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Arpana Pandey
Silviculture Division, Forest Research Institute, Dehradun, Uttarakhand, India

Dinesh Kumar
Silviculture Division, Forest Research Institute, Dehradun, Uttarakhand, India

VK Dhawan
Silviculture Division, Forest Research Institute, Dehradun, Uttarakhand, India

Corresponding Author:
Arpana Pandey
Silviculture Division, Forest Research Institute, Dehradun, Uttarakhand, India

Growth assessment of poplar clones developed by FRI, at Saharanpur, Uttar Pradesh and Hoshiarpur, Punjab

Arpana Pandey, Dinesh Kumar and VK Dhawan

Abstract
FRI developed *Poplar deltoides* clones trailed at Nanauta district, Uttar Pradesh and Hoshiarpur district, Punjab aimed to obtain the better clones, which satisfied the need of the people and wood-based industries. Data collected from these sites has been listed on the basis of girth measurement in the present study report. At Nanauta trail site, poplar clone FRI-PD-OP-41(71.56cm) shows maximum girth, followed by clones FRI-PD-OP-1, FRI-PD-OP-40, FRI-PD-OP-26 and at Hoshiarpur trail site, poplar clone FRI-AM-45(43.58cm) shows maximum girth, followed by FRI-AM-202, FRI-AM-57, FRI-AM-32 and FRI-AM-229.

Keywords: *Poplar deltoides*, clones, girth

Introduction
Poplar is amongst world's fastest growing multi-purpose tree species and its wood is in much demand for paper& pulp, plywood and matchwood, packing cases and light constructional timber all over the world. Poplar based agroforestry economically viable and more profitable than any other crop rotation (Jain and Singh, 2000) [3]. Approximately, the farmer's plants 95 per cent poplar in India mainly as agroforestry tree and it represents approximately half of the world's poplar based agroforestry resources (Ball *et al*., 2005) [2].
In India, poplar trials on larger scale started by FRI in 1959. During 1959 to 1976, FRI introduced 199 clones of various exotic species and hybrids, which included 29 clones of *P. deltoides*, among others. Clones G-3, G-48 and D-121 became very popular among growers, were also introduced during 1969 (Kaul and Sharma, 1982) [4]. Introduction of more clones continued and, as a result, about 440 clone of *Populus spp*. had been introduced till 1983 by FRI (Tewari, 1993) [5]. Initially, Wimco promoted poplar plantations for meeting their requirements of logs for manufacture of safety matches, plywood industry saw a good opportunity to set up veneering and plywood units based on this resource. By the year 2000, nearly 15 million poplar plants covering roughly 30,000ha area being were planted annually and similar area was being harvested maintaining a healthy balance between demand and supply of poplar logs (Anon, 2011) [11]. Bulk of the poplar planted in Hoshiarpur, Ropar, Nawan Shahar and Ludhiana Districts in Punjab; Yamuna Nagar District in Haryana; Saharanpur, Muzaffar Nagar, Meerut, Rampur and Bareilly districts in Uttar Pradesh; and Udham Singh Nagar and Haridwar districts in Uttarakhand in the country.

Materials and Methods
Study site
The assessment was carried out in Nanauta, Saharanpur district, UP and Hoshiarpur district, Punjab. Nanauta village, located at latitude $29^0.71''$ and longitude is $77^0.42''$. It has an area of about 3860 Km^2 and close to the foothills of Shivalik range. Soil types are sandy loam.
Hoshiarpur, located at latitude $31^0.644''$ and longitude is $75^0.793''$. The district has an area of 3365 km^2 and has mild climate.

Methodology
The girth measurements of stem over bark were taken at right angles to each other at 1.37 m above ground level with the help of tree meter tape and each clone have 10 replications. Data analysis was carried out with the help of using MS Excel software

Formula used for calculation

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

$\bar{X}$ = Average
X_i = observations (i to n)

Results and Discussions

The present piece of work was undertaken with a view to assess the growth of FRI develops Poplar clones on their experimental sites i.e. Nanauta and Hoshiarpur, from state Uttar Pradesh and Punjab respectively. The whole results have been presented into the following two sections-

a) Nanauta
b) Hoshiarpur

a) Nanauta: FRI develops 31 clones were planted on the experimental site; Nanauta and each clone have 10 replications. Girth of trees measured over bark at the height of 1.37 m by using meter tape. Girth (cm) of different clones is presented in Table 1. Based on data, shows that girth of clones lies between 53cm and 72cm at age of seven years.

