.0	26	26
31.0	27	27
32.0	28	28
33.0	29	28
34.0	30	29
35.0	31	30
36.0	32	31

[a] Data were collected in 1956 and 1957 in Minn.
[b] Stump diameters were measured at 12" above ground level
  for sawtimber and 6" above ground level for smaller trees.
Note: Broken line separates sawtimber size from poletimber and sapling sizes. *17*

Quick Cruise Computer[8]

Volume - Board Feet - Int.
(1 log = 16 ft)

Basal Area (Sq. Ft.)

Volume (Thousand Board Feet)

1 log
1.5 logs
2 logs
2.5 logs
3 logs
3.5 logs
4 logs
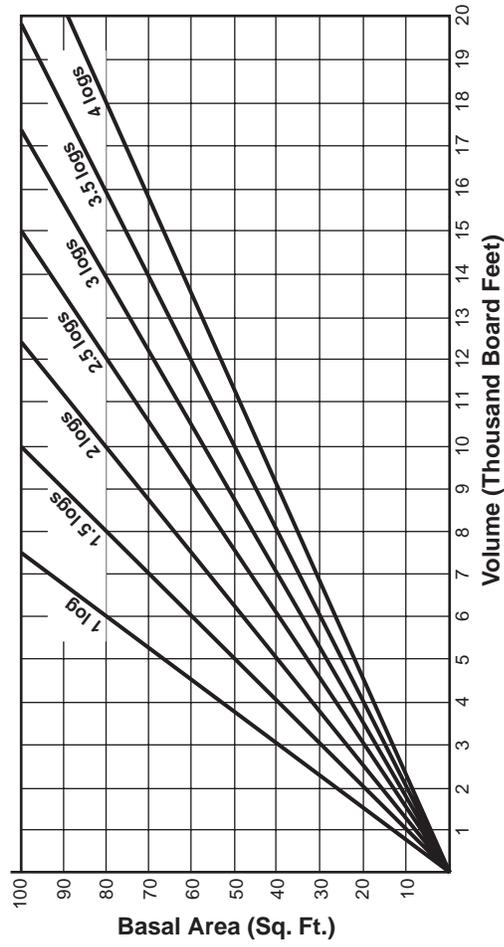
Note: At a height of 1.5 logs, each 10 feet of Board Area = 1,000 Board Feet.

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Quick Cruise Computer[8]

Volume - Cords
(1 stick = 8 ft.)

Basal Area (Sq. Ft.): 100, 90, 80, 70, 60, 50, 40, 30, 20, 10

1 stick
2 sticks
3 sticks
4 sticks
5 sticks
6 sticks
7 sticks

Volume (Cords): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50
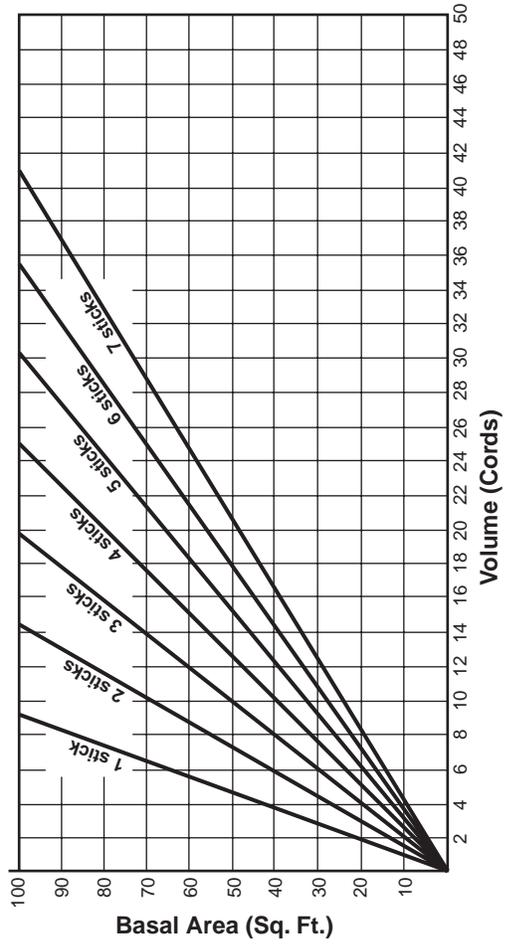
Volume Distribution in Percent[10]

Feet	1	2	3	4	5	6	7	8
60-64								2
56-60								3
52-56							3	4
48-52							3	4
44-48						5	4	4
40-44						5	5	5
36-40					7	6	6	6
32-36					7	7	7	6
28-32				9	8	7	7	6
24-28				10	9	8	7	7
20-24			13	11	9	9	8	8
16-20			14	11	10	9	9	8
12-16		21	15	12	11	9	9	8
8-12		23	17	14	12	11	10	9
4-8	39	26	19	16	13	12	11	10
0-4	61	30	22	17	14	12	11	10

Merchantable Height – 8' Sections

Gross Tree Volume
Board Feet, Scribner Rule[6]

Diameter Breast High (inches)	Number of 16-Foot Logs							
	½	1	1½	2	2½	3	3½	4
	Contents in Board Feet*							
12	28	48	66	78				
14	40	70	96	116	141	160		
16	54	93	129	158	191	224	248	263
18	72	122	168	207	248	292	325	355
20	90	156	212	262	317	366	415	450
22	111	194	262	328	392	450	510	560
24	137	236	319	400	470	550	620	690
26	165	281	381	480	565	650	740	820
28	195	331	450	560	670	760	860	960
30	227	383	529	650	770	890	1000	1110
32	260	440	600	740	890	1020	1150	1280
34	294	500	680	840	1010	1160	1300	1560
36	330	565	770	960	1140	1310	1480	1650
38	365	630	860	1070	1270	1470	1660	1840
40	405	700	950	1180	1400	1630	1850	2050

*Volume to a minimum top diameter (inside bark) of 8.0 inches.

Gross Tree Volume
Board Feet, International ¼ Inch[8]

Diameter Breast High (inches)	Number of 16-Foot Logs							
	½	1	1½	2	2½	3	3½	4
	Contents in Board Feet							
12	30	60	80	100	120			
14	40	80	110	140	160	180		
16	60	100	150	180	210	250	280	310
18	70	140	190	240	280	320	360	400
20	90	170	240	300	350	400	450	500
22	110	210	290	360	430	490	560	610
24	130	250	350	430	510	590	660	740
26	160	300	410	510	600	700	790	880
28	190	350	480	600	700	810	920	1020
30	220	410	550	690	810	930	1060	1180
32	260	470	640	790	940	1080	1220	1360
34	290	530	730	900	1060	1220	1380	1540
36	330	600	820	1010	1200	1380	1560	1740
38	370	670	910	1130	1340	1540	1740	1940
40	420	740	1010	1250	1480	1700	1920	2160
42	460	820	1100	1360	1610	1870	2120	2360

Gross Tree Volume
Board Feet, Doyle

Diameter Breast High (inches)	Number of 16-Foot Logs							
	½	1	1½	2	2½	3	3½	4
	Contents in Board Feet							
12	20	30	40	50	60			
14	30	50	70	80	90	100		
16	40	70	100	120	140	160	180	190
18	60	100	130	160	200	220	240	260
20	80	130	180	220	260	300	320	360
22	100	170	230	280	340	380	420	460
24	130	220	290	360	430	490	540	600
26	160	260	360	440	520	590	660	740
28	190	320	430	520	620	710	800	880
30	230	380	510	630	740	840	940	1040
32	270	440	590	730	860	990	1120	1220
34	300	510	680	850	1000	1140	1300	1440
36	350	580	780	970	1140	1310	1480	1640
38	390	660	880	1100	1290	1480	1680	1860
40	430	740	990	1230	1450	1660	1880	2080
42	470	830	1100	1370	1620	1860	2100	2320

Gross Tree Volume
Rough Cords[6]

Diameter Breast High (inches)	Number of 8-Foot Bolts							
	1	2	3	4	5	6	7	8
	Contents in Cords*							
4	**.007**	**.011**						
6	.017	.028	.040	**.047**				
8	.031	.050	.068	.087	.106	**.116**		
10	.049	.082	.111	.133	.160	.188	**.211**	
12	.070	.121	.165	.198	.225	.260	.300	**.330**
14	.095	.167	.228	.273	.311	.353	.400	.470
16	.122	.220	.300	.367	.420	.470	.530	.590
18	.155	.282	.382	.470	.550	.600	.650	.730
20	.194	.353	.480	.590	.680	.760	.810	.890
22	.240	.440	.600	.730	.840	.930	1.000	1.070
24	.288	.520	.720	.880	1.000	1.120	1.210	1.280
26	.340	.620	.840	1.040	1.190	1.330	1.440	1.510
28	.388	.720	.970	1.200	1.380	1.550	1.670	1.760
30	.430	.800	1.100	1.370	1.590	1.700	1.930	2.040

*The bold figures in the upper portion of the table are to a minimum top diameter (inside bark) of 3.0 inches. Other top diameters are to a minimum of 4.0 inches.

