

BIOMASS PRODUCTION BY DIFFERENT SPECIES AND CLONES OF POPLAR

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Introduction

An important study titled "Comparative growth study of *Eucalyptus camaldulensis*, *Salmaalial malabarica*, *Morus alba* and Poplars under different quantities of water" was laid out in Chichawatni plantation in August, 1977 by the P.F.I. The objective of the study as is clear from the title, was to find out the optimum quantity of water best suitable for growth of species/poplar clones. Original spacing was 10' x 6' (3 x 2 m) and one year old entire plants were transplanted at the above spacing in RCB design with four replications. First thinning was done in the crop in autumn of 1980 but it was rather on conservative side. The crop gave a congested appearance on visit in September 1984. Therefore second thinning was done giving a release to the left over plants to put up better growth.

Data Collection

Eight felled trees of each of the four clones covering dbh range from 7.1 cm (2.8") to 14.0 cm (5.5") scattered in all the four replications and 11 to 14 trees of three other species with dbh varying from 6.9 cm (2.7") to 26.7 cm (10.5") were measured for the purpose. DBH and total height were measured for each tree. The trees were felled about 6" (15 cm) above ground level. Leaving stump and underground root mass, the whole of above ground biomass was weighed green in terms of following components:

- (i) Stem weight upto 2" (5 cm) diameter at their end.
- (ii) Branch weight less than 2" (5 cm) diameter and leaves weight combined. Adding up above, total weight was calculated.

Analysis of Data

The data were analysed statistically. To see if a relationship existed between biomass and dbh of the tree a simple linear model of the type $Y = A + BX$ was used. 'Y' in this model denotes Total or Stem or Branch/Leaves weight, as the case may be, and X is the dbh or independent variable. 'A' signifies regression constant and 'B' is the regression coefficient. For each of the four clones three equations on the lines of above model were developed; stem weight upto 5 cm, branch/leaves weight and total weight. Important statistical parameters derived from the above model are given in Table 1 below:

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Table 1.—Important parameters for biomass production

S.No.	Poplar clone/ species	Component	Regression constant 'A'	Regression coefficient 'B'	Correlation coefficient 'r'	No. of measurements 'n'
1.	I-69/55	Stem upto 5 cm	-54.0533	9.6203	0.9916	8
		Branches/Leaves	3.2304	0.8392	0.5353	8
		Total	-50.8229	10.4595	0.9959	8
2.	I-90/60	Stem upto 5 cm	-41.2257	7.7167	0.9595	8
		Branches/leaves	-7.7778	1.9197	0.8863	8
		Total	-49.0034	9.6364	0.9762	8
3.	I-72/58	Stem upto 5 cm	-48.3273	8.4692	0.9796	8
		Branches/Leaves	-5.7226	1.8845	0.8223	8
		Total	-54.0499	10.3537	0.9827	8
4.	I-4/64	Stem upto 5 cm	-76.5239	11.8388	0.9834	8
		Branches/Leaves	-6.6638	1.7312	0.9500	8
		Total	-83.1877	13.5700	0.9917	8
5.	<i>E. camaldulen</i> <i>sis</i>	Stem upto 5 cm	-111.4246	11.9316	0.9848	14
		Branches/Leaves	-26.1603	5.4572	0.9380	14
		Total	-137.5848	22.3887	0.9921	14
6.	<i>Salmalia</i> <i>malabarica</i>	Stem upto 5 cm	-93.1693	12.7008	0.9794	14
		Branches/Leaves	-35.4398	4.0599	0.8345	14
		Total	-128.6091	16.7608	0.9668	14
7.	<i>Morus alba</i>	Stem upto 5 cm	-53.3493	9.2894	0.9738	11
		Branches/Leaves	-45.6990	7.6484	0.8889	11
		Total	-99.0483	16.9378	0.9522	11

Following inferences can be drawn from the above statistics:

(a) *Poplar clones*

- (i) There exists a very strong linear relationship between dbh and total biomass production. This is evident from the high value of correlation coefficient 'r'. More than 95% of the variation has been accounted for by using single variable i.e. dbh for estimation of total biomass.

- (ii) Again a strong relationship is exhibited by dbh in estimating stem biomass. The correlation coefficient for all the four clones account for more than 90% variation attributable to this single variable of dbh.
- (iii) Except for clone I-69/55, branch/leaves biomass is also well estimated by using dbh. In later cases contribution to variation is more than 67% which is quite reasonable.

