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Effect of method of orchard establishment and propagation on growth and development of aonla (*Emblica officinalis* Gaertn.) plants in wastelands

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Abstract

To standardize the rehabilitation technology for degraded pasture/grazing lands through aonla (*Emblica officinalis*), an experiment was conducted at Krishi Vigyan Kendra, Deendayal Research Institute, Satna for two consecutive years with 5 methods of orchard establishment (*in situ* raising of seedlings/rootstocks, transplanting of one month old seedlings/rootstocks raised in poly bags, transplanting of one year old seedlings/rootstocks raised in poly tubes, transplanting of *ex situ* raised grafts/budlings in poly bags and transplanting of *ex situ* raised grafts/budlings in nursery) and 5 methods of propagation, *i.e.* patch, shield, chip, forkert budding and wedge grafting. Growth parameters were higher in the plants raised by transplanting of one month old polythene raised seedling method for orchard establishment. The *in situ* raising of seedlings was found to be next suitable method in respect of growth parameters. Among the different methods of propagation, chip budding recorded the maximum growth of budlings closely followed by patch budding. The interaction between method of orchard establishment and propagation registered better growth of budlings under transplanting of one month old polythene raised seedling and performing chip budding next year. Based on these results, transplanting one month old seedlings/rootstocks raised in poly bags and performing chip budding next year during last week of June can be recommended for the rehabilitation of wastelands on a commercial scale for the economic utilization of such wastelands through aonla cultivation.

Key words: Aonla, *in situ, ex situ,* method of orchard establishment, method of propagation, budlings/graft

Introduction

Fruit culture on wastelands and degraded forestlands is becoming important in India due to increasing needs for fruits, and the realization that certain fruits can be grown successfully on such lands with the adoption of suitable technology. Central Government, as well as some State Governments, have extended their support for bringing degraded lands, which cannot be used for food production, under fruit cultivation. India has vast tracts of wastelands, which have been lying barren for ages. According to the report of the National Remote Sensing Agency in Hyderabad, the country has 63.85 million hectares of wastelands, which account for 20.17% of the total geographical area (328.72 million hectares) and in Madhya Pradesh, 59.34 lakh hectares (19.3 %) of the total geographical area of 307.44 lakh is wastelands. The large percentage of it is under pastures and grazing lands, gullied/ravenous land, degraded notified forestland, and barren rocky areas (Upadhyaya *et.al.,* 2005). Most of these lands are suitable for growing trees and thus could be put to socially productive uses (Balooni and Singh, 2003). However, the major constraint on the pace of expansion of rehabilitation programmes is the non-availability of suitable location specific technologies. Several workers have reported that waste and degraded forestlands can be economically utilized for growing certain economic plants by employing suitable technologies. Singh (1992) studied the performance of certain fruit trees on wastelands in the Bundelkhand region and found that the abundant wastelands available in the region could be successfully developed for the plantation of fruits. According to Srivastava *et. al.* (2002), aonla plants offer the best option for both, to cultivate wastelands and create self-employment opportunities for the rural poor and marginal farmers. While identifying the most suitable species for rehabilitation of wastelands, Roy *et al.* (2005) found aonla as the most suitable species for planting on wastelands in semi-arid regions of India. However, the plants often have poor establishment, growth and development in wastelands on account of damaged roots while lifting from nurseries and poor soil conditions. The poor survival, growth and development of plants after transplanting is a major problem in the expansion of area under its cultivation as heavy mortality (up to 50 %) occurs after transplanting from nursery to field at distant places. So, there is a need to standardize the method of orchard establishment and propagation in order to ensure good survival and growth of the plants in such degraded soils. Therefore, the present study was carried out to investigate the effect of method of orchard establishment and vegetative propagation on plant growth and development of aonla on degraded pasture/ grazing lands.

Materials and methods

The experiment was conducted during two consecutive years (2006 and 2007) at Krishi Vigyan Kendra, Satna on degraded pasture/grazing lands. Twenty five treatment combinations, consisting of 5 methods of orchard establishment *i.e. in situ* raising of seedlings/rootstocks, transplanting of one month old seedlings/rootstocks raised in poly bags, transplanting of one year old seedlings/rootstocks raised in poly tubes, transplanting of *ex situ* raised grafts/budlings in poly bags and transplanting of *ex situ* raised grafts/budlings in nursery along with 5 methods of