Volume of Firewood in Cords for the Tops of Red Oak Trees[3]

Diameter Breast High (inches)	Length of Stem Removed (feet)	Total Height (feet)					
		40	50	60	70	80	90
12	8	.16	.20	.24	.28		
	16		.16	.20	.24		
14	8	.20	.26	.31	.36	.42	
	16	.14	.20	.25	.30	.36	
	24		.14	.19	.25	.30	
16	8	.25	.32	.39	.46	.53	.60
	16	.17	.24	.31	.38	.46	.53
	24		.17	.24	.31	.38	.45
	32			.16	.23	.30	.37
18	8	.30	.39	.48	.57	.66	.75
	16	.21	.30	.39	.48	.57	.65
	24		.20	.29	.38	.47	.56
	32			.19	.28	.37	.46
	40				.18	.27	.36
20	16		.36	.47	.58	.69	.80
	24		.24	.35	.46	.57	.68
	32			.23	.34	.45	.56
	40				.22	.33	.44
22	16		.42	.56	.69	.82	.96
	24		.28	.41	.54	.68	.81
	32			.27	.40	.53	.67
	40				.25	.39	.52
24	16		.49	.65	.81	.97	1.13
	24		.32	.48	.64	.80	.96
	32			.31	.47	.63	.79
	40				.29	.45	.61
26	24		.37	.56	.74	.93	1.12
	32			.35	.54	.73	.91
	40				.34	.53	.71
28	24			.64	.86	1.07	1.29
	32			.40	.62	.84	1.05
	40				.39	.60	.82

Volume of Firewood in Cords for the Tops of White Oak Trees[3]

Diameter Breast High (inches)	Length of Stem Removed (feet)	Total Height (feet)					
		40	50	60	70	80	90
12	8	.04	.10	.16	.22		
	16		.06	.11	.17		
14	8	.11	.19	.27	.35	.43	
	16	.05	.13	.21	.29	.37	
	24		.07	.15	.23	.31	
16	8	.19	.29	.39	.50	.60	.70
	16	.11	.21	.32	.42	.52	.63
	24		.14	.24	.34	.45	.55
	32			.16	.27	.37	.47
18	8	.28	.41	.54	.67	.80	.93
	16	.18	.31	.44	.57	.70	.83
	24		.21	.34	.47	.61	.74
	32			.25	.38	.51	.64
	40				.28	.41	.54
20	16		.42	.58	.74	.90	1.06
	24		.30	.46	.62	.78	.94
	32			.34	.50	.66	.82
	40				.38	.54	.70
22	16		.54	.73	.93	1.12	1.32
	24		.39	.59	.78	.98	1.17
	32			.44	.64	.83	1.03
	40				.49	.69	.88
24	16		.67	.90	1.13	1.36	1.59
	24		.50	.73	.96	1.19	1.42
	32			.55	.79	1.02	1.25
	40				.61	.85	1.08
26	24		.61	.88	1.15	1.42	1.69
	32			.68	.95	1.22	1.49
	40				.75	1.02	1.29
28	24			1.04	1.36	1.67	1.99
	32			.81	1.12	1.44	1.75
	40				.89	1.20	1.52

Scribner Decimal C Log Scale[12]

(In Tens — i.e., 0 omitted)

Dia.* (in.)	Contents in Bd. Ft. of Logs of Length (feet)									
	6	8	10	12	14	16	18	20	22	24
8	1	1	2	2	2	3	3	3	4	4
9	1	2	3	3	3	4	4	4	5	6
10	2	3	3	3	4	6	6	7	8	9
11	2	3	4	4	5	7	8	8	9	10
12	3	4	5	6	7	8	9	10	11	12
13	4	5	6	7	8	10	11	12	13	15
14	4	6	7	9	10	11	13	14	16	17
15	5	7	9	11	12	14	16	18	20	21
16	6	8	10	12	14	16	18	20	22	24
17	7	9	12	14	16	18	21	23	25	28
18	8	11	13	16	19	21	24	27	29	32
19	9	12	15	18	21	24	27	30	33	36
20	11	14	17	21	24	28	31	35	38	42
21	12	15	19	23	27	30	34	38	42	46
22	13	17	21	25	29	35	38	42	46	50
23	14	19	23	28	33	38	42	47	52	57
24	15	21	25	30	35	40	45	50	55	61
25	17	23	29	34	40	46	52	57	63	69
26	19	25	31	37	44	50	56	62	69	75
27	21	27	34	41	48	55	62	68	75	82
28	22	29	36	44	51	58	65	73	80	87
29	23	31	38	46	53	61	68	76	84	91
30	25	33	41	49	57	66	74	82	90	99
31	27	36	44	53	62	71	80	89	98	106
32	28	37	46	55	64	74	83	92	101	110
33	29	39	49	59	69	78	88	98	108	118
34	30	40	50	60	70	80	90	100	110	120
35	33	44	55	66	77	88	98	109	120	131
36	35	46	58	69	81	92	104	115	127	138
37	39	51	64	77	90	103	116	129	142	154
38	40	54	67	80	93	107	120	133	147	160
39	42	56	70	84	98	112	126	140	154	168
40	45	60	75	90	105	120	135	150	166	181

*Inside bark, small end.

International 1/4 Inch Log Scale[8]

Diameter* (inches)	Length of Log (feet)					
	6	8	10	12	14	16
	Contents in Board Feet					
8	10	15	20	25	35	40
9	15	20	30	35	45	50
10	20	30	35	45	55	65
11	25	35	45	55	70	80
12	30	45	55	70	85	95
13	40	55	70	85	100	115
14	45	65	80	100	115	135
15	55	75	95	115	135	160
16	60	85	110	130	155	180
17	70	95	125	150	180	205
18	80	110	140	170	200	230
19	90	125	155	190	225	260
20	100	135	175	210	250	290
21	115	155	195	235	280	320
22	125	170	215	260	305	355
23	140	185	235	285	335	390
24	150	205	255	310	370	425
25	165	220	280	340	400	460
26	180	240	305	370	435	500
27	195	260	330	400	470	540
28	210	280	355	430	510	585
29	225	305	385	465	545	630
30	245	325	410	495	585	675

28   *Inside bark, small end.

Doyle Log Scale[8]

Diameter* (inches)	Length of Log (feet)					
	6	8	10	12	14	16
	Contents in Board Feet					
8	6	8	10	12	14	16
9	9	13	16	19	22	25
10	14	18	23	27	32	36
11	18	25	31	37	43	49
12	24	32	40	48	56	64
13	30	41	51	61	71	81
14	38	50	63	75	88	100
15	45	61	76	91	106	121
16	54	72	90	108	126	144
17	63	85	106	127	148	169
18	74	98	123	147	172	196
19	84	113	141	169	197	225
20	96	128	160	192	224	256
21	108	145	181	217	253	289
22	122	162	203	243	284	324
23	135	181	226	271	316	361
24	150	200	250	300	350	400
25	165	221	276	331	386	441
26	182	242	303	363	424	484
27	198	265	331	397	463	529
28	216	288	360	432	504	576
29	234	313	391	469	547	625
30	254	338	423	507	592	676

*Inside bark, small end.

