Research Notes

Variability, heritability and genetic advance in propagation parameters of mulberry (*Morus* species)

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Mulberry is a perennial heterozygous plant possesses variability due to its free crossing in nature. In farmer's field, mulberry is generally propagated and multiplied through vegetative means. In vegetatively cultivated crops, root initiation and rooting ability are considered as primary selection criteria as they contribute and stabilize yield (Chloupek and Rod, 1992). The development of root system enhanced the plant growth by utilizing soil resources, nutrients and water (Hartman and Kester, 1978). Moreover, vegetative propagation is an added advantage for direct multiplication and perpetuation of true to type genetic identity to conserve and maintain mulberry germplasm resources. Earlier studies on mulberry propagation carried out by different authors are limited to green house (Bhatt and Hittalmani, 1996; Tikader *et al.,* 1996). Moreover, the material collected through survey and exploration from different eco-zones was not tested properly in field condition.

Thus, the present study was undertaken to know the rooting percentage variability of propagation traits, interaction of accessions with different season and genetic contribution of mulberry accession toward expression of propagation traits.

Six month-old vegetative twigs of selected mulberry accessions were used for preparation of cuttings. Before planting, the soil in the nursery bed was prepared by mixing farm yard manure, sand and soil in equal proportion (Tikader *et al.,* 1995). The length and diameter of mulberry cuttings were 15-20 cm and 1.3 - 1.8 cm, respectively, with 4 - 5 active buds. The cuttings of 30 mulberry accessions were planted at 15 x 15 cm spacing in Randomized Block Design. Fifty cuttings per replication were planted and studied in three replications. Two seasons (February and September, 2004) were studied at Central Sericultural Germplasm Resources Centre, Hosur. During dry season 0.2% urea solution was used as foliar spray to supplement the nutrient requirement of the saplings. Survival data were recorded after 90 days. The saplings were uprooted (10 saplings / replication) from the nursery bed without damaging the root system (Goel *et al.,* 1998). The plant material was dried in hot air oven at 80^0C for 24 hours and dry weight recorded (Tikader and Roy, 1999). The data were compiled and analyzed as mentioned by Singh and Chaudhury (1979).

The materials used in this study are presented in Table 1. The mulberry accession was grouped based on survival per cent (Table 2). The group indicates poor (<=50%), medium (>50% and <=70%) and good rooters (>70%). Maximum distribution of accessions was found in medium and good rooters group both from

Table 1. List of the accessions used for the study.

Accessions	Name of acc.	Collected from	Collected through	Species
MI-0211	Jhorpokharia	West Bengal	Survey Collection	*M.alba*
MI-0307	Kariyankadu	Tamil Nadu	Survey collection	*M.alba*
MI-0309	Periyasolakadu	Tamil Nadu	Survey collection	*M.alba*
MI-0312	Gulikadava	Tamil Nadu	Survey collection	*M.indica*
MI-0313	Seekupari	Tamil Nadu	Survey collection	*M.alba*
MI-0316	Jagdalpur	Madhya Pradesh	Survey collection	*M.indica*
MI-0329	Solakadu	Tamil Nadu	Survey collection	*M.indica*
MI-0346	Tingari local	Assam	Survey collection	*M.indica*
MI-0349	Garobadha	Meghalaya	Survey collection	*M.indica*
MI-0360	Jabalpur	Madhya Pradesh	Survey collection	*M.alba*
MI-0369	Resham Majri-6	Uttaranchal	Survey collection	*M.alba*
MI-0376	Kunjagao-2	Uttaranchal	Survey collection	*M.indica*
MI-0382	Farabori	West Bengal	Survey collection	*M.alba*
MI-0388	Herbertpur	Uttaranchal	Survey collection	*M.alba*
MI-0404	Dehradun local-1	Uttaranchal	Survey collection	*M.indica*
MI-0406	Dehradun local-6	Uttaranchal Sur	Survey collection	*M.alba*
MI-0415	Guhanathapuram	Kerala	Survey collection	*M.indica*
MI-0416	Keeraithodu	Keral	Survey collection	*M.indica*
MI-0422	Pichmadi-2	Madhya Pradesh	Survey collection	*M.indica*
MI-0423	Srinagar	Uttaranchal	Survey collection	*M.alba*
MI-0431	Saharanpur Road	Uttaranchal	Survey collection	*M.indica*
MI-0437	Baragarh-2	Uttaranchal	Survey collection	*M.indica*
MI-0438	Ranipukhri	Uttaranchal	Survey collection	*M.alba*
MI-0439	RSRS, Sahaspur	Uttaranchal	Survey collection	*M.indica*
MI-0442	Surari	Uttaranchal	Survey collection	*M.alba*
MI-0469	WB x Kosen	Karnataka	Survey collection	*M.alba*
MI-0498	Tiparpur -2	Uttaranchal	Survey collection	*M.alba*
MI-0511	Tiparpur-1	Uttaranchal	Survey collection	*M.alba*

Table 2. Grouping of mulberry accessions based on survival per cent.