(b) *Other species*

- (i) Total biomass has been reasonably accounted for by using dbh as independent variable (more than 90%) as is shown by high values of 'r' for the species.
- (ii) Stem biomass is again highly correlated with dbh of the corresponding trees.
- (iii) Strongly related is dbh with branch/leaves biomass production as well (more than 68% is the coefficient of determination i.e. r^2).

Estimation of Biomass

Using regression equations developed from the simple linear model, estimates for stem, branch/leaves and total biomass have been made for 1 cm dbh class separately for each clone from 6 cm to 30 cm and from 6 cm to 40 cm separately for each of three species. Ratio of stem and branch/leaves biomass to total biomass have also been worked. These estimates are given in Table 2.

Ratio of stem biomass to total biomass varies from 75 to 80% in case of clone I-90/60 and I-72/58; and for clones I-69/55 and I-4/64 it ranges between 80 to 90% for dbh greater than 10 cm. As for *E. camaldulensis* the range is 70-75%. *S. malabarica* shows downward trend from 83-76%. Ratio for *M. alba* is almost constant viz, 55% for dbh greater than 10 cm. This can be a good guide in cases where lops and tops have to be left in the forest due to transportation costs and other considerations. As reported earlier, the original data ranged from 7 cm to 14 cm dbh for poplar clones and 7 cm to 27 cm for species. Therefore estimates below this limit and especially those for dbh 10 cm and less and more than 25 cm dbh are based on extrapolation due to non availability of data for these classes. As such these estimates may be considered as approximation only.

Table 2 Estimation of total biomass green weight in kg above ground from poplar clones and tree species

D.B.H.		Clone: Px E Cv 1-69/55				Clone: Px E Cv 1-90/60					
(cm)		Stem upto 5 (cm)		Leaves & branches		Total	Stem upto 5 (cm)		Leaves & branches		Total
		1	%	2	%	3	4	%	5	%	6
6	3.66	30.7	69.3	8.27	69.3	11.93	5.07	57.5	3.74	42.5	8.81
7	13.28	59.3	40.7	9.10	40.7	22.38	12.79	69.3	5.66	30.7	18.45
8	22.90	69.7	30.3	9.95	30.3	32.85	20.51	73.0	7.58	27.0	28.09
9	32.52	75.1	26.9	10.78	26.9	43.30	28.22	74.8	9.50	25.2	37.72
10	42.14	78.4	21.6	11.63	21.6	53.77	35.94	75.9	11.42	24.1	47.36
11	51.76	80.5	19.5	12.46	19.5	64.29	43.66	76.6	13.33	23.4	56.99
12	61.38	82.2	17.8	13.30	17.8	74.68	51.37	77.1	15.26	22.9	66.63
13	71.00	83.4	16.6	14.14	16.6	85.14	59.09	77.5	17.18	22.5	76.27
14	80.62	84.3	15.8	14.98	15.8	95.60	66.81	77.8	19.10	22.2	85.91
15	90.24	85.1	14.9	15.82	14.9	106.06	74.52	78.0	21.02	22.0	95.54
16	99.86	85.7	14.3	16.66	14.3	116.52	82.24	78.2	22.94	21.8	105.18
17	109.49	86.2	13.8	17.49	13.8	126.98	89.96	78.3	24.85	21.7	114.81
18	119.11	86.7	13.3	18.33	13.3	137.44	97.67	78.5	26.78	21.5	124.45
19	128.73	87.0	13.0	19.17	13.0	147.90	105.39	78.6	28.70	21.4	134.09
20	138.35	87.4	12.6	20.01	12.6	158.36	113.11	78.7	30.61	21.3	143.72
21	147.97	87.6	12.4	20.85	12.4	168.82	120.82	78.8	32.54	21.2	153.36
22	157.59	87.9	12.1	21.69	12.1	179.28	128.54	78.9	34.45	21.1	162.99
23	167.21	88.1	11.9	22.53	11.9	189.74	136.26	78.9	36.37	21.1	172.63
24	176.83	88.3	11.7	23.37	11.7	200.20	143.97	79.0	38.20	21.0	182.27
25	186.45	88.5	11.5	24.21	11.5	210.66	151.69	79.0	40.22	21.0	191.91
26	196.07	88.7	11.3	25.05	11.3	221.12	159.41	79.1	42.13	20.9	201.54
27	205.69	88.8	11.2	25.89	11.2	231.58	167.12	79.1	44.06	20.9	211.18
28	215.31	88.9	11.1	26.73	11.1	242.04	174.84	79.2	45.98	20.8	220.82
29	224.93	89.1	10.9	27.57	10.9	252.50	182.56	79.2	47.89	20.8	230.45
30	234.55	89.2	10.8	28.41	10.8	262.96	190.27	79.2	49.82	20.8	240.09