Firewood
Approximate BTU Content

1 pound of wood = 6,000 - 7,200 BTU
1 pounds of coal = 12,000 BTU
1 pound of fuel oil = 18,000 BTU

General Rule
1 cord of dry wood = 1 ton of coal = 200 gallons of fuel oil

Measurement

1 standard cord (4'x4'x8') = 128 cubic feet
The solid content depends on size and straightness
Large straight sticks — 1 cord = 90 cubic feet
Small crooked sticks — 1 cord = 70 cubic feet
Average — 1 cord = 80 cubic feet

Trees per Cord and Cords per MBF[4]

Diameter Breast High (inches)	Number of Trees per Cord	Cords per 1,000 Board Feet		
		Int. 1/4	Scribner	Doyle
5	46	--	--	--
6	21	--	--	--
7	15	--	--	--
8	10	4.0	4.4	6.8
9	8	3.7	4.1	6.8
10	6	3.4	3.8	6.8
11	5	3.2	3.6	6.3
12	4	2.9	3.4	6.2
13	--	2.7	3.2	5.2
14	--	2.5	3.0	4.5

Firewood Facts[4]

Species	Weight (lbs./Cord)		Heat/Cord (Million BTU's) (20% M.C.)	Fuel Oil Equivalent (gallon)*
	Green	Dry		
Apple	4,850	3,888	27.0	193
Ash, Green	4,184	2,880	20.0	143
Ash, White	3,952	3,472	24.2	173
Basswood	4,404	1,984	13.8	99
Birch, Paper	4,312	2.992	20.8	149
Boxelder	3,589	2,632	18.3	131
Buckeye, Ohio	4,210	1,984	13.8	99
Catalpa	4,560	2,360	16.4	117
Cherry, Black	3,696	2,928	20.4	146
Coffeetree, Kentucky	3,872	3,112	21.6	154
Cottonwood	4,640	2,272	15.8	113
Elm, American	4,456	2,872	20.0	143
Elm, Red	4,800	3,112	21.6	154
Elm, Siberian	3,800	3,020	20.9	149
Hackberry	3.984	3,048	21.2	151
Hickory, Bitternut	5,032	3,832	26.7	191
Hickory, Shagbark	5,104	3,952	27.5	196
Honeylocust	4,640	3,832	26.7	191
Ironwood	4,590	4,016	27.9	199
Locust, Black	4,616	4,016	27.9	199
Maple, Other	4,685	3,680	25.5	182
Maple, Silver	3,904	2,752	19.0	136
Mulberry	4,712	3,712	25.8	184
Oak, Bur	4.960	3,768	26.2	187
Oak, Red	4,888	3,529	24.6	176
Oak, White	5,573	4,200	29.1	208
Osage-Orange	5,120	4,728	32.9	235
Pine, Eastern White	2,780	2,250	15.6	111
Pine, Jack	3,200	2,488	17.2	123
Redcedar, Eastern	2,950	2,632	18.2	130
Spruce	2,800	2,240	15.5	111
Sycamore	5,096	2,808	19.5	139
Walnut, Black	4,584	3,192	22.2	159
Willow	4,320	2,540	17.6	126

*140,000 BTU per gallon of fuel oil.

Fuel Required for Heat Equivalent to
1,000 Cubic Feet of Natural Gas[4]

Natural gas (77.8% Eff.)* .... 1,000 ft.^{3}
Butane gas (79.0% Eff.) .... 10.20 ga.
Propane gas (78.7% Eff.) .... 11.04 gal.
#2 Fuel oil (82.5% Eff.) .... 6.73 gal.
#4 Fuel oil (82.5% Eff.) .... 6.50 gal.
#6 Fuel oil (82.5% Eff.) .... 6.29 gal.
Electricity (90.0% Eff.) .... 253.26 kWh
Bituminous coal (85.0% Eff.) .... 0.034 tons
Lignite or sub-bituminous coal (80.0% Eff.) .... 0.057 tons
Oven-dry wood (80.08% Eff.) .... 0.56 tons
Planer shavings (15% MC, 78.08% Eff.) .... 0.067 tons
                (30.0% MC, 76.08% Eff.) .... 0.077 tons
                (40.0% MC, 74.74% Eff.) .... 0.085 tons
Chips,   (50.0% MC, 73.40% Eff.) .... 0.092 tons
sawdust,   (60.0% MC, 72.07% Eff.) .... 0.100 tons
and bark   (70.0% MC, 70.73% Eff.) .... 0.109 tongs
                (80.0% MC, 69.39% Eff.) .... 0.117 tons
                (90.0% MC, 68.08% Eff.) .... 0.126 tons
                (100.0% MC, 66.72% Eff.) ...... 0.136 tons

*Assumed net boiler efficiencies.

Board Foot Content of Lumber[4]

Board Size	Board Length (Feet)				
(Inches)	8	10	12	14	16
1x4	2.67	3.33	4	4.67	5.33
1x6	4	5	6	7	8
1x8	5.33	6.67	8	9.33	10.67
1x10	6.67	8.33	10	11.67	13.33
1x12	8	10	12	14	16
2x4	5.33	6.67	8	9.33	10.67
2x6	8	10	12	14	16
2x8	10.67	13.33	16	18.67	21.33
2x10	13.33	16.67	20	23.33	26.67
2x12	16	20	24	28	32
3x4	8	10	12	14	16
3x6	12	15	18	21	24
3x8	16	20	24	28	32
3x10	20	25	30	35	40
3x12	24	30	36	42	48
4x4	10.67	13.33	16	18.67	21.33
4x6	16	20	24	28	32
4x8	21.33	26.67	32	37.33	42.67
4x10	26.67	33.33	40	46.67	53.33
4x12	32	40	48	56	64
6x6	24	30	36	42	48
6x7	28	35	42	49	56
6x8	32	40	48	56	64
6x10	40	50	60	70	80
6x12	48	60	72	84	96
7x9	42	52.5	63	73.5	84
8x8	42.67	53.33	64	74.67	85.33
8x10	53.33	66.67	80	93.33	106.67
8x12	64	80	96	112	128
10x10	66.67	83.33	100	116.67	133.33
10x12	80	100	120	140	160

Weight Table for Various Woods[8]

Species	Weight per 1000 Board Feet of Green Lumber (Pounds)
Ash, White	4,000
Aspen	3,600
Basswood	3,500
Birch, White	4,200
Cedar, Red	3,100
Cedar, Northern White	2,300
Cherry, Black	3,800
Cottonwood	4,100
Elm	4,600
Hackberry	4,200
Hickory	5,300
Locust, Black	4,800
Maple, Hard	4,600
Maple, Soft	3,900
Oak, Red	5,200
Oak, White	5,200
Pine, Red	3,500
Pine, White	3,000
Spruce	2,800
Sycamore	4,300
Walnut, Black	4,800

Species with Heartwood of
High Resistance to Decay[4]

Softwoods (conifers)	Hardwoods
Cedars	Catalpa
Junipers	Locust, Black
Redwood	Mulberry, Red
Yew, Pacific	Osage-Orange
	Walnut, Black

Species with Heartwood of Moderate
to Low Resistance to Decay

Softwoods (conifers)	Hardwoods
Douglas-Fir	Alders
Fires, true	Ashes
Hemlocks	Aspens
Larch, Western	Basswood
Pine, Ponderosa	Beech
Pine, White (several species)	Birches
Pine, Southern Yellow	Butternut
(several species)	Cherry, Black
Spruces	Cottonwoods
Tamarack	Elms
	Hackberry
	Hickory
	Honeylocust
	Maples
	Oaks
	Sycamore
	Willows
	Yellow-Poplar

Causes of Degrade in Air-dried Lumber[4]

To reduce degrade in air-dried hardwood lumber, follow proper stacking and storing principles. Here are types of degrade and causes.

