CLONAL VARIATION IN REGENERATION OF SHOOTS AFTER HEDGING IN VEGETATIVE MULTIPLICATION GARDEN OF *DALBERGIA SISSOO* (SHISHAM) ROXB.

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Introduction

Clonal propagation of *Dalbergia sissoo* (Shisham) Roxb. through rooting of juvenile shoot cuttings is the most practical approach for mass scale production of superior planting stock. Continuous supply of juvenile shoots is possible through establishment and maintenance of Vegetative Multiplication Garden (VMG)/ Hedge garden of superior clones and extracting shoots from them through regular hedging/coppicing. Cuttings obtained from coppiced shoots are juvenile and thus have higher rooting potentiality (Gurumurti *et al.,* 1988). Successful rejuvenation by coppicing adult trees has been achieved in many forest tree species (Bonga, 1982; Gurumurti *et al*., 1988; Bakshi, 1989; Robertson and Kleinschmit, 1991). Since regenerated shoots after coppicing form the raw material for propagule production, success of any clonal forestry programme will depend on good regeneration capacity of shoots. Shoot production in hedge garden/VMG is affected by a number of factors (Pong-anant 1989, Bagchi and Mittel, 1986, Pal *et al.*, 2003) and can be enhanced by proper management.

The present observations were made in 96 clones of Shisham in VMG at Birplasi, Nalagarh (Himachal Pradesh) to identify the best clones producing maximum shoots.

Material and Methods

Under planting stock improvement programme of World Bank-FREE project, a VMG using clonal material of selected plus trees was established at Birplasi, Nalagarh (H.P.) in year 1999 (5 years old). For this, one year old material was procured from Forest Research Institute, Dehra Dun which was raised by means of juvenile shoot cuttings obtained from root suckers of selected plus trees. The present investigation was carried out in 96 clones planted in hedge garden at Birplasi which were maintained in a row to row design with forty five ramets/row/clone.

Hedging was performed in the month of Jan. - Feb. 2003 at 30 cm hedging level. Ten stumps/clone chosen randomly were observed for shoot emergence and six weeks after hedging, data was recorded on collar diameter of cut stump, number of shoots regenerated, maximum length of shoots and their basal diameter. The data

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pertaining to 96 clones (10 ramets of each clone) with regard to above parameters was subjected to ANOVA using SPSS computer program and correlation between collar diameter and shoot number was worked out.

Results and Discussion

Significant clonal variation (P< 0.001) was observed for the collar diameter of coppiced stump, days of emergence of shoots after hedging, shoot number, their length and basal diameter (Table 1). The maximum collar diameter of coppiced stump (89.2 mm) was observed in clone 6 belonging to Chiryapur (Bijnor) followed by 86 mm in clone 207 belonging to Gonda and the minimum collar diameter (34.4mm) was recorded in clone 106 (Hanumangarh, Rajasthan). Days to emergence of shoots ranged between 5 to

Table 1

Collar diameter of stump, days of shoot emergence, mean number of shoot, mean shoot length and collar diameter of shoot after hedging in different clones of Dalbergia sissoo at the age of 5 years.

Clone No.	Collar dia. stump (mm)		Days of shoot emergence after hedging		No. of shoots/ stump		Max. shoot length (cm)		Shoot diameter (mm)	
1	2		3		4		5		6	
6	89.2	5.3	16.0	0.73	56.2	2.4	103.2	4.3	8.7	0.5
9	82.7	5.7	17.0	0.64	42.0	3.4	132.8	3.5	11.0	0.4
10	47.0	4.9	15.0	0.64	45.5	4.5	67.5	3.4	6.2	0.5
15	55.9	6.3	11.0	0.40	35.1	2.4	73.3	5.0	6.1	0.5
16	65.8	1.2	13.0	0.56	42.0	2.1	71.2	.6.5	7.5	0.6
18	53.0	5.6	13.0	0.34	36.9	2.9	75.2	8.0	8.0	0.7
19	73.3	6.0	13.0	0.61	43.2	3.8	105.4	5.1	9.6	0.7
20	65.4	4.4	13.0	0.54	45.6	5.9	88.1	4.8	7.4	0.5
21	64.7	5.6	12.0	0.39	40.7	5.1	77.1	5.6	6.7	0.6
33	42.2	6.3	11.0	0.40	34.0	7.3	95.4	6.6	8.4	0.6
34	51.1	8.7	12.0	0.41	42.9	4.8	70.2	9.1	5.7	0.9
36	60.0	7.5	14.0	0.87	42.6	2.4	76.0	3.8	6.6	0.6
40	68.8	8.5	11.0	0.16	54.0	4.7	102.6	8.1	8.0	0.6
41	67.5	7.2	11.0	0.58	52.2	2.2	87.2	7.5	7.2	0.5
42	80.9	3.1	11.0	0.87	57.2	4.0	94.6	2.4	7.9	0.2
44	63.6	8.5	10.0	0.48	47.4	4.5	87.2	7.5	8.4	0.9
47	80.9	8.3	12.0	0.31	42.9	4.4	102.6	3.3	9.0	0.4

Contd...

