VOLUME TABLES FOR G48 AND D121 CLONES OF *POPULUS DELTOIDES* FOR THE TARAI AND BHABHAR REGION OF UTTARANCHAL

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Introduction

Poplars are amongst the world's fastest growing industrial wood which can be grown as pure of mixed plantations as well as in combination with agriculture crops. They are multipurpose tree species and there is great demand for their wood for paper and pulp, plywood, matchwood, packing cases, sports goods, artificial limbs and light construction timber. A number of clones of *Populus deltoides*, have been developed and the present paper gives the volume tables for two of them viz. G48 and D121 grown in the Tarai and Bhabhar region of Uttaranchal.

Material and Methods

Data was collected by felling spatially well distributed sample trees of G48 and D121 clones of Poplar in the Tanda and Pipal Parao Ranges of the Haldwani Division of State Forest Department (Uttaranchal). The details of sample trees are given in Table 1.

The age of the sample trees varied from 4 to 13 years.

Sample plots were laid out and sample trees were selected from the surrounds of the plots by stratified random sampling

Table 1

Details of sample trees

Location	Clone	No. of plots	No. of sample trees
Dhimri Block (Tanda)	G48	10	113
Tanda Block	G48	4	31
Pipal Parao	G48	10	96
Tanda Block	G48	—	256
Pipal Parao	G48	—	82
Tanda Range	D121	1	10
Pipal Parao	D121	3	33
Tanda Range	D121	—	104

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covering all diameter classes. The felled sample trees were measured for dbh, height and volume, both over-bark and under-bark. The data was then compiled, calculated and analysed. Regression equations were developed for estimating the volume of individual tree taking dbh and height as well as dbh and age as independent variables. Equation for estimating the underbark volume has also been developed with over-bark volume as the independent variable.

Results and Discussion

Following equations provided the best estimates for under-bark volume and heights of individual trees :

G48 :

$$V = -0.0045 + .000026\ D^2H \qquad ...(1)$$

Analysis of Variance : ANOVA for eq. (1) is given in Table 2a.

$$V = 0.00017206 * D^{2.26615} * A^{0.179782} \qquad ...(2)$$

Analysis of Variance : ANOVA for eq. (2) is given in Table 2b.

$$H = 2.75193 * D^{0.58865} * A^{0.131764} \qquad ...(3)$$

Analysis of Variance : ANOVA for eq. (3) is given in Table 2c.

D121

$$V = -0.0194 + .000028\ D^2H \qquad ...(4)$$

Analysis of Variance : ANOVA for eq. (4) is given in Table 2d.

$$V = 0.00006073 * D^{2.422605} * A^{0.44244} \qquad ...(5)$$

Analysis of Variance : ANOVA for eq. (5) is given in Table 2e.

$$H = 3.50431 * D^{0.473439} * A^{0.20741} \qquad ...(6)$$

Analysis of Variance : ANOVA for eq. (6) is given in Table 2f.

where :
V is the volume in cubic metres.
D is the dbh in centimetres.
H is the height in metres.
A is the age in years.

Following equations gave the best estimates for under-bark volume of individual trees with over-bark volume as the independent variable :

G48

$$Vub = -0.0028 + 0.8302\ Vob$$
$$D.f = 430,\ R^2 = 0.994 \qquad ...(7)$$

D121

$$Vub = -0.0078 + 0.8451\ Vob$$
$$D.f. = 144,\ R^2 = 0.992 \qquad ...(8)$$

where:
Vub is the volume under-bark in m^3.
Vob is the volume over-bark in m^3.

The under-bark volumes of G48 and D121 clones, for different dbh and heights are given in Table 3 and Table 4 respectively.

The equations (3) and (6) have a relatively low value of the coefficient of determination and somewhat high values for the mean residual sum of squares. This is due to high variability in heights in the collected data.