	Clone : Px E Cv 1-72/58				Clone : Px E Cv 1-4/64			
	Stem upto 5 (cm)		Leaves & branches		Stem upto 5 (cm)		Leaves & branches	
	7	8	%	Total	10	11	%	Total
6	2.49	5.58	30.8	8.07				
7	10.96	7.46	59.5	18.42	6.35	5.45	53.8	11.80
8	19.43	9.35	67.5	28.78	18.19	7.18	71.7	25.37
9	27.89	11.24	71.3	39.13	30.02	8.92	77.1	38.94
10	36.36	13.13	73.5	49.49	41.86	10.65	79.7	52.51
11	44.83	15.01	74.9	59.84	53.70	12.38	81.3	66.08
12	53.30	16.89	75.9	70.19	65.54	14.11	82.3	79.65
13	61.77	18.78	76.7	80.55	77.38	15.84	83.0	93.22
14	70.24	20.66	77.3	90.90	89.22	17.57	83.5	106.79
15	78.71	22.54	77.7	101.25	101.06	19.30	84.0	120.36
16	87.18	24.43	78.1	111.61	112.90	21.03	84.3	133.93
17	95.65	26.31	78.4	121.96	124.74	22.76	84.6	147.50
18	104.12	28.20	78.7	132.32	136.57	24.50	84.8	161.07
19	112.59	30.08	78.9	142.67	148.41	26.23	85.0	174.64
20	121.06	31.96	79.1	153.02	160.25	27.96	86.0	186.21
21	129.52	33.85	79.3	163.37	172.09	29.69	85.3	201.78
22	137.99	35.74	79.4	173.73	183.93	31.42	85.4	215.35
23	146.46	37.62	79.6	184.08	195.77	33.15	85.5	228.92
24	154.93	39.51	79.7	194.44	207.61	34.88	85.6	242.49
25	163.40	41.39	79.8	204.79	219.45	36.61	85.7	256.06
26	171.87	43.28	79.9	215.15	241.29	38.34	89.5	269.63
27	180.34	45.16	80.0	225.50	243.12	40.08	85.8	283.20
28	188.81	47.04	80.0	235.85	254.96	41.81	85.9	296.77
29	197.28	48.93	80.1	246.21	266.80	43.54	86.0	310.34
30	205.75	50.81	80.2	256.56	278.64	45.27	86.0	323.91

D.B.H. (cm)	Species : <i>Eucalyptus camaldulensis</i> weight (kg)				
	Stem upto 5 (cm)		Leaves and branches		Total
	1		2		3
		%		%	
7	7.10	37.1	12.04	62.9	19.14
8	24.03	57.9	17.49	42.1	41.52
9	40.96	64.1	22.95	35.9	63.91
10	57.89	67.1	28.41	32.9	86.30
11	74.82	68.8	33.87	31.2	108.69
12	91.75	70.0	39.43	30.0	131.08
13	108.68	70.8	44.78	29.2	153.46
14	125.62	71.4	50.24	28.6	175.86
15	142.55	71.9	55.70	28.1	198.25
16	159.48	72.3	61.15	27.7	220.63
17	176.41	72.6	66.61	27.4	243.02
18	193.34	72.8	72.07	27.2	265.41
19	210.27	73.1	77.53	26.9	287.80
20	227.21	73.2	82.98	26.8	310.19
21	244.14	73.4	88.44	26.6	332.58
22	261.07	73.5	93.90	26.5	354.97
23	278.00	73.7	99.35	26.3	377.35
24	294.93	73.8	104.81	26.2	399.74
25	311.86	73.9	110.27	26.1	422.13
26	328.79	74.0	115.73	26.0	444.52
27	345.73	74.0	121.18	26.0	466.91
28	362.66	74.1	126.64	25.9	489.30
29	379.59	74.2	132.10	25.8	511.69
30	396.52	74.2	137.55	25.8	534.07
31	413.45	74.3	143.01	25.7	556.46
32	430.38	74.3	148.47	25.7	578.85
33	447.32	74.4	153.93	25.6	601.25
34	464.25	74.4	159.38	25.6	623.63
35	481.18	74.5	164.84	25.5	646.02
36	498.11	74.5	170.30	25.5	668.41
37	515.04	74.5	175.76	25.5	690.80
38	531.97	74.6	181.21	25.4	713.18
39	548.91	74.6	186.67	25.4	735.58
40	565.84	74.6	192.13	25.4	757.97