Split:
1. Too few stickers
2. Lack of roofing or poor roofing
3. Stickers not flush with ends of boards

Check:
1. Lack of roofing
2. Board edges exposed at bunk spaces
3. Stickers not flush with ends of boards
4. Drying too rapid due to excessive exposure of lumber stacks

Warp:
1. Poor sticker alignment
2. Poor bunk alignment
3. Lack of sufficient stickers
4. Foundation out of level
5. Thick and thin lumber in same course in stack

Stain:
1. No chemical dip
2. Use of green or wide stickers
3. Base of piles too low
4. Grass and weeds
5. Poor yard location

Growth Factor Table[8]

| Diameter Breast High (inches)	Rings Per Inch											
	4	5	6	7	8	9	10	11	12	13	14	15
4	.282	.225	.188	.161	.141	.125	.113	.102	.094	.087	.080	.075
5	.220	.177	.147	.126	.110	.098	.088	.080	.073	.068	.063	.059
6	.181	.145	.121	.103	.091	.080	.072	.065	.060	.056	.052	.048
7	.153	.123	.103	.088	.077	.068	.061	.056	.051	.047	.044	.041
8	.133	.106	.089	.076	.067	.059	.053	.048	.044	.041	.038	.035
9	.116	.093	.078	.067	.058	.052	.047	.042	.039	.036	.033	.031
10	.105	.084	.070	.060	.053	.047	.042	.038	.035	.032	.030	.028
11	.095	.076	.063	.054	.047	.042	.038	.034	.032	.029	.027	.025
12	.087	.070	.058	.050	.044	.039	.035	.032	.029	.027	.025	.023
13	.080	.064	.053	.046	.040	.035	.032	.029	.027	.025	.023	.021
14	.074	.059	.049	.042	.037	.033	.030	.027	.025	.024	.021	.020
15	.069	.055	.046	.039	.034	.031	.028	.025	.023	.021	.020	.018
16	.064	.052	.043	.037	.032	.029	.026	.023	.021	.020	.018	.017
17	.061	.048	.040	.035	.030	.027	.024	.022	.020	.019	.017	.016
18	.057	.046	.038	.033	.029	.025	.023	.021	.019	.018	.016	.015
19	.054	.043	.036	.031	.027	.024	.022	.020	.018	.017	.015	.014
20	.051	.041	.034	.029	.025	.023	.020	.019	.017	.016	.015	.014
21	.049	.039	.033	.028	.024	.022	.020	.018	.016	.015	.014	.013
22	.046	.037	.031	.027	.023	.021	.019	.017	.015	.014	.013	.012

Procedure

1. Determine GROWTH FACTOR by applying average DBH and average rings per inch to above table.
2. Compute annual rate of growth of BASAL AREA, CORDS, TONS, BOARD FEET (International), or CUBIC FEET by multiplying amount of good growing stock in each category by the GROWTH FACTOR.
3. Multiply GROWTH FACTOR by 100 for growing percent.

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Upland Central Hardwood Stocking Guide[2]
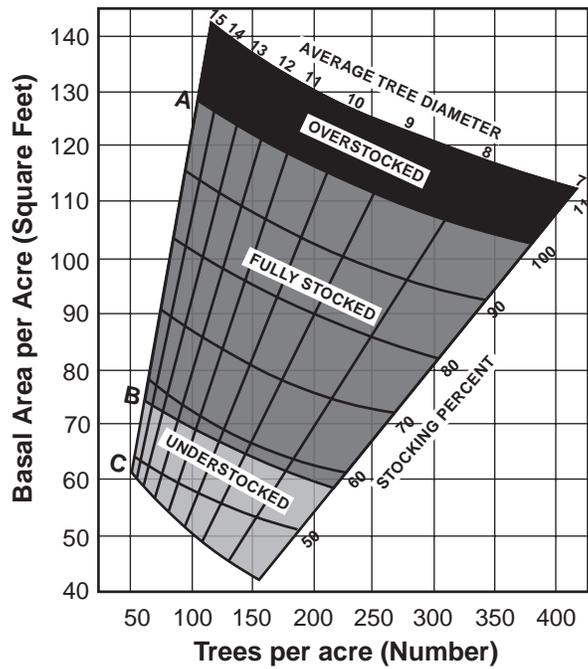
Relation of basal area, number of trees, and average tree diameter to stocking percent for upland central hardwoods. Tree-diameter range 7-3 (page 39). The area between curves A and B indicates the range of stocking and

Upland Central Hardwood Stocking Guide (cont.)[2]
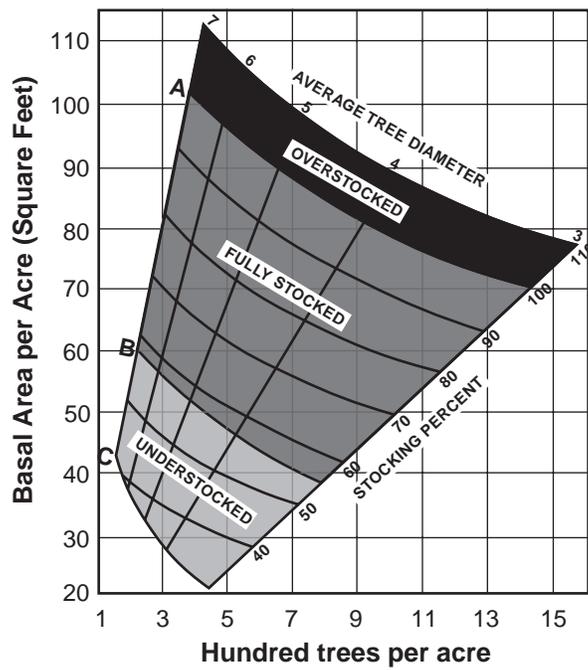
trees can fully utilize the site. Curve C shows the lower limit of stocking necessary to reach the B level in 10 years on average sites. (Average tree diameter is the diameter of the tree of average basal area.)

Central Hardwood Spacing Table[8]

Diameter (Inches)	Maximum Stocking "A"–Level*	Minimum Stocking "B"–Level*
	Spacing (feet)	Spacing (feet)
2	4.6	6.5
3	6.1	8.2
4	7.6	9.9
5	9.0	11.6
6	10.3	13.4
7	11.6	15.0
8	13.0	17.0
9	14.3	18.7
10	15.6	20.4
11	17.0	22.1
12	18.1	23.8
13	19.4	25.6
14	20.8	27.2
15	21.9	29.0

General Rule:

For "A"–level stocking spacing, multiply diameter by 1.5.
For "B"–level stocking spacing, multiply diameter by 2.0.