Groups	Mulberry species	Accessions
Poor rooter (<=50%)	*M.indica*	MI 0335
Medium rooter (>50%	*M.indica*	MI 0312, 0316, 0349 0360, 0415, 0416, 0439
and <=70%)	*M.alba*	MI-0369, 0388, 0442, 0498, 0511
	M.indica	MI 0329, 0346, 0376, 0404, 0422, 0431, 0437
Good rooter (>70%)	*M.alba*	MI 0307, 0309, 0313, 0362, 0382, 0406, 0211, 0423, 0438, 0469

Table 3. Mean performance and variability in propagation traits of *Morus* species.

Accessions	SUR	SHL	SWTF	SWTD	SDIA	RTNO	LRL	RWTF	RWTD
MI-0211	81.28	46.10	37.57	10.05	0.68	11.70	22.80	6.45	1.82
MI-0307	79.72	43.18	13.21	4.88	0.71	11.57	22.22	5.23	1.68
MI-0309	76.05	50.52	12.76	4.99	0.67	12.23	20.20	5.49	2.10
MI-0312	58.12	70.50	12.76	4.99	0.67	12.23	20.20	5.49	2.10
MI-0313	72.92	58.92	37.35	14.00	0.77	10.09	24.09	9.48	3.66
MI-0316	50.34	100.20	91.29	32.14	1.01	13.01	28.67	19.01	6.51
MI-0329	85.83	90.55	89.55	29.83	0.82	10.90	35.28	20.63	7.40
MI-0335	40.28	72.42	74.38	27.68	0.86	7.23	40.98	20.51	8.00
MI-0346	83.56	64.00	42.15	16.96	0.73	11.24	33.86	11.20	3.97
MI-0349	57.75	80.62	40.76	17.04	0.87	10.85	27.43	15.96	6.25
MI-0360	60.84	55.43	10.03	3.73	0.89	10.88	31.42	18.43	6.33
MI-0362	81.62	71.62	40.69	14.29	0.86	6.56	42.96	14.23	4.22
MI-0369	69.89	61.23	46.63	13.45	0.84	9.58	29.17	7.83	2.30
MI-0376	75.99	100.18	74.48	27.52	1.05	13.33	31.60	17.40	7.49
MI-0382	73.79	68.49	43.84	14.24	0.85	6.55	25.22	5.66	1.93
MI-0388	66.41	86.28	33.55	16.53	0.85	6.89	48.75	16.96	5.22
MI-0404	74.52	77.08	25.31	10.70	0.86	7.62	46.82	9.76	2.38
MI-0406	79.83	36.67	12.18	3.82	0.50	7.50	30.17	4.05	1.39
MI-0415	66.33	96.33	64.42	20.88	1.10	17.33	31.17	19.50	6.67
MI-0416	67.83	66.33	50.67	18.39	0.72	15.02	39.04	11.52	3.98
MI-0422	73.33	49.33	32.62	10.91	0.78	5.50	28.83	5.11	2.06
MI-0423	86.67	47.67	8.40	2.86	0.48	4.83	34.17	5.61	2.20
MI-0431	73.00	46.67	27.56	8.76	0.62	4.33	32.00	4.86	1.94
MI-0437	81.67	54.50	18.33	6.85	0.85	6.20	31.42	10.82	3.23
MI-0438	82.17	43.17	23.78	7.51	0.60	4.67	31.17	4.92	1.81
MI-0439	65.33	51.92	39.03	10.26	0.93	8.83	32.50	8.53	3.00
MI-0442	65.67	19.92	7.58	2.34	0.35	3.50	18.00	2.18	1.03
MI-0469	75.17	80.17	69.92	30.37	0.98	5.50	30.00	8.32	3.65
MI-0498	66.67	50.83	33.56	10.51	0.70	5.83	32.75	3.89	1.43
MI-0511	68.33	47.50	34.42	11.52	0.77	5.83	31.33	8.62	2.46
Mean	71.37	62.94	40.37	14.26	0.78	8.96	31.58	10.60	3.74
SD	10.64	19.80	24.08	8.80	0.17	3.57	7.07	5.77	2.14
CV%	14.91	31.46	59.65	61.72	21.23	39.79	22.40	54.45	57.39
F-test Acc	**	**	**	**	**	**	**	**	**
Season	NS	**	**	**	**	NS	*	**	**
Acc x season	**	**	**	**	**	**	**	**	**

Acc. = Accession, SD = Standard deviation, CV% = Coefficient of variation, SUR = Survival %, SHL = Shoot length (cm), SWTF = Shoot weight (fresh)(g), SWTD = Shoot weight (dry) (g), SDIA = Shoot diameter (cm), RTNO = Root number / sapling, LRL = Longest root length (cm), RWTF = Root weight (fresh) (g), RWTD = Root weight (dry) (g).