Species : *Salmaalial malabaricum* weight (kg)

D.B.H. (cm)	Stem upto 5 cm		Leaves & branches		Total
	4		5		6
		%		%	
9	21.14	95.0	1.10	5.0	22.24
10	33.85	86.8	5.16	13.2	39.00
11	46.54	83.5	9.22	16.5	55.76
12	59.24	81.7	13.28	18.3	72.52
13	71.94	90.3	17.34	19.7	89.58
14	86.64	81.7	21.40	18.3	106.04
15	97.34	79.3	25.46	20.7	122.80
16	110.04	78.8	29.52	21.2	139.56
17	122.74	78.5	33.58	21.5	156.32
18	135.44	78.2	37.64	21.8	173.08
19	148.15	78.0	41.69	22.0	189.84
20	160.85	77.8	45.76	22.2	206.61
21	173.55	77.7	49.82	22.3	223.37
22	186.25	77.6	53.88	22.4	240.13
23	198.95	77.4	57.94	22.6	256.89
24	211.65	77.3	62.00	22.7	273.65
25	224.35	77.2	66.06	22.8	290.41
26	237.05	77.2	70.12	22.8	307.17
27	249.75	77.1	74.17	22.9	323.93
28	262.45	77.0	78.24	23.0	340.69
29	275.15	73.3	82.30	26.7	375.45
30	287.85	76.9	86.36	23.1	374.21
31	300.56	76.9	90.41	23.1	390.97
32	313.26	76.8	94.48	23.2	407.73
33	325.96	76.8	98.54	23.2	424.50
34	338.66	76.7	102.60	23.3	441.26
35	351.36	76.7	106.66	23.3	458.02
36	364.06	76.7	110.72	23.3	474.78
37	376.76	76.6	114.78	23.4	491.54
38	389.46	76.6	118.84	23.4	508.30
39	402.16	76.6	122.90	23.4	525.06
40	414.86	76.6	126.96	23.4	541.82

Species : *Morus alba* weight (kg)

D.B.H. (cm)	Stem upto 5 cm		Leaves & branches		Total
	7	%	8	%	9
6	2.38	92.2	0.20	7.8	2.58
7	11.68	59.8	7.84	40.2	19.52
8	20.97	57.5	15.48	42.5	36.45
9	30.26	56.7	23.13	43.3	53.39
10	39.54	56.2	30.79	43.8	70.33
11	48.83	55.9	38.44	44.1	87.27
12	58.12	55.8	46.08	44.2	104.20
13	67.41	55.6	53.73	44.4	121.14
14	76.70	55.5	61.38	44.5	138.08
15	85.99	54.9	69.03	45.1	155.02
16	95.28	55.4	76.68	44.6	171.96
17	104.57	55.4	84.32	44.6	188.89
18	113.86	55.3	91.97	44.7	205.83
19	123.15	55.3	99.62	44.7	222.77
20	132.44	55.2	107.27	44.8	239.71
21	141.73	55.2	114.92	44.8	256.65
22	151.02	55.2	122.56	44.8	273.58
23	160.31	55.2	130.21	44.8	290.52
24	169.60	55.2	137.86	44.8	307.46
25	178.89	55.1	145.51	44.9	324.40
26	188.18	55.1	153.15	44.9	341.44
27	197.46	55.1	160.81	44.9	358.27
28	206.75	55.1	168.46	44.9	375.21
29	216.04	55.1	176.11	44.9	392.15
30	225.33	55.1	183.76	44.9	409.08
31	234.62	55.1	191.40	44.9	426.02
32	243.91	55.1	199.05	44.9	442.96
33	253.20	55.0	206.70	45.0	459.90
34	262.49	55.0	214.35	45.0	476.84
35	271.78	55.0	221.99	45.0	493.77
36	281.07	55.0	229.64	45.0	510.71
37	290.36	55.0	237.29	45.0	527.65
38	299.65	55.0	244.54	45.0	544.59
39	308.94	55.0	252.59	45.0	561.53
40	318.23	55.0	260.23	45.0	578.46