* "A" and "B" level stocking relate to graphs, pages 38 and 39.
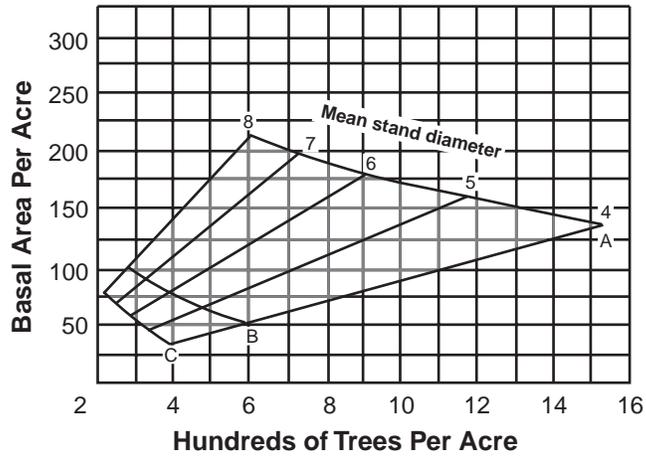
Plantation Black Walnut Stocking Per Acre[7]
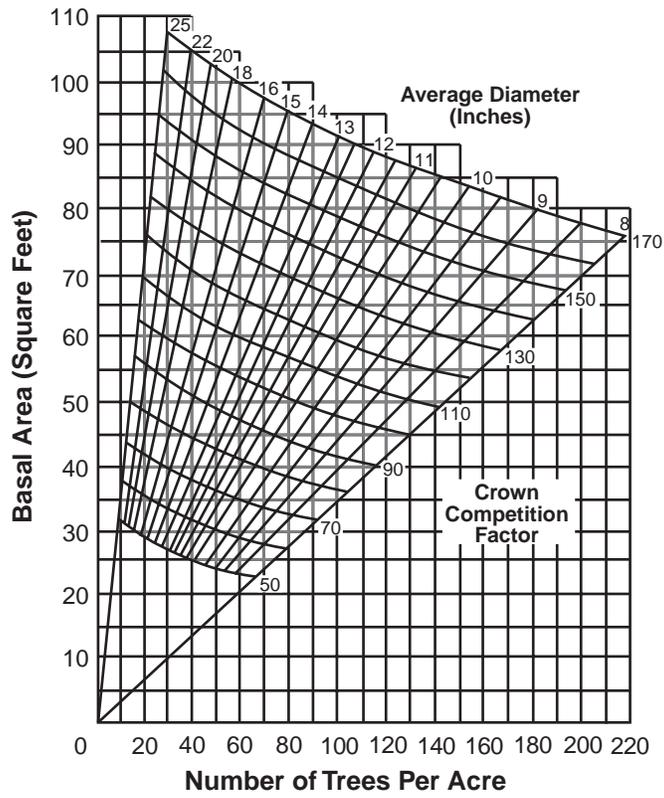
Stocking Levels:
  Low   70   CCF
  High   110   CCF

Plantation Black Walnut Stocking Per Acre (cont.)[7]
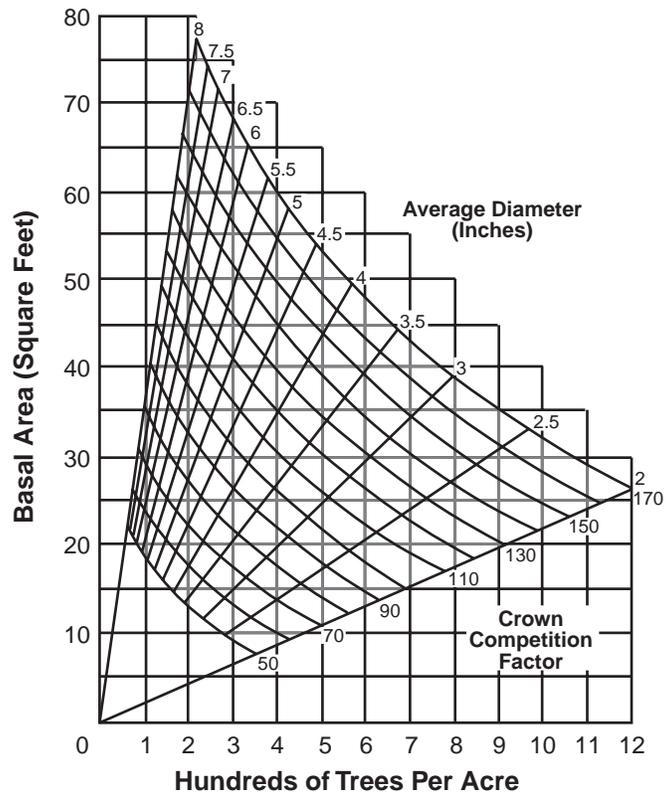
Stocking Levels:
  Low   70 CCF
  High 110 CCF

White Pine Stocking Guide[8]
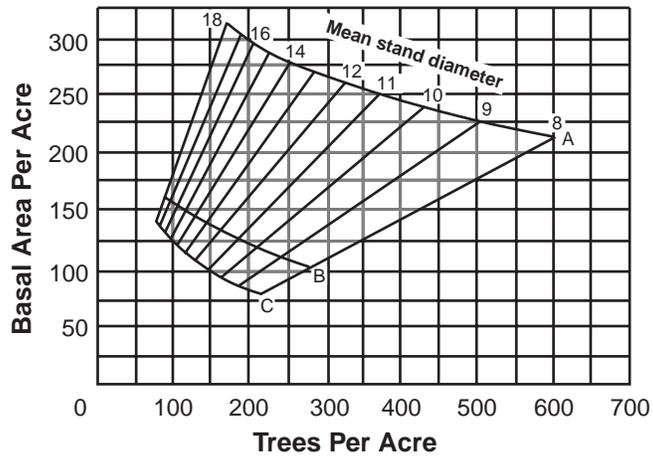
Basal Area Table[8]

Diameter (Inches)	Area (Sq. Ft.)	Diameter (Inches)	Area (Sq. Ft.)
1	.006	21	2.40
2	.022	22	2.64
3	.049	23	2.88
4	.087	24	3.14
5	.136	25	3.41
6	.196	26	3.69
7	.267	27	3.98
8	.349	28	4.28
9	.442	29	4.59
10	.545	30	4.91
11	.660	31	5.24
12	.785	32	5.59
13	.922	33	5.94
14	1.069	34	6.30
15	1.227	35	6.68
16	1.396	36	7.07
17	1.576	37	7.47
18	1.767	38	7.88
19	1.969	39	8.30
20	2.181	40	8.73

Number of Trees Per Acre by Diameter and Basal Area[8]

Basal Area (Square Feet)	Average Diameter															
	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	14"	16"	18"	20"	22"	24"
10	204	115	74	51	38	29	23	18	15	12.7	9.4	7.2	5.7	4.6	3.8	3.2
20	408	230	147	102	75	58	45	37	30	25.5	18.7	14.3	11.3	9.2	7.6	6.4
30	612	345	221	153	112	86	68	55	45	38.2	28.1	21.5	17.0	13.7	11.4	9.5
40	816	460	294	204	150	115	90	73	61	50.9	37.4	28.6	22.6	18.3	15.2	12.7
50	1020	575	368	255	187	143	113	92	76	63.7	46.8	35.8	28.3	22.9	19.0	15.9
60	1225	690	441	306	225	172	136	110	91	76.4	56.1	43.0	34.0	27.5	22.7	19.1
70	1429	805	515	357	262	201	158	128	106	89.1	65.5	50.1	39.6	32.1	26.5	22.3
80	1633	920	588	408	300	229	181	147	121	101.8	74.8	57.3	45.3	36.6	30.3	25.4
90	1835	1034	662	459	337	258	204	165	135	114.6	84.2	64.4	50.9	41.2	34.1	28.6
100	2041	1149	735	510	375	287	226	183	152	127.3	93.5	71.6	56.6	45.8	37.9	31.8

Number of Trees Per Acre by Various Spacings[8]

Spacing (Feet)	Trees (No.)	Spacing (Feet)	Trees (No.)	Spacing (Feet)	Trees (No.)
2x2	10,890	7x10	622	12x20	182
3x3	4,840	7x12	519	12x25	145
4x4	2,722	7x15	415	13x13	258
4x5	2,178	8x8	681	13x15	223
4x6	1,815	8x9	605	13x20	168
4x7	1,556	8x10	544	13x25	134
4x8	1,361	8x12	454	14x14	222
4x9	1,210	8x15	363	14x15	207
4x10	1,089	8x25	218	14x20	156
5x5	1,742	9x9	538	14x25	124
5x6	1,452	9x10	484	15x15	194
5x7	1,245	9x12	403	15x20	145
5x8	1,089	9x15	323	15x25	116
5x9	968	10x10	436	16x16	170
5x10	871	10x12	363	16x20	136
6x6	1,210	10x15	290	16x25	109
6x7	1,037	10x18	242	18x18	134
6x8	908	11x11	360	18x20	121
6x9	807	11x12	330	18x25	97
6x10	726	11x15	264	20x20	109
6x12	605	11x20	198	20x25	87
6x15	484	11x25	158	25x25	70
7x7	889	12x12	302	30x30	48
7x8	778	12x15	242	30x35	41
7x9	691	12x18	202	40x40	27

