LOCAL VOLUME TABLES FOR PALACH (*POPULUS CILIATA*) OF N.W.F.P.

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Introduction

Populus ciliata is a useful broad leaved tree and grows naturally in coniferous forests of N.W.F.P. and Azad Kashmir. Wood of this species is used for cattle troughs, packing cases, veneer sheets and match splints.

Basic Data

Data on 68 trees ranging from 15 cms (6 inches) to 106 cms (42 inches), mainly from Galies, Kaghan and Hazara tribal Forest Divisions were collected for the preparation of these volume tables.

Method and Procedure

Trees were measured as per standard procedure for measurement of sample tree (7). Volume upto 5 cms (2 inches) diameter overbark at thin end of the stem including branches was taken as total volume of the tree. Total volume, timber (over bark) and smallwood of different logs of a tree were calculated using Huber formula and were summed to get volume of timber (o.b.) and smallwood separately for each tree. Total volume (o.b.) was obtained by adding total timber volume (o.b.) and total smallwood volume of a tree. Similarly by the use of same formula timber volume under bark and smallwood volume under bark of different logs of a tree were calculated using under bark mid diameters obtained by subtracting measured double bark thickness from the measured over bark diameters of all logs. Total under bark volume of a tree was obtained by adding total timber volume (u.b.) and total small wood volume (u.b.) of a tree. The estimates of heights and volume (timber and total separately) against dbh classes were obtained using regression techniques.

Following mathematical models were used for estimating heights, timber volume (o.b.) and total volume (o.b.).

I. Models for height

$H = a+b \log D$

$H = a+b\ D$

$\log H = a+b \log D$

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II. Models for timber volume (o.b.)

$$V(tim) = a+b\frac{D^2H}{100}$$

$$V(tim) = a+b \log \frac{D^2H}{100}$$

$$\log V(tim) = a+b \log \frac{D^2H}{100}$$

III. Models for total volume (o.b.).

$$V = a+b \frac{D^2H}{100}$$

$$V = a+b \log \frac{D^2H}{100}$$

$$\log V = a+b \log \frac{D^2H}{100}$$

where
H stands for total height in feet.
D stands for total diameter at breast height in inches.
V (tim) stands for total timber volume (o.b.) in cft.
V stands for total volume (o.b.) in cft.

The regression equations developed from the above models are given in Appendix I along their measures of precision.

Height Estimation

Regression equations for height estimation are presented in Appendix I at serial No. 1, 2 and 3. On the basis of better measures of precision equation No. 1 i.e.,

$$H = -4.934 + 70.3916 \log D$$

was selected for the estimation of heights for dbh classes. Estimated values were rounded to whole numbers (Appendix II).

Overbark Timber Volume Estimation

Estimates of timber volume were obtained from two better equations No. 4 and 6 of Appendix I. The estimated values from both equations were compared with actual average values against different dbh classes and it was found that estimates from equation No. 4 i.e.,

$$V\,(tim) = -6.9193 + 0.2520\,\frac{D^2H}{100}$$

were nearer to actual values as compared to the estimates of other equation No. 6. Therefore estimated values of timber volume (o.b.) were obtained from the above equation and are reproduced in Appendix II.

Total Volume (O.B) Estimation

Estimates of total volume were obtained from the following two better equations No. 7 and 9 of Appendix I:

$$V = -1.8530 + 0.2558\,\frac{D^2H}{100}$$

$$\log V = -0.6049 + 0.9992 \log\,\frac{D^2H}{100}$$

The estimated values from both equations were compared with actual average values for different dbh classes. It was observed that estimates from equation No. 9 were nearer to actual average values upto 20 inches dbh class and thereafter estimates from both the equations deviated from the actual values. Therefore estimates for total volume were obtained using equation No. 9 upto 20 "dbh class and thereafter average values of estimates from both equations were taken as total volume to bring the estimates nearer to actual average values.

These estimates are given in Appendix II.

Smallwood Estimation

Smallwood volume for dbh classes were obtained by subtracting timber volume (o.b.) from total volume and are presented in Appendix II.

Conversion to Metric Units

Finally selected equations for volume table in the British units were converted to metric units. Volume table in metric units was prepared using diameter breast height in centimeters and height in metres. The converted equations in metric units are:

$$H = -10.9346 + 21.4554 \log D$$

$$V\,(tim) = -0.1959 + 0.0036 \frac{D^2H}{100}$$

$$\log V = -4.4447 + 0.9992 \log D^2H$$

$$V = -0.0525 + 0.0037 \frac{D^2H}{100}$$

Local Volume Tables

Local volume tables given in Appendices II and III are prepared by one inch diameter classes in the British units and two centimeter class intervals in metric units. In these tables diameter classes are middle values between two ranges. For example, 20 inch dbh class includes trees from 19.6 to 20.5 inches in the British units while 50 centimeter dbh class includes trees with dbh 49.1 to 51.0 centimeters in metric units.

Under Bark Volume Conversion

To convert over bark timber volume to under bark timber volume multiply with 0.8834 and to convert overbark total volume to under bark total volume multiply with 0.8880 against any dbh class in both systems of measurements. The above two factors were obtained by taking the average values of ratios of available data separately for under bark volume of timber to over bark volume of timber and under bark total volume to overbark total volume.