Maximum girth (71.56cm) was found in FRI-PD-OP-41 clone and the minimum girth (52.78cm) was observed in clone FRI-PD-OP-61. Poplar clone FRI-PD-OP-41 shows maximum girth, followed by clones FRI-PD-OP-1, FRI-PD-OP-40, and FRI-PD-OP-26. Clone FRI-PD-OP-41 considered to be best performing clone in Saharanpur area.

b) Hoshiarpur: FRI develops 95 clones were planted in the experimental area of Hoshiarpur district as in Table 2 shows that girth of clone's lies between 31.9cm and 43.8cm at age of seven years. The maximum girth was 43.87cm observed in FRI-AM-45 clone and the minimum girth was 31.9cm was found in FRI-AM-69 clone.

Poplar clone FRI-AM-45 shows maximum girth, followed by FRI-AM-202, FRI-AM-57, FRI-AM-32 and FRI-AM-229. Thus the clone FRI-AM-45 has proven to be the best clone in Punjab.

1 2

Fig 1&2: Taking measurement of girth over bark by meter tape

Table 1: Data of girth of different clones at Nanauta

Clone no.	Clone name	Gbh. Measurements(cm)									Average
1	FRI PD OP-1	70	75	76	66	61	71	75	67	72	70.33
2	FRI PD OP-2	63	60	55	54	57	60	55	72	63	59.89
3	FRI PD OP-6	64	72	60	60	61	57	63	56	73	62.89
4	FRI PD OP-7	65	60	66	67	61	57	69	61	65	63.44
5	FRI PD OP-14	45	68	66	43	69	46	62	58	54	56.78
6	FRIPD OP-15	71	64	60	60	63	61	57	62	64	62.44
7	FRI PD OP-16	60	57	60	58	60	58	58	43	64	57.56
8	FRI PD OP-18	67	68	61	65	62	65	66	58	65	64.11
9	FRI PD OP-24	55	56	56	57	62	52	43	71	43	55.00
10	FRI PD OP-25	51	80	63	61	58	60	58	71	52	61.56
11	FRI PD OP-26	73	67.5	68	71	64	65	70	68	70	68.50
12	FRI PD OP-30	66	70	66	68	62	64	70	74	69	67.67
13	FRI PD OP-31	67	69	80	56	62	65	65	72	68	67.11
14	G48	72	71	70	71	62	70	69	65	70	68.89
15	FRI PD OP-40	74	76	78	63	65	70	65	70	62	69.22
16	FRI PD OP-41	73	80	72	80	69	69	70	68	63	71.56
17	FRI PD OP-42	64	78	68	73	71	74	68	69	68	70.33
18	FRI PD OP-50	73	68	67	74	63	68	68	67	70	68.67
19	FRI PD OP-54	72	54	60	70	60	61	59	65	59	62.22
20	FRI PD OP-55	61	58	56	54	58	59	60	55	71	59.11
21	FRI PD OP-56	66	71	70	66	63	65	70	67	73	67.89
22	FRI PD OP-60	57	53	52	43	70	47	59	60	53	54.89
23	FRI PD OP-61	50	52	43	60	52	58	39	57	64	52.78
24	FRI PD OP-66	47	60	56	58	49	63	62	48	50	54.78
25	FRI PD OP-74	53	60	60	57	48	55	56	60	60	56.56

26	FRI PD OP-75	63	62	61	68	60	64	74	50	68	63.33
27	FRI PD OP-76	63	60	56	72	61	62	66	62	62	62.67
28	FRI PD OP-80	60	71	60	63	67	56	59	70	51	61.89
29	FRI PD OP-81	74	52	62	71	61	62	58	61	57	62.00
30	FRI PD OP-89	53	53	68	27	50	60	50	64	64	54.33
31	FRI PD OP-95	62	64	65	58	60	72	48	58	61	60.89

Note: Gbh-Girth at breast height

Table 2: Girth data of different clones at Hoshiarpur.