Seeds per Pound and Bushel[9]

Species	Cleaned Seeds/lb.	Average Cleaned Seeds/lb.	Cleaned Seeds/bushel	Average Cleaned Seeds/bushel
Ash, Black	6,100–9,500	8,100		
Ash, Green	11,000–24,600	17,260		
Ash, White	5,540–18,185	13,120	68,690–225,490	162,680
Birch, River	287,000–548,000	375,000		
Black Cherry	2,800–6,040	4,240		
Black Locust		24,000		
Black Walnut	11–100	40	484–4,400	1,760
Boxelder	8,200–20,400	13,400		
Buckeye, Ohio	48–67	58		
Butternut	15–40	30		
Chokecherry	3,010–8,400	4,790		
Cottonwood	200,000–590,000	350,000		
Dogwood, Gray	10,200–15,300	13,000		
Elm, American	48,000–109,000	70,900		
Elm, Slippery	35,000–54,000	41,000		
Hackberry	3,500–5,400	4,300		
Hawthorn		4,700		
Hazel, American	197–736	491		
Hickory, Bitternut	125–185	156	5,000–7,400	6,240
Hickory, Shagbark	80–150	100	2,720–5,100	3,400
Hickory, Shellbark	25–35	30		
Maple, Silver	900–3200	1,780		
Maple, Sugar	3,200–9,100	7,030		
Oak, Black	125–400	245	6,500–18,000	11,000
Oak, Bur	40–135	75	1,300–4,380	2,960
Oak, Northern Pin	205–290	245		
Oak, White	70–210	120	5,070–15,200	8,700
Oak, Swamp White	90–175	120		
Oak, Red	75–256	125	4,720–16,100	7,870
Redbud	14,000–25,000	18,000		
Sycamore	133,500–267,400	193,270		
Wild Plum	550–1,500	870		

Number of Seed per Acre by Various Spacings

Row Spacing	Seed Spacing in the Row (Inches)			
	6 inch	12 inch	24 inch	36 inch
3 feet	29,040	14,420	7,260	4,840
4 feet	21,780	10,890	5,445	3,630
8 feet	10,890	5,445	2,722	1,815
9 feet	9.680	4,840	2,420	1,630
10 feet	8,712	4,356	2,178	1,452
12 feet	7,260	3,630	1,815	907
15 feet	5,808	2,904	1,452	726

For broadcast seed, count the number of seeds in a milacre plot (diameter of 7 feet 6 inches) and multiply by 1,000 to determine the number of seeds per acre.

Hours Required to Plant 1,000 Trees with Various Tools by Land Conditions[10]

Equipment Used	Land Conditions	Hours Required
Mattock	Rough and rocky	26
Mattock or Bar	Smooth	13
Bar	Light and easy to work	7-10
Machine*	Open and smooth	1.5-3

*500-1,000 trees per machine hour

Estimated Cost per Tree for Pruning Pine[11]

Height (Feet)	Hourly Labor Rate		
	$6.00	**$7.00**	**$8.00**
6	.32	.38	.43
7	.36	.42	.48
8	.40	.47	.53
9	.44	.51	.58
10	.48	.56	.64
11	.56	.65	.74
12	.64	.75	.85
13	.72	.84	.96
14	.81	.95	1.08
15	.96	1.12	1.28
16	1.08	1.26	1.44
17	1.20	1.40	1.60

Estimated Thinning Cost per Square Foot of Basal Area for Young Stands — No Chemical[11]

Height (Feet)	Hourly Labor Rate		
	$6.00	**$7.00**	**$8.00**
2	4.86	5.67	6.48
3	3.30	3.85	4.40
4	2.31	2.70	3.09
5	1.89	2.21	2.53
6	1.47	1.72	1.97
7	1.23	1.44	1.65
8	1.05	1.23	1.41
9	.90	1.05	1.20
10	.81	.96	.99

Compound Interest Table (single payment multiplier)[13]

Years	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	1.040	1.050	1.060	1.070	1.080	1.090	1.100	1.110	1.120	1.130	1.140	1.150
2	1.082	1.103	1.124	1.145	1.166	1.188	1.210	1.232	1.254	1.277	1.300	1.323
3	1.125	1.158	1.191	1.225	1.260	1.295	1.331	1.368	1.405	1.443	1.482	1.521
4	1.170	1.216	1.262	1.311	1.360	1.412	1.464	1.518	1.574	1.630	1.689	1.749
5	1.217	1.276	1.338	1.403	1.469	1.539	1.611	1.685	1.762	1.842	1.925	2.011
6	1.265	1.340	1.419	1.501	1.587	1.677	1.772	1.870	1.974	2.082	2.195	2.313
7	1.316	1.407	1.504	1.606	1.714	1.828	1.949	2.076	2.211	2.353	2.502	2.660
8	1.369	1.477	1.594	1.718	1.851	1.993	2.144	2.305	2.476	2.658	2.853	3.059
9	1.423	1.551	1.689	1.838	1.999	2.172	2.358	2.558	2.773	3.004	3.252	3.518
10	1.480	1.629	1.791	1.967	2.159	2.367	2.594	2.839	3.106	3.395	3.707	4.046
15	1.801	2.079	2.397	2.759	3.172	3.642	4.177	4.785	5.474	6.254	7.138	8.137
20	2.191	2.653	3.207	3.870	4.661	5.604	6.728	8.062	9.646	11.523	13.743	16.367
25	2.666	3.386	4.292	5.427	6.848	8.623	10.835	13.585	17.000	21.231	26.462	32.919
30	3.243	4.322	5.743	7.612	10.063	13.268	17.449	22.892	29.960	39.116	50.950	66.212
35	3.946	5.516	7.686	10.677	14.785	20.414	28.102	38.575	52.800	72.069	98.100	133.176
40	4.801	7.040	10.286	14.974	21.725	31.409	45.259	65.001	93.051	132.782	188.884	267.864

Discount Factors (Single Payment Multiplier)[13]

Years	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	.962	.952	.943	.935	.926	.917	.909	.901	.893	.885	.877	.870
2	.925	.907	.890	.873	.857	.842	.826	.812	.797	.783	.769	.756
3	.889	.864	.840	.816	.794	.772	.751	.731	.712	.693	.675	.658
4	.855	.823	.792	.763	.735	.708	.683	.659	.636	.613	.592	.572
5	.822	.784	.747	.713	.681	.650	.621	.593	.567	.543	.519	.497
6	.790	.746	.705	.666	.630	.596	.564	.535	.507	.480	.456	.432
7	.760	.711	.665	.623	.583	.547	.513	.482	.452	.425	.400	.376
8	.731	.677	.627	.582	.540	.502	.467	.434	.404	.376	.351	.327
9	.703	.645	.592	.544	.500	.460	.424	.391	.361	.333	.308	.285
10	.676	.614	.558	.508	.463	.422	.386	.352	.322	.295	.270	.247
15	.555	.481	.417	.363	.315	.275	.239	.209	.183	.160	.140`	.123
20	.456	.377	.311	.258	.215	.178	.149	.124	.104	.087	.073	.061
25	.375	.295	.233	.184	.146	.116	.092	.074	.059	.047	.038	.030
30	.308	.231	.174	.131	.099	.075	.057	.044	.033	.026	.020	.015
35	.253	.181	.130	.094	.068	.049	.036	.026	.019	.014	.010	.008
40	.208	.142	.097	.067	.046	.032	.022	.015	.011	.008	.005	.004

Economic Formulas

V_n = End Value V_o = Initial Value
r = Interest Rate   n = Number of Years

End value of initial value after a number of years $V_n = V_o(1 + r)^n$
    (Compounding)

Initial value of end sum $V_o = \dfrac{V_n}{(1 + r)^n}$
    (Discounting)

Present Net Value $\sum$ Discounted Revenues - $\sum$ Discounted Costs

Benefit Cost Ratio $\dfrac{\sum \text{Discounted Revenues}}{\sum \text{Discounted Costs}}$

General Rule
Dividing 72 by the interest rate gives the number of years that it takes to double the initial value. For example, at 8%, 72 divided by 8 = 9 years to double the initial value.