1	2		3		4		5		6	
49	54.4	8.1	13.0	0.31	35.1	5.0	70.6	9.6	6.4	0.8
51	65.4	4.7	12.0	0.36	42.6	2.2	95.7	7.1	8.6	0.7
55	45.0	3.2	14.0	0.87	37.2	4.9	60.5	5.0	5.3	0.5
57	53.2	6.9	12.0	0.36	42.8	4.0	77.1	8.0	6.6	0.7
59	75.0	3.5	11.0	0.40	40.9	2.6	98.8	3.7	9.3	0.4
60	69.0	.7.1	11.0	0.24	48.4	2.9	96.1	8.0	8.7	0.8
61	58.4	2.5	12.0	0.36	37.0	5.8	75.7	4.5	7.3	0.5
62	63.0	5.0	12.0	0.23	46.2	2.8	91.6	5.1	8.3	0.5
64	35.5	3.6	15.0	0.64	26.6	4.9	68.8	5.2	6.2	0.7
66	55.8	9.8	11.0	0.40	37.5	2.7	76.2	10.7	6.7	1.0.
67	64.2	3.1	13.0	0.61	54.9	3.5	73.8	3.4	6.7	0.5
78	59.1	6.9	10.0	0.48	41.6	2.5	96.6	6.6	8.7	0.8
79	36.8	5.0	14.0	0.65	27.5	2.1	92.8	8.9	8.5	0.8
80	57.1	5.0	13.0	1.23	42.1	3.5	78.0	2.8	6.0	0.4
81	49.0	2.5	15.0	0.82	34.0	1.8	106.1	6.9	9.3	0.2
82	50.1	7.2	10.0	0.62	32.5	4.9	79.9	7.4	6.6	0.8
83	46.1	5.3	14.0	1.0	38.6	5.1	69.5	5.6	5.7	0.5
84	42.4	2.7	13.0	0.49	38.4	3.9	74.7	3.5	5.9	0.3
86	63.0	4.6	5.0	0.33	53.6	2.6	93.2	3.4	7.8	0.3
87	39.4	6.3	8.0	0.34	33.5	5.0	66.5	5.6	4.9	0.5
90	71.8	3.8	13.0	1.23	49.0	2.9	79.6	5.1	6.7	0.5
91	51.0	3.3	5.0	0.33	47.1	3.5	80.3	5.3	7.3	0.5
92	65.3	4.7	11.0	0.82	47.2	2.7	87.2	4.3	7.4	0.5
99	62.3	6.6	11.0	0.68	32.9	2.8	79.4	6.8	6.9	0.6
101	48.9	3.6	9.0	0.38	42.7	5.0	69.1	3.9	5.9	0.4
103	68.1	5.8	8.0	0.29	54.6	3.3	92.7	5.4	8.1	.0.5
106	34.4	7.9	9.0	0.38	38.8	7.2	65.6	9.8	5.7	0.9
107	68.9	8.5	11.0	0.94	**67.0 ±**	**8.5**	90.6	3.6	7.2	0.5
114	44.8	4.7	14.0	0.95	33.5	2.0	93.9	8.9	8.8	0.5
121	48.7	3.0	15.0	1.06	27.1	. 2.5	98.3	7.1	8.8	0.7
123	74.8	3.1	13.0	0.97	47.2	2.3	92.2	2.3	7.8	0.5
129	67.7	8.8	9.0	1.03	43.8	5.1	103.4	7.1	9.0	1.0
133	62.6	2.0	11.0	0.74	43.7	5.9	102.3	5.2	9.4	0.7
136	47.7	2.7	11.0	0.94	43.2	3.1	106.0	3.0	9.6	0.3
137	45.1	3.6	12.0	0.80	44.4	1.9	110.3	5.3	10.2	.0.4

Contd...