Table 2a

ANOVA for eq. (1) $V = -0.0045 + 0.000026\ D^2H$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	1	8.047	8.04700	0.970
Residual	430	0.247	0.00058	

Table 2b

ANOVA for eq. (2) $V = 0.00017206 * D^{2.26615} * A^{0.179782}$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	3	25.394	8.4640	0.933
Residual	429	0.558	0.0013	
Uncorrected Total	432	25.953		
(Corrected Total)	431	8.295		

Table 2c

ANOVA for eq. (3) $H = 2.75193 * D^{0.58865} * A^{0.131764}$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	3	176956.767	58985.589	0.806
Residual	429	1726.182	4.023	
Uncorrected Total	432	178682.950		
(Corrected Total)	431	8604.151		

Table 2d

ANOVA for eq. (4) $V = -0.0194 + .000028\ D^2H$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	1	2.8950	2.89500	0.958
Residual	144	0.1285	0.00089	

Table

Volume Table of G48 Clone of

D.B.H. (cm)	Underbark Height										
	9	10	11	12	13	14	15	16	17	18	19
8	0.010	0.012	0.014	0.015	0.017	0.019					
9	0.014	0.017	0.019	0.021	0.023	0.025					
10		0.022	0.024	0.027	0.029	0.032	0.035				
11		0.027	0.030	0.033	0.036	0.040	0.043				
12			0.037	0.040	0.044	0.048	0.052	0.055	0.059	0.063	
13			0.044	0.048	0.053	0.057	0.061	0.066	0.070	0.075	0.079
14				0.057	0.062	0.067	0.072	0.077	0.082	0.087	0.092
15				0.066	0.072	0.077	0.083	0.089	0.095	0.101	0.107
16					0.082	0.089	0.095	0.102	0.109	0.115	0.122
17					0.093	0.101	0.108	0.116	0.123	0.131	0.138
18					0.105	0.113	0.122	0.130	0.139	0.147	0.156
19						0.127	0.136	0.146	0.155	0.164	0.174
20						0.141	0.152	0.162	0.172	0.183	0.193
21						0.156	0.167	0.179	0.190	0.202	0.213
22							0.184	0.197	0.209	0.222	0.235
23							0.202	0.216	0.229	0.243	0.257
24							0.220	0.235	0.250	0.265	0.280
25								0.256	0.272	0.288	0.304
26								0.277	0.294	0.312	0.329
27								0.299	0.318	0.337	0.356
28									0.342	0.362	0.383
29									0.367	0.389	0.411
30										0.417	0.440
31										0.445	0.470
32											0.501
33											0.533
34											
35											

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Populus deltoides

Volume (m^3)										
(m)										
20	21	22	23	24	25	26	27	28	29	30
0.097										
0.113	0.118									
0.129	0.135									
0.146	0.153	0.161	0.168							
0.164	0.172	0.181	0.189	0.198						
0.183	0.193	0.202	0.211	0.221						
0.204	0.214	0.224	0.235	0.245	0.256					
0.225	0.236	0.248	0.259	0.271	0.282	0.294				
0.247	0.260	0.272	0.285	0.298	0.310	0.323				
0.271	0.284	0.298	0.312	0.326	0.339	0.353	0.367			
0.295	0.310	0.325	0.340	0.355	0.370	0.385	0.400	0.415		
0.321	0.337	0.353	0.369	0.386	0.402	0.418	0.434	0.451		
0.347	0.365	0.382	0.400	0.417	0.435	0.452	0.470	0.488		
0.375	0.394	0.412	0.431	0.450	0.469	0.488	0.507	0.526		
0.403	0.424	0.444	0.464	0.485	0.505	0.525	0.546	0.566	0.587	
0.433	0.455	0.477	0.498	0.520	0.542	0.564	0.586	0.608	0.630	
0.464	0.487	0.510	0.534	0.557	0.581	0.604	0.627	0.651	0.674	
0.495	0.520	0.545	0.570	0.595	0.620	0.645	0.670	0.695	0.720	
0.528	0.555	0.581	0.608	0.634	0.661	0.688	0.714	0.741	0.768	0.794
0.562	0.590	0.618	0.647	0.675	0.703	0.732	0.760	0.788	0.817	0.845
0.597	0.627	0.657	0.687	0.717	0.747	0.777	0.807	0.837	0.867	0.897
	0.664	0.696	0.728	0.760	0.792	0.824	0.855	0.887	0.919	0.951