Elementary Statistical Considerations
for Cruising[8]

Formulas

1. Mean (M) = $\dfrac{\text{Total for samples}}{\text{Number of samples}}$

2. Standard Deviation (SD) = $\sqrt{\dfrac{\sum X^2 - \dfrac{(\sum X)^2}{N}}{N-1}}$

3. Coefficient of
   Variation (C) = $100 \sqrt{\left(\dfrac{N}{N-1}\right)\left(\dfrac{N\sum X^2}{(\sum X)^2} - 1\right)}$ or $\dfrac{SD}{M}$

4. Limit of Error (E) = $\dfrac{C}{\sqrt{N^*}}$ (number of samples)

5. Number of samples (N) = $\dfrac{C^2}{E^2}$ for 68% accuracy level; or

   $\dfrac{4C^2}{E^2}$ for 95% accuracy level

X = observation
N = population size

Plot Size of Circles and Squares

Area in Acres	Square Dimensions (Feet & Inches)	Square Dimensions (Chains)	Radius of Circle (Feet & Inches)	Radius of Circle (Chains)
1/1,000	6'7"	0.10	3'9"	—
1/300	12'1"	0.18	6'10"	0.10
1/100	20'10"	0.32	11'9"	0.18
1/20	46'8"	0.71	26'4"	0.40
1/10	66'0"	1.00	32'3"	0.56
1/5	93'4"	1.41	52'8"	0.80
1/4	104'4"	1.58	58'10"	0.89
1	208'8"	3.16	117'9"	1.78

Basal Area Determination

Tips on the Use of a Prism

1. Hold prism over sampling point, not the sighting eye.

2. Always hold face of prism at right angle to eyesight.

3. For leaning trees, align vertical axis of prism along slope of the trunk.

4. View hidden trees by moving sideways, but keeping the same distance.

5. For brush, have partner hold brush to one side, cut brush, or sight tree over brush. (If trees is "in" higher up it is "in" at DBH).

6. Correct for slope by rotating prism to the same slope as the topographic slope.

7. Count the number of trees where the portion of the tree offset by the prism overlaps the portion of the tree below the prism at DBH.

8. Multiply the tree count by the prism factor (e.g., 10 for a 10-factor prism) to determine the basal area per acre.

Alternate Technique

1. Hold the sighting eye over the sampling point.

2. A .75 inch wide object (penny, nickel, .75 inch wide black tape, or thumb nail) held 25 inches from your eye approximates a 10-factor prism.

3. Count the number of trees wider than the object.

4. Multiply the tree count by 10 to determine the basal area per acre.

Checklist For Bid Notices and Timber Sale Contracts

1. **Sale Area** — carefully and definitely located.

2. **Price and Payment** — billing, time of payment, stumpage deposit, lump sum price or price on net scale by species. In some cases billing and time of payment are planned so that the amount of timber that is felled and removed does not exceed the stumpage deposit. This provides a lever for contract enforcement, and can eliminate trying to collect from the organization that can't afford to pay "now."

3. **Scaling** — This section on scaling is not necessary for recommended lump sum sales. Log lengths, log rule in use, person scaling, check scaling, payment for scaling. The detailed agreement specifies the log rule to be used, who will scale, and procedure for check scaling.

4. **Status of Purchaser** — specified that the purchaser is an independent contractor and not an employee.

5. **Merchantable Timber** — marked trees and damaged trees, size of merchantable log, top log diameter, penalty payments for unnecessary damage of unmarked trees.

6. **Passage of Title** — when risk of loss passes to purchaser.

7. **Conduct of Operations** — logging plan, fire prevention and control plan, good logging practices, skidroad layout, road and fence maintenance. Avoid the standard contract form; too often such unrealistic phraseology is employed as "perform in a workmanlike manner" or "the timber shall be cut in accordance with sound forestry practices." Such wording is too unspecific to convey the intent of the parties and cannot be enforced.

8. **Right to Stop Work** — when the purchaser fails to perform according to the terms and conditions of the contract.

9. **Liability** — damage by purchaser to property of others, purchaser to indemnify and hold harmless the seller in all cases.

10. **Insurance** — comprehensive liability and workmen's compensation insurance certificates shall be supplied to the seller.

11. **Completion Date**

12. **General** — nonassignment clause, all modifications of agreement to be in writing, specified that time is of the essence.

All provisions listed here will not apply to every timber sale, and other provisions may be included.

The terms of the written contract should be agreed upon and signed by you and the buyer. A written contract alone does not automatically give you a good sale agreement; it is only one part of the formula.

Don't overlook these points in preparing a better sales agreement:

(1) Use a written timber sales contract. Make sure it is a legal document and the forest management specifications are clearly and completely stated.

(2) Make sure there is complete understanding on all phases of the written contract.

Better Sales Supervision

If you've taken care in selecting the logging operator and prepared a good written contract, then the major job left is supervising the sale. Many landowners have omitted supervising the timber sale and have been unhappy with the returns and condition of the forest land after logging. Proper supervision is a must in obtaining better timber sales. Successful supervision includes cooperating and communicating with the logger about the kind of job desired.

For effective supervision, it's important for the landowner and logging operator to have spelled out and agreed on all of the conditions of the sale in the written contract. Supervision then involves making frequent trips to the logging area and checking compliance with the written agreement.

These are important points to consider in better sales supervision:
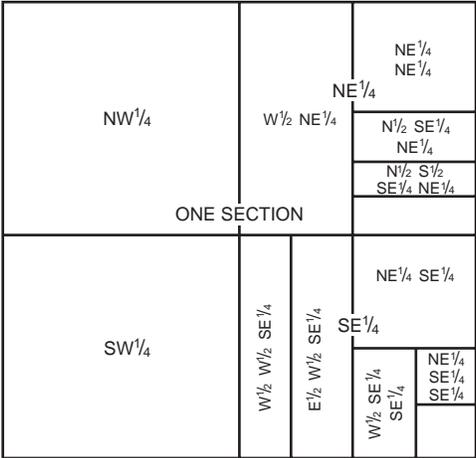
(1) Have a mutual understanding with the operator of all specifications in the written contract.

(2) Make frequent inspection trips.

(3) Check compliance with all phases of the written agreement. Pay particular attention to:

    (a) Boundaries of sale.
    (b) Care of remaining trees, forest land, and other property.
    (c) Size of trees cut and utilization standards.
    (d) Method and place of scaling.
    (e) Method and terms of payment.
    (f) Slash disposal and care with fire.

(4) Appreciate the logger's problem.