1	2		3		4		5		6	
200	47.8	4.4	11.0	0.42	39.2	2.6	107.4	1.7	10.2	0.2
203	77.3	4.4	11.0	0.95	40.9	2.7	94.7	5.5	7.6	0.6
204	73.0	6.0	14.0	0.95	47.8	3.3	107.4	5.5	10.0	0.6
207	86.0	5.0.	11.0	0.94	41.6	2.9	92.5	4.1	7.7	0.5
215	55.7	6.1	10.0	0.41	44.5	3.4	102.8	5.9	9.3	0.8
236	66.5	5.2	15.0	0.41	43.6	3.6	87.9	7.7	7.5	0.8
237	60.9	6.2	12.0	0.54	45.5	4.6	93.0	6.5	8.0	0.8
243	59.5	1.9	13.0	0.91	47.4	3.2	86.1	6.5	7.3	0.7
249	46.9	6.4	11.0	0.94	47.0	3.0	78.7	8.5	6.8	0.8
250	72.4	8.3	13.0	0.92	33.1	1.7	96.6	7.1	7.8	0.8
252	49.2	1.8	16.0	0.75	30.5	1.6	111.7	4.6	9.7	0.5
253	41.0	4.7	15.0	0.80	25.6	2.8	87.6	7.8	9.6	0.4
254	52.4	. 5.0	17.0	0.68	43.5	1.4	131.3	4.9	**11.5 ±**	**0.5**
260	78.7	4.7	12.0	1.00	32.7	1.9	95.9	7.8	6.0	0.4
262	51.7	3.4	12.0	0.94	35.1	2.8	92.4	4.1	7.8	0.5
266	42.3	8.4	15.0	0.80	33.0	2.6	83.2	3.3	7.6	0.5
268	45.3	8.4	12.0	0.76	33.1	4.5	72.5	6.3	7.2	1.0.
269	45.5	5.6	14.0	0.76	30.5	4.2	91.5	9.2	7.9	0.9
270	44.0	2.3	11.0	0.94	32.5	2.6	83.1	5.1	7.6	0.2
MMP1	47.6	4.4	17.0	0.83	25.7	2.1	119.1	4.5	10.4	0.6
NP1	46.0	2.2	17.0	1.03	31.3	1.6	99.2	4.9	8.7	0.3
NP2	43.9	2.8	16.0	0.76	27.1	1.6	96.6	3.0	8.2	0.5
NP3	55.9	3.1	12.0	0.76	47.2	4.1	97.2	3.8	8.1	0.5
P1	56.2	4.4	11.0	0.94	51.6	2.3	82.1	6.0	7.5	0.5
P2	68.0	8.2	13.0	0.86	41.2	5.7	106.9	7.1	10.0	0.6
P3	43.1	2.4	15.0	0.38	31.0	1.7	84.2	3.2	7.0	0.6
P5	51.7	7.9	9.0	0.76	36.4	4.4	73.1	8.7	6.6	0.8
P7	61.0	2.3	12.0	0.94	35.6	2.9	77.4	3.2	6.5	0.6
S9	75.0	6.9	11.0	0.94	35.1	1.4	122.5	4.1	10.9	0.6
S12	46.0	2.2	11.0	0.4	35.4	2.4	107.5	6.5	9.9	0.6
S 19	69.4	4.8	10.0	0.95	33.5	4.2	118.6	2.8	10.6	0.5
S 24	52.4	5.2	14	0.95	33.5	3.8	96.6	4.6	8.7	0.4
S 33	67.6	4.7	14	0.83	35.6	1.8	91.1	7.7	8.1	0.7
S 35	53.4	4.3	15	0.81	35.6	2.3	88.4	2.7	8.5	0.7
S 40	56.0	4.7	11	1.05	45.4	3.2	103.8	8.2	9.5	0.9

Contd...

1	2		3		4		5		6	
S 41	64.4	3.8.	13	0.50	39.5	2.8	88.3	5.0	8.0	0.4
S 42	46.2	3.8	11	0.95	36.6	2.3	86.5	2.9	8.0	0.3
S 44	47.1	3.8	14	1.05	36.3	1.9	80.2	6.8	7.0	0.9
S 57	48.2	4.1	13	0.42	35.0	2.8	74.5	6.5	6.9	0.7
S 66	59.8	4.1	11	0.50	50.6	2.7	113.1	4.7	10.3	0.3
S 93	37.8	5.7	11	0.39	29.4	3.4	65.6	7.4	5.7	0.6
S 123	57.9	3.1	12	0.95	38.5	1.9	106.7	3.0	9.7	0.3
S 137	52.7	7.0	14	0.95	36.0	3.2	78.9	5.1	7.2	0.5
S 189	63.6	3.6	14	0.38	39.0	3.3	99.6	2.7	9.0	0.2
Mean	57.5	5.06	12.3	0.68	40.3	3.35	90.20	5.5	7.94	0.59
CD		4.77		2.21		6.23		8.15		0.54

17 days with the earliest being in clone 86 and 91 (Rajasthan) and lately being in 9, 254, MMP1 and NP1 belonging to Bareilly, Rishikesh, Matak Majri and Nalagarh respectively (Table 1). The number of shoots ranged from 25.6 (253 Rishikesh) to 67 (107, Hanumangarh). As regards shoot length and basal diameter, maximum values of 133 cm and 11 mm respectively were shown by clone 9 belonging to Pathri, Haridwar (Table 1). Correlation between collar diameter and shoot number was feeble (r =0.68).