Clone no.	Clone Names	Gbh. Measurements(cm)					Avg.
1	FRI-AM-58	41.32	39.50	42.30	40.30	41.60	41.00
2	FRI-AM-51	39.44	37.00	38.00	40.10	39.90	38.88
3	FRI-AM-41	39.52	37.50	39.00	38.00	36.90	38.18
4	FRI-AM-32	40.08	39.60	38.90	42.10	40.00	40.13
5	FRI-AM-54	39.30	38.60	37.80	40.00	41.30	39.40
6	FRI-AM-44	38.59	36.70	38.00	37.10	39.40	37.95
7	FRI-AM-59	38.56	38.10	40.50	37.40	41.50	39.12
8	FRI-AM-12	38.96	38.40	35.10	40.12	39.40	38.39
9	FRI-AM-48	37.26	35.60	39.40	38.70	33.90	36.90
10	FRI-AM-42	37.96	40.70	39.10	35.60	39.00	38.72
11	FRI-AM-106	39.09	39.50	43.40	38.20	40.00	40.03
12	FRI-AM-4	37.86	37.00	35.60	39.80	36.90	37.40
13	FRI-AM-89	38.27	37.80	40.00	39.00	38.30	38.60
14	FRI-AM-53	38.33	35.30	37.40	39.40	38.30	37.70
15	FRI-AM-105	36.93	34.50	37.10	38.00	35.50	36.40
16	FRI-AM-40	37.51	36.40	39.00	37.60	35.30	37.16
17	FRI-AM-24	37.48	38.80	36.10	37.40	39.50	37.80
18	FRI-AM-33	37.36	36.40	38.30	37.80	37.90	37.50
19	FRI-AM-87	39.61	37.90	39.50	40.50	38.60	39.20
20	FRI-AM-20	36.59	35.70	36.70	39.80	38.80	37.50
21	FRI-AM-109	36.55	34.50	37.80	37.00	39.00	36.97
22	FRI-AM-7	41.56	39.08	42.10	40.00	41.90	40.92
23	FRI-AM-13	39.64	38.60	39.10	37.90	40.90	39.22
24	FRI-AM-45	44.99	45.80	42.20	44.50	41.90	43.87
25	FRI-AM-30	36.31	38.80	37.60	39.10	36.00	37.50
26	FRI-AM-93	38.33	38.90	40.40	39.80	37.50	38.90
27	G-48	35.01	38.10	33.00	37.00	35.90	35.80
28	FRI-AM-21	32.23	30.40	33.50	31.00	32.90	32.00
29	FRI-AM-14	35.98	37.80	34.00	35.80	36.00	35.90
30	FRI-AM-50	34.60	34.90	33.40	33.90	36.00	34.50
31	FRI-AM-46	34.78	36.50	33.60	37.80	35.00	35.50
32	FRI-AM-15	35.94	33.00	36.00	37.00	39.30	36.20
33	FRI-AM-27	35.75	37.60	34.90	33.90	34.00	35.20
34	FRI-AM-18	34.75	37.00	36.50	35.60	34.80	35.73
35	FRI-AM-49	35.39	36.10	34.90	35.00	36.60	35.50
36	FRI-AM-98	33.59	35.50	33.40	36.00	34.30	34.50
37	FRI-AM-19	34.65	36.60	35.40	34.40	33.90	34.90
38	FRI-AM-70	34.35	35.90	34.20	33.20	34.90	34.51
39	FRI-AM-110	34.08	35.90	34.50	33.20	31.60	33.85
40	FRI-AM-116	35.36	35.60	38.00	34.30	35.50	35.70
41	FRI-AM-47	33.90	35.70	33.20	31.00	35.50	33.86
42	FRI-AM-121	33.98	34.20	33.60	35.50	34.40	34.33
43	FRI-AM-78	34.65	36.80	39.50	32.60	35.50	35.81
44	FRI-AM-16	35.13	35.50	36.10	38.10	33.40	35.64
45	FRI-AM-6	34.15	37.80	33.10	34.60	36.00	35.13
46	47-7	34.39	33.50	36.00	35.10	34.40	34.67
47	FRI-AM-112	34.41	37.10	36.10	33.40	35.20	35.20
48	FRI-AM-82	33.95	31.60	36.40	32.20	33.30	33.49
49	FRI-AM-107	33.64	33.65	31.10	33.40	35.10	33.37
50	FRI-AM-92	33.43	34.70	36.10	32.10	33.00	33.86
52	FRI-AM-72	33.87	31.50	32.00	36.60	33.90	33.50
53	FRI-AM-20	33.46	32.30	39.40	32.60	34.80	34.50
53	FRI-AM-39	33.43	32.10	30.00	37.60	33.50	33.30
54	FRI-AM-80	33.67	35.50	33.00	36.20	30.00	33.67
55	FRI-AM-2	33.99	35.40	33.30	34.20	36.10	34.50
56	FRI-AM-36	33.84	33.40	30.10	35.20	37.00	33.90
57	FRI-AM-8	33.44	32.20	36.60	33.10	32.50	33.50
58	FRI-AM-64	33.63	34.50	36.80	34.90	33.90	34.74