Landline Location Diagrams

Section Numbering System
within a Township[4]

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Section Diagram

NW$\frac{1}{4}$

W$\frac{1}{2}$ NE$\frac{1}{4}$

NE$\frac{1}{4}$

NE$\frac{1}{4}$ NE$\frac{1}{4}$

N$\frac{1}{2}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$

N$\frac{1}{2}$ S$\frac{1}{2}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$

ONE SECTION

SW$\frac{1}{4}$

W$\frac{1}{2}$ W$\frac{1}{2}$ SE$\frac{1}{4}$

E$\frac{1}{2}$ W$\frac{1}{2}$ SE$\frac{1}{4}$

SE$\frac{1}{4}$

NE$\frac{1}{4}$ SE$\frac{1}{4}$

W$\frac{1}{2}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$

NE$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$

Pesticide Mixing Formulas[4]

The following formulas may be helpful when mixing herbicides or pesticides:

1. To figure the percent of active ingredients in a spray mixture:

$$\frac{\text{lbs. of “cide” used} \times \text{\% active ingredient in “cide”}}{\text{gals. of spray mixture} \times \text{wt. 1 gal. diluent}}$$

2. To figure the pounds of wettable powder needed to mix a spray containing a given percentage of active ingredient:

$$\frac{\text{gals. of spray wanted} \times \text{\% active ingredient wanted} \times \text{wt. 1 gal. diluent}}{\text{\% active ingredient in “cide” wettable powder used}}$$

3. To figure the gallons of concentrate needed to mix a spray containing a given percentage of active ingredient:

$$\frac{\text{gals. of spray wanted} \times \text{\% of active ingredient wanted} \times \text{wt. 1 gal. diluent}}{\text{lbs. active ingredient per gallon in “cide” concentration used} \times 100}$$

4. To figure the pounds of concentrate to use to prepare a solution or suspension on a weight-to-weight basis:

$$\frac{\text{\% active ingredient in finished spray} \times \text{amount in gals. of finished spray} \times \text{weight of 1 gal. diluent}}{\text{\% active ingredient of concentrate}}$$

Conversion Factors[4]

Some conversion figures that might be valuable in herbicide and pesticide mixing are:

Measures

1 tablespoon = 3 teaspoons

2 tablespoons = 1 fluid ounce

16 tablespoonfuls
8 fluid ounces
} = 1 cup

2 cups
16 fluid ounces
} = 1 pint

16 cups
128 fluid ounces
3785.3 ccs
} = 1 gallon

Weights

1 gallon of pure water weights 8.345 lbs.

1 gallon of diesel oil weights 7.0 lbs.

454 grams = 1 pound

1 ounce per square foot = about 2,722.5 lb. per acre

1 ounce per square yard = about 302.5 lb. per acre

1 pound per 100 square feet = 435.6 lb. per acre

1 pint per square rod = 20 gal. per acre

1 gram per square foot = about 96 lb. per acre

Metric Conversion Factors[8]

Multiply	By	Divide	By	To Obtain
Acres	0.405	Acres	2.471	Hectares
Centimeters	0.394	Centimeters	2.540	Inches
Chains	20.12	Chains	0.050	Meters
Feet	0.305	Feet	3.281	Meters
Feet^2/acre	0.230	Feet^2/acre	4.356	Meters^2/hectare
Feet^3	0.0283	Feet^3	35.311	Meters^3
Gallons	3.785	Gallons	0.264	Liters
Hectares	2.471	Hectares	0.405	Acres
Inches	2.540	Inches	0.394	Centimeters
Inches^3	0.0164	Inches^3	61.013	Liters
Kilometers	0.621	Kilometers	1.609	Miles
Liters	61.013	Liters	0.0164	Inches^3
Liters	0.264	Liters	3.785	Gallons
Meters	0.199	Meters	5.03	Rods
Meters	0.050	Meters	20.12	Chains
Meters	3.281	Meters	0.305	Feet
Meters^2/hectare	4.356	Meters^2/hectare	0.230	Feet^2/acre
Meters^3	35.311	Meters^3	0.0283	Feet^3
Miles	1.609	Miles	0.621	Kilometers
Number/acre	2.471	Number/acre	0.405	Number/hectare
Number/hectare	0.405	Number/hectare	2.471	Number/acre
Rods	5.03	Rods	0.199	Meters

Convenient Conversion Factors[4]

Multiply	By	To Get
Acres	43,560	Square feet
Acres	4,840	Square yards
Bushels	4	Pecks
Bushels	64	Pints
Bushels	32	Quarts
Centimeters	0.3937	Inches
Centimeters	0.01	Meters
Centimeters	10	Millimeters
Cubic feet	1,728	Cubic inches
Cubic feet	0.03704	Cubic yards
Cubic feet	7.4805	Gallons
Cubic feet	59.84	Pints (liquid)
Cubic feet	29.92	Quarts (liquid)
Cubic inches	16.39	Cubic centimeters
Cubic meters	1,000,000	Cubic centimeters
Cubic meters	35.31	Cubic feet
Cubic meters	61,023	Cubic inches
Cubic meters	1.308	Cubic yards
Cubic meters	264.2	Gallons
Cubic meters	2,113	Pints (liquid)
Cubic meters	1,057	Quarts (liquid)
Cubic yards	27	Cubic feet
Cubic yards	0.7646	Cubic meters
Feet	30.48	Centimeters
Feet	12	Inches
Feet	0.3048	Meters
Feet per minute	0.01667	Feet per second
Feet per minute	0.01136	Miles per hour

Convenient Conversion Factors (cont.)

Multiply	By	To Get
Gallons	3,785	Cubic centimeters
Gallons	0.1337	Cubic feet
Gallons	231	Cubic inches
Gallons	128	Ounces (liquid)
Gallons	8	Pints (liquid)
Gallons	4	Quarts (liquid)
Gallons of water	8.3453	Pounds of water
Grains	0.0648	Grams
Grams	15.43	Grains
Grams	0.001	Kilograms
Grams	1,000	Milligrams
Grams	0.0353	Ounces
Grams per liter	1,000	Parts per million
Inches	2.54	Centimeters
Inches	0.083333	Feet
Inches	0.02778	Yards
Kilograms	1,000	Grams
Kilograms	2.205	Pounds
Kilometers	3,281	Feet
Kilometers	1,000	Meters
Kilometers	0.6214	Miles
Kilometers	1,094	Yards
Liters	1,000	Cubic centimeters
Liters	0.0353	Cubic feet
Liters	61.02	Cubic inches
Liters	0.001	Cubic meters
Liters	0.2642	Gallons

Convenient Conversion Factors (cont.)

Multiply	By	To Get
Liters	2.113	Pints (liquid)
Liters	1.057	Quarts (liquid)
Meters	100	Centimeters
Meters	3.281	Feet
Meters	39.37	Inches
Meters	0.001	Kilometers
Meters	1,000	Millimeters
Meters	1.094	Yards
Miles	5,280	Feet
Miles	320	Rods
Miles	1,760	Yards
Miles per hour	88	Feet per minute
Miles per hour	1.467	Feet per second
Miles per minute	88	Feet per second
Miles per minute	60	Minutes per hour
Ounces (dry)	28.3495	Grams
Ounces (dry)	0.0625	Pounds
Ounces (liquid)	29.573	Milliliters (cubic centimeters)
Ounces (liquid)	0.0625	Pints (liquid)
Ounces (liquid)	0.03125	Quarts (liquid)
Parts per million	0.0584	Grains per U.S. gallon
Parts per million	0.001	Grams per liter
Parts per million	8.345	Pounds per million gallon
Pints (liquid)	0.4732	Liters

Convenient Conversion Factors (cont.)

Multiply	By	To Get
Pounds	453.59	Grams
Pounds	16	Ounces
Pounds of water	0.01602	Cubic feet
Pounds of water	0.1198	Gallons
Quarts (liquid)	57.75	Cubic inches
Quarts (liquid)	0.9463	Liters
Quarts (liquid)	32	Ounces (liquid)
Rods	16.5	Feet
Square feet	144	Square inches
Square feet	0.11111	Square yards
Square inches	0.00694	Square feet
Square miles	640	Acres
Square yards	9	Square feet
Square yards	1,296	Square inches
Ton	907.1849	Kilograms
Ton	32,000	Ounces
Ton	2,000	Pounds
Yards	3	Feet
Yards	36	Inches
Yards	0.9144	Meters
Yards	0.000568	Miles

1 Acre Foot = 43,560 cu. ft. = 325,835 gals.

1 1/2 cu. ft./sec. = 1,000,000 gals/day

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Notes

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