Hedge garden/VMG of Shisham at Birplasi was maintained to capture maximum juvenility. Age of hedging / No. of hedges also play an important role in regeneration of shoots, though level of hedging has a variable effect on shoot production as well as rooting (Pal *et al*., 2003), *Dalbergia sissoo* continues to produce rooted propagules for at least 5-6 years without affecting much the rooting potentiality. Seasonal fluctuations in regeneration potential of shoots like other species is obvious in sissoo as well. Hedging made in dormant- winter season showed best response (unpublished). Similar response was observed in *Eucalyptus oblique* L. Herit (Blake, 1972), *Platnus occidentalis* L. (Belanger, 1979) and *Eucalyptus* hybrid (Bakshi, 1989) when trees were coppiced in winter or early spring.

The findings of present work clearly showed that variation exists with respect to collar diameter of coppiced stump, days of emergence of shoots after hedging, shoot number, their length and basal diameter in different genotypes of *D. sissoo*. Differential response in sprouted shoots of sixty clones was also observed in *Eucalyptus tereticornis* (Verma *et al*., 2003) and eight clones of *D. sissoo* (Pal *et al*., 2003).

Existence of feeble correlation between collar diameter and shoot number in this study envisages that shoot production is independent of collar diameter in 5 year old hedges. Similar correlation between these two factors has earlier been reported in *D. sissoo* (Pal *et al*., 2003) which however is contradictory to reports of Babitha *et al*. (2000) in *Eucalyptus tereticornis* and Singh and Gupta (1996) in *Debregeasia hypoleula*.

The findings of this investigation suggest that preliminarily selection of clones could be made on the basis of high shoot regeneration capacity following hedging coupled with maximum shoot length and early emergence of shoots assuming that higher shoot regeneration would lead to maximum plantlet production and hence will be suitable for large scale multiplication.

SUMMARY

Ninety six clones of *Dalbergia sissoo* were hedged at 30 cm of height level in the month of Jan. - Feb. in VMG at Birplasi, Nalagarh (HP) to assess shoot regeneration capacity of different clones. Significant differences (P> 0.001) were observed among clones regarding days to shoot emergence, collar diameter of cut stumps, shoot number, shoot length and basal diameter of shoots. The earliest shoot emergence (5 days) was recorded in clone 86 and 91 both belonging to Rajasthan. The maximum number of shoots (67) were recorded in clone 107 (Rajasthan) followed by 57 shoots (Clone 42, Gonda), while maximum shoot length (133cm) and diameter (11 mm) was observed in clone 9 (Pathri, Haridwar). A feeble (r=0.68) correlation was observed between collar diameter of stump and number of regenerated shoots.

डलबर्गिया सिस्सु (शीशम) राक्स० के वर्धीप्रवर्धन उद्यान में बाड़ लगाने पर प्ररोह पुनर्जनन होने में कृन्तकीय विभिन्नता

मीना बख्शी, के०एस० ठाकुर व सुरेन्द्र कुमार

सारांश

विभिन्न कृन्तकों की प्ररोह पुनर्जनन क्षमता का आकलन करने के लिए बीरपलासी, नालागढ (हिमाचल प्रदेश) के वर्धीप्रवर्धन उद्यान में जनवरी–फरवरी के महीनों डलबर्गिया सिस्सु के 96 कृन्तकों पर 30 सेमी ऊंचाई स्तर रखकर बाड़ लगाई गई। प्ररोह निकलने में लगे दिन, कटे ठूंठ के मूलंसधि व्यास, प्ररोह संख्या, प्ररोह लम्बाई और प्ररोहों के आधार व्यास की दृष्टि से कृन्तकों में सार्थक अन्तर (P> 0.001) रहता पाया गया। सबसे पहले प्ररोह निकलने लगना (5 दिनों में) कृन्तक 86 और 91 में देखा गया जो दोनों राजस्थान के कृन्तक है। सबसे अधिक संख्या में (67) प्ररोह कृन्तक 107 (राजस्थान) में निकले देखे गए जिसके बाद 57 प्ररोह (कृन्तक 42, गोंडा) में निकले, जबकि प्ररोह की अधिकतम लम्बाई (133 सेमी) और व्यास (11 मिमी), कृन्तक 9 (पथरी, हरिद्वार) की रही। एक हल्का–सा सहसम्बन्ध (r = 0.68) ठूंठ के मूलसंधि व्यास और पुनर्जनित हुए प्ररोहो की संख्या में रहता पाया गया।

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