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APPENDIX – I

Poplar (*Populus ciliata*) Height and Volume Equations with Measures of Precision

S. No.	Regression equations	Correlation coefficient (R)	Coefficient of determination (R^2)	Standard error of estimates (SEE)	SE%	No. of observations
1.	$H = -4.9346 + 70.3916 \log D$	0.7760	0.6022	11.74	15.0	68
2.	$H = 50.4473 + 1.6439 D$	0.7206	0.5193	12.91	16.5	68
3.	$\log H = 1.3671 + 0.4337 \log D$	0.7683*	0.5903*	0.07*	3.95*	68
4.	$V(tim) = -6.9193 + 0.2520 \frac{D^2H}{100}$	0.9799	0.9602	20.65	25.88	62
5.	$V(tim) = -409.7512 + 209.2920 \log \frac{D^2H}{100}$	0.8301	0.6891	57.76	72.4	62
6.	$\log V(tim) = -1.2873 + 1.2483 \log \frac{D^2H}{100}$	0.9729*	0.9465*	0.12*	7.47*	62
7.	$V = -1.8530 + 0.2558 \frac{D^2H}{100}$	0.9815	0.9661	19.75	25.06	68
8.	$V = -272.5582 + 156.7343 \log \frac{D^2H}{100}$	0.7682*	0.5901*	65.97*	83.71*	68
9.	$\log V = -0.6049 + 0.9992 \log \frac{D^2H}{100}$	0.9954*	0.9908*	0.05*	0.98*	68

* Not in original units.

APPENDIX II

Local volume table of Poplar (*Populus ciliata*) for N.W.F.P.
(British units)

D.B.H. classes (inches)	Height (feet)	Total volume (o.b.) (cft)	Timber volume (o.b.) (cft)	Smallwood volume (o.b.) (cft)
5	44	2.73	–	2.73
6	50	4.46	–	4.46
7	54	6.55	–	6.55
8	59	9.35	2.59	6.76
9	62	12.4	5.73	6.67
10	65	16.1	9.46	6.64
11	68	20.4	13.8	6.60
12	71	25.3	18.8	6.50
13	73	30.5	24.2	6.30
14	76	36.8	30.6	6.20
15	78	43.4	37.3	6.10
16	80	50.6	44.7	5.90
17	82	58.6	52.8	5.80
18	83	66.6	60.8	5.80
19	85	76.2	70.4	5.80
20	87	86.7	80.8	5.90
21	88	96.8	90.8	6.00
22	90	109	103	6.00
23	91	120	114	6.00
24	92	133	127	6.00
25	93	145	139	6.00
26	95	151	155	6.00
27	96	175	169	6.00
28	97	190	185	5.00
29	98	206	201	5.00
30	99	223	218	5.00
31	100	240	235	5.00
32	101	259	254	5.00
33	102	278	273	5.00
34	103	298	293	5.00
35	104	319	314	5.00
36	105	341	336	5.00
37	105	360	355	5.00
38	106	384	379	5.00

D.B.H. classes (inches)	Height (feet)	Total volume (o.b.) (cft)	Timber volume (o.b.) (cft)	Smallwood volume (o.b.) (cft)
39	107	408	403	5.00
40	108	433	428	5.00
41	109	460	455	5.00
42	109	482	477	5.00
43	110	510	505	5.00
44	111	539	534	5.00
45	111	569	559	5.00

APPENDIX III

Local volume table of Poplar (*Populus ciliata*) for N.W.F.P.
(Metric units)

D.B.H. classes (cms)	Height (m)	Total volume (o.b.) (m^3)	Timber volume (o.b.) (m^3)	Smallwood volume (o.b.) (m^3)
12	12.22	0.063	–	0.063
14	13.66	0.095	–	0.095
16	14.90	0.136	–	0.136
18	16.00	0.185	–	0.185
20	16.98	0.242	0.050	0.192
22	17.87	0.308	0.118	0.190
24	18.68	0.383	0.194	0.189
26	19.42	0.468	0.280	0.188
28	20.11	0.562	0.376	0.186
30	20.76	0.666	0.482	0.184
32	21.36	0.779	0.598	0.181
34	21.92	0.904	0.723	0.181
36	22.46	1.04	0.860	0.180
38	22.96	1.18	1.01	0.170
40	23.44	1.33	1.16	0.170
42	23.89	1.50	1.33	0.170
44	24.33	1.68	1.51	0.170
46	24.74	1.86	1.70	0.160
48	25.14	2.00	1.84	0.160
50	25.52	2.28	2.12	0.160
52	25.88	2.50	2.34	0.160
54	26.23	2.74	2.58	0.160
56	26.57	2.99	2.83	0.160
58	26.90	3.25	3.09	0.160
60	27.22	3.52	3.36	0.160
62	27.52	3.80	3.64	0.160
64	27.82	4.10	3.94	0.160
66	28.10	4.40	4.24	0.160
68	28.38	4.72	4.56	0.160
70	28.65	5.06	4.90	0.160
72	28.91	5.40	5.24	0.160
74	29.17	5.75	5.60	0.150
76	29.42	6.12	5.97	0.150
78	29.66	6.50	6.35	0.150

D.B.H. classes (cms)	Height (m)	Total volume (o.b.) (m^3)	Timber volume (o.b.) (m^3)	Smallwood volume (o.b.) (m^3)
80	29.90	6.89	6.75	0.140
82	30.13	7.30	7.15	0.150
84	30.35	7.72	7.57	0.150
86	30.57	8.15	8.01	0.140
88	30.78	8.60	8.45	0.150
90	30.99	9.05	8.91	0.140
92	31.20	9.53	9.38	0.150
94	31.40	10.0	9.87	0.130
96	31.60	10.5	10.4	0.100
98	31.79	11.0	10.9	0.100
100	31.98	11.5	11.4	0.100

$$H = -10.9346 + 21.4554 \log D$$

Total volume

I $$V = -0.0525 + 0.0037 \frac{D^2H}{100}$$

II $$\log V = -4.4447 + 0.9992 \log D^2H$$

Timber

$$V = -0.1959 + 0.0036 \frac{D^2H}{100}$$