59	FRI-AM-33	33.84	35.50	33.00	36.20	32.00	34.10
60	FRI-AM-74	33.63	35.00	34.40	37.10	38.00	35.60
62	FRI-AM-73	33.07	35.60	33.00	34.90	32.60	33.80
63	FRI-AM-200	33.36	32.30	36.00	33.50	30.00	33.03
63	FRI-AM-76	33.53	35.20	30.00	34.90	33.50	33.40
64	FRI-AM-63	33.83	33.40	31.00	36.00	34.60	33.70
65	FRI-AM-95	33.87	30.10	34.20	33.90	32.30	32.80
66	FRI-AM-224	32.46	36.70	33.10	29.80	34.00	33.20
67	FRI-AM-73	33.47	31.50	32.60	34.80	37.50	33.97
68	FRI-AM-97	32.86	30.40	33.90	34.90	36.30	33.60
69	FRI-AM-37	33.07	30.00	34.30	32.10	30.50	31.90
70	FRI-AM-222	33.28	31.90	34.50	36.70	35.50	34.30
72	FRI-AM-230	32.63	33.50	36.30	37.50	32.50	34.50
73	FRI-AM-227	33.68	36.30	37.50	32.50	34.50	34.80
73	FRI-AM-34	32.80	31.30	34.50	33.30	36.10	33.60
74	FRI-AM-9	32.43	34.10	32.50	36.50	36.80	34.60
75	FRI-AM-33	32.86	35.70	31.10	30.00	36.40	33.20
76	FRI-AM-57	42.07	43.40	45.50	40.40	41.10	42.50
77	FRI-AM-229	42.22	40.40	39.40	44.20	43.60	41.90
78	FRI-AM-202	42.32	40.70	43.50	43.30	41.10	42.10
79	FRI-AM-82	40.36	38.40	42.80	41.10	39.90	40.50
80	FRI-AM-32	38.99	39.50	40.50	37.70	38.90	39.11
82	FRI-AM-77	38.28	37.80	39.90	36.50	40.50	38.50
83	FRI-AM-92	38.73	38.00	40.50	35.40	37.60	38.07
83	FRI-AM-60	38.92	42.80	41.10	39.90	40.50	38.00
84	FRI-AM-225	39.29	37.60	38.70	39.80	42.20	39.50
85	FRI-AM-27	38.59	36.00	38.10	33.20	40.40	37.20
86	FRI-AM-90	37.98	38.70	39.80	42.20	36.50	39.03
87	FRI-AM-5	38.39	38.70	39.80	42.20	41.80	40.10
88	FRI-AM-79	37.78	36.50	36.80	39.50	35.50	37.20
89	FRI-AM-96	37.54	39.20	35.20	40.40	37.00	37.80
90	FRI-AM-53	35.35	37.10	32.10	35.00	34.90	34.80
92	FRI-AM-88	37.78	35.50	34.00	38.10	33.20	35.70
93	FRI-AM-35	30.92	32.10	33.00	31.70	33.40	32.20
93	FRI-AM-3	NA					
94	FRI-AM-62	NA					
95	FRI-AM-203	43.64	40.20	41.10	39.08	38.00	40.40

Note: Gbh-Girth at breast height

Conclusion

Poplar (*P. deltoides)* is amongst world's fastest growing species which can be harvested within 5-8 years of plantation. It is multipurpose tree species whose wood is in demand for paper & pulp, plywood, matchwood, packing case and light construction. Poplar is considered as the most promising species under agroforestry system of plantation because it remain "leafless in winter so beneficial for rabi crops, while in summer it provides appropriate shade for the kharif crop". In this way poplar reduce our dependency on the slow growing species and natural forest. The demand of poplar has kept on increasing in the north India due to its multipurpose value especially in industries. Some of the tried clones have been affected by pathogen and insects. Organisations like ICFRE/ FRI are trying to develop some clones of poplar which can withstand harsh environment, increase productivity and fulfil the immediate need of the industries. The multi-location trail of such clones would select the superior clones for the commercial purposes.

Experimental trails were laid by FRI at district Nanauta, Uttar Pradesh and District Hoshiarpur, Punjab trails were developed to observe the most promising clones of poplar for agroforestry and softwood industries. At Nanauta 31, clones of poplar were tried; among them FRI-PD-OP-41 shows the maximum girth i.e. 72cm and FRI-PD-OP-61 shows minimum girth i.e. 53cm. At Hoshiarpur 95, clones of poplar were tried; among them FRI-AM-45 shows maximum girth i.e. 43.87cm and FRI-AM-69 shows the minimum girth i.e. 31.9cm.

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