M.indica and *M. alba.* The mean performance of different rooting parameters is presented in Table 3. Maximum rooting per cent was recorded in MI-0438 followed by MI-0437. Minimum survival per cent was recorded in MI-0442. Analysis of variance in all propagation parameters was significant at P<0.01. The seasonal variation was non- significant in case of survival per cent and no of roots / saplings. But other parameters showed significant difference. The result indicated that environmental influence prevailed during the study period. The interaction between accessions x season was significant at P<0.001 for all the parameters studied. Similar findings were reported earlier (Dorcus and Vivekanandan, 1997; Tikader and Pavankumar, 1998). This indicated that different mulberry accessions had bearing on season to express their genetic potential. The coefficient of variation was maximum in shoot weight (dry) followed by shoot weight (fresh), root weight (fresh), root weight (dry), no. of roots and shoot length. Minimum CV per cent was recorded for survival per cent of the saplings. The result indicated that the environment had

played little role or no adverse effect for survival per cent.

The mean, maximum, minimum values and estimates of genetic parameters are presented in Table 4. Wide variation between PCV and GCV value indicated that all 9 parameters had considerable environmental influence for expression. Both PCV and GFV were found high for shoot weight (dry) followed by shoot weight (fresh), root weight (fresh and dry) where as lowest was for survival per cent. The heritable variation determines the degree of success in selection of parameters. In the present study, moderate to high heritability was observed for survival per cent, shoot length, no. of roots, root weight (fresh and dry). These parameters also showed high estimates of genetic advance, which confirmed the additive gene effects in determining the parameters, and would be effective in selection procedure (Goel *et al.,* 1998). Bhat and Hittalmani (1996) also reported the influence of environment on the expression of different characters at sapling stage and similar magnitude of variability in genetic parameters.

Table 4. Evaluation of genetic variability in mulberry germplasm at sapling stage.

Parameter	Mean+SE	Min.	Max.	PCV%	GCV%	Heritability (Broad sense)	Genetic advance (% of mean)
Survival (%)	71.37+2.89	40.28	86.67	17.53	14.33	66.83	24.13
Shoot length(cm)	62.94+5.62	19.92	100.20	37.46	30.11	64.64	49.87
Shoot weight (fresh) (g)	40.37+9.46	7.58	91.29	80.35	54.58	46.13	76.37
Shoot weight (dry) (g)	14.26+3.49	2.34	32.14	83.09	56.48	46.21	79.09
Shoot diameter (cm)	0.78+0.04	0.36	1.10	24.93	20.42	67.09	34.45
No. of roots	8.96+0.75	3.50	17.33	44.08	38.88	77.80	70.64
Longest root length (cm)	31.58+12.25	18.00	48.75	27.63	21.20	58.86	33.50
Root weight (fresh) (g)	10.60+1.93	2.18	20.63	68.36	51.21	56.12	79.82
Root weight (dry) (g)	3.74+0.82	1.03	8.00	75.94	52.90	48.55	75.94

Thus, the information gathered on different propagation parameters of mulberry accessions would be useful for selecting the appropriate accessions for further use.

References

Bhat, G.G. and Hittalmani, S. (1996). Clonal differences in mulberry *(Morus* spp.)　for root growth parameters. *Indian J. Sericulture,* **31 (1) :** 5-8.

Chloupek, O. and Rod, J. (1992). The root system as a selection criterion. *Plant Breeding Abstract,* **62 (12) :** 1337-1341.

Dorcus David and Vivekanandan. (1997). Exploitation of mulberry for drought resistance potential. *Journal of Sericultrual Science of Japan,* **66 (2) :** 71–80.

Goel, A. K., Ravindran, S., Rao, A.A., Naik, V.G., Tikader, A., Mukherjee, P. and Sekar, S. (1998). Variability in rooting parameters at juvenile stage in mulberry *(Morus* spp.) germplasm. *Indian J. Sericulture,* **37(2):** 109-112.

Hartman, H.T. and Kester, D.E. (1978). Plant propagation, Principle and Practices. Prentice Hall of India Private limited, Third Edition, New Delhi 110 001, pp. 255 and 662.

Tikakader, A., Shamsuddin, M., Vijayan, K. and Pavankumar, T. (1995). Survival potential in different varieties of mulberry *(Morus* species). *Ind. J. Agric. Sciences,* **65(2):** 133 – 135.

Tikader, A., Vijayan, K., Roy, B.N. and Pavankumar, T. (1996). Studies on propagation efficiency of mulberry *(Morus* spp.) at ploidy level. Sericologia, **36(2):** 345 – 349.

Tikader, A. and Pavankumar, T. (1998). Variation analysis among some rooting parameters in mulberry *(Morus* spp.). *Indian J. Forestry,* **21(4):** 304 – 307.

Tikader, A. and Roy, B.N. (1999), Correlation and path analysis studies in rooting parameters of exotic mulberry germplasm accessions *(Morus* spp.). *Indian J. Forestry,* **22(4):** 357 – 361.

Singh, R.K. and Chaudhury, B.D. (1979). Biometrical methods in quantitatice genetic analysis. Kalyani Publishers, 1/1, Rajendranagar, Ludhiana, pp 39-63.

Research Notes

Studies on relationship between yield and its components in Indian mustard

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Understanding the relationship between yield and its components is of paramount importance for making best use of these

relationships in selection. Correlation coefficient and path analysis are the important parameters for achieving this purpose. The correlation