Table

Volume Table of D 121 Clone of

D.B.H. (cm)	Under-bark Height								
	11	12	13	14	15	16	17	18	19
8	0.001	0.003							
9	0.006	0.008	0.010	0.012					
10	0.012	0.014	0.017	0.019	0.022				
11		0.021	0.024	0.027	0.030	0.034	0.037	0.040	0.043
12		0.028	0.032	0.036	0.039	0.043	0.047	0.051	0.055
13		0.036	0.040	0.045	0.049	0.054	0.058	0.063	0.067
14			0.050	0.055	0.060	0.065	0.070	0.075	0.081
15			0.060	0.065	0.071	0.077	0.083	0.089	0.095
16			0.070	0.077	0.084	0.090	0.097	0.104	0.111
17				0.089	0.097	0.104	0.112	0.119	0.127
18				0.102	0.110	0.119	0.127	0.136	0.145
19				0.116	0.125	0.135	0.144	0.153	0.163
20					0.140	0.151	0.161	0.172	0.182
21					0.157	0.168	0.180	0.191	0.203
22						0.186	0.199	0.212	0.224
23						0.205	0.219	0.233	0.247
24							0.240	0.255	0.270
25							0.262	0.278	0.295
26								0.303	0.320
27								0.328	0.347
28									0.374
29									0.403
30									
31									
32									
33									
34									
35									

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Populus deltoides

Volume (m^3)										
(m)										
20	21	22	23	24	25	26	27	28	29	30
0.058										
0.071	0.076									
0.086	0.091									
0.101	0.107	0.113								
0.117	0.124	0.131	0.137							
0.135	0.142	0.150	0.157							
0.153	0.162	0.170	0.179	0.187						
0.172	0.182	0.191	0.201	0.210						
0.193	0.204	0.214	0.225	0.235	0.246					
0.215	0.226	0.238	0.249	0.261	0.273					
0.237	0.250	0.263	0.275	0.288	0.301	0.314				
0.261	0.275	0.289	0.303	0.317	0.330	0.344				
0.286	0.301	0.316	0.331	0.346	0.361	0.376	0.392			
0.311	0.328	0.344	0.361	0.377	0.394	0.410	0.426			
0.338	0.356	0.374	0.392	0.409	0.427	0.445	0.463			
0.366	0.385	0.404	0.424	0.443	0.462	0.481	0.500	0.519		
0.395	0.416	0.436	0.457	0.477	0.498	0.519	0.539	0.560		
0.425	0.447	0.469	0.491	0.513	0.536	0.558	0.580	0.602	0.624	
0.456	0.480	0.503	0.527	0.551	0.574	0.598	0.622	0.645	0.669	
	0.513	0.539	0.564	0.589	0.614	0.640	0.665	0.690	0.716	0.741
		0.575	0.602	0.629	0.656	0.683	0.710	0.737	0.764	0.791
		0.613	0.641	0.670	0.699	0.727	0.756	0.785	0.813	0.842
			0.682	0.712	0.743	0.773	0.803	0.834	0.864	0.895
				0.756	0.788	0.820	0.852	0.885	0.917	0.949

Table 2e

ANOVA for eq. (5) $V = 0.00006073 * D^{2.422605} * A^{0.44244}$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	3	15.275	5.092	0.961
Residual	143	0.117	8.233E-04	
Uncorrected Total	146	15.393		
(Corrected Total)	145	3.02416		

Table 2f

ANOVA for eq. (6) $H = 3.50431 * D^{0.473439} * A^{0.20741}$

Source	DF	Sum of Squares	Mean Square	R^2
Regression	3	85459.275	28486.425	0.881
Residual	143	242.954	1.698	
Uncorrected Total	146	85702.230		
(Corrected Total)	145	2042.462		

A comparison of equations (3) and (6) for different values of dbh and age, show that the performance of D121 is better than that of G48 in terms of height. The difference is more for lower diameter and it increases continuously with increase in age.

As per the collected data, the form factors of G48 are better than those of D121, as is evident from equations (1) and (4) and also the volume tables (Tables 3 and 4) based on these equations. For higher ages and diameters, D121 gives better volume due to better height growth.

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SUMMARY

In this paper regression equations for volume and height of two clones of Poplar viz. G 48 and D 121 grown in the forest land of the Tarai and Bhabhar region of U.P. have been developed. Based on them the volume tables of these two clones have been prepared.

उत्तरांचल के तराई भाबर क्षेत्र के लिए *पोपुलस डेल्टायडिस* के जी48 व डी121 कृन्तकों की आयतन सारणियां

वी०एन० सिंह व ए०के० उपाध्याय

साराशं

इस अभिपत्र में उत्तरांचल के तराई व भाबर क्षेत्र के रोपवनों में उगाए जा रहे पोपलर के दो कृन्तकों अर्थात् जी48 व डी121 के आयतन और ऊंचाई के लिए प्रतियापन समीकरण विकसित किए गए हैं । उनको आधार बनाकर इन दोनों कृन्तकों की आयतन सारणियां तैयार की गई हैं ।