propagation *viz.,* patch budding, shield budding, chip budding, forkert budding and wedge grafting were tested. The experiment was laid out in a Factorial Randomized Block Design with three replications and 10 plants in each replication. The experiment site was cleared off all the shrubs/bushes during May, 2005 and 2006. Pits of 90 x 90 x 90 cm. size in square system at spacing of 6 x 6 m were dug out during May. The pits were filled with a mixture of good soil and FYM in the ratio of 1:1. Polythene bags and tubes (25 x 10 cm size) were filled with a mixture containing soil, sand and FYM in equal proportion. The *desi* aonla seeds after treatment with carbendazim (0.25%) were sown in pits, polythene bags/tubes, and in nursery beds for raising rootstocks in the last week of June after the first shower of rains as per the experimental details during 2005 and 2006. 2-3 healthy seeds were sown in each pit, poly bag and tube. After germination only one healthy seedling was retained in each pit, poly bag and tube. After one year, the seedlings/rootstock raised by different methods were budded/grafted through different methods *viz.,* patch, shield, chip, forkert budding and wedge grafting with aonla cultivar, NA-7 during the last week of June in the following year *i.e.* 2006 and 2007.The observations on growth parameters (length of scion shoot, diameter of scion shoot just above the graft/bud union, number of branchlets, number of leaves, leaf area of grafts/budlings were recorded. For taking observations on growth parameters, five plants in each replication were marked permanently. The data on length and diameter of scion, shoot number of branchlets and number of leaves were recorded at monthly interval after 45 days of budding till the cessation of growth took place. The height was measured from the bud union to the terminal bud of the main axis. Diameter was measured just above the bud union with the help of vernier callipers. The data on number of branchlets were recorded during September. The leaf area was recorded during October. Ten leaves were collected at random from each budling, and out of the pooled leaves, ten leaves were further selected at random for measuring the leaf area. The leaf area was measured with the help of LICOR 6100 leaf area meter.

Results and discussion

Data pertaining to growth performance of grafts/budlings *i.e.* length of sprouted bud/graft, diameter of scion shoot just above the graft union, number of branchlets per graft, number of leaves per budling/graft and leaf area, as influenced by different treatment combinations are presented in Table 1 to 5.

It is evident from the data that the method of orchard establishment had significant effect on growth parameters. Among all the methods of orchard establishment, transplanting of one month old seedlings raised in polythene bags produced the maximum growth of budlings in terms of scion shoot length (30.72 cm); diameter of budlings/grafts just above the union (0.78 cm); number of branchlets (25.69); number of leaves (865.55) and leaf area (0.58 cm^2). *In situ* raising of seedlings was the next best method of orchard establishment. Whereas, transplanting of *ex situ* nursery raised grafts/buds recorded the minimum values of the above growth parameters. The results obtained in respect of growth performance are in close conformity with the results of Singhrot *et al.* (1970) who recorded better root and top growth in *in situ* grown ber budlings as compared to nursery grown budlings. Srivastava *et al*. (2002) and Lal *et al.* (2004) also recorded better growth of grafts/budlings in terms of scion shoot length and diameter with *in situ* raising of seedlings.

The differences in the response of growth parameters of budlings/grafts of aonla to methods of orchard establishment are purely due to difference in water and nutrients uptake. The higher growth of budlings under transplanting of one month old polythene raised seedlings and *in situ* raising of seedlings methods of orchard establishment, may be attributed to better establishment of seedlings and nutrient uptake from the soil under these treatments. Agarwal *et al.* (1982) also stated that the *in situ* raising of

Table 1. Effect of method of orchard establishment and propagation on length of scion shoot

Method of orchard establishment		Propagation method					
		Patch budding	Shield budding	Chip budding	Forkert budding	Wedge grafting	Mean
In-situ raising of seedlings / rootstocks	2006	38.09	24.92	40.37	29.64	17.47	30.10
	2007	39.74	25.85	42.38	30.21	17.95	31.23
	Mean	38.92	25.39	41.38	29.92	17.71	30.66
Transplanting of one month old seedlings /rootstock raised in poly bags	2006	38.48	24.68	40.93	30.32	16.27	30.14
	2007	41.05	25.47	41.96	31.24	16.83	31.31
	Mean	39.76	25.08	41.45	30.78	16.55	30.72
Transplanting of one year old seedlings / rootstock raised in poly tubes	2006	35.28	23.81	36.19	28.30	15.94	27.90
	2007	36.24	24.88	37.49	29.24	16.63	28.90
	Mean	35.76	24.35	36.84	28.77	16.29	28.40
Transplanting of *ex situ* raised grafts/ budlings in poly bags	2006	31.53	21.76	33.93	27.70	15.44	26.07
	2007	33.20	23.01	35.00	28.94	15.97	27.22
	Mean	32.37	22.39	34.47	28.32	15.71	26.65
Transplanting of *ex situ* raised grafts / budlings in nursery.	2006	26.30	16.81	28.49	21.63	14.26	21.50
	2007	27.32	17.46	29.19	22.64	15.10	22.34
	Mean	26.81	17.14	28.84	22.14	14.68	21.92
Mean	2006	33.94	22.40	35.98	27.52	15.88	
	2007	35.51	23.33	37.2	28.45	16.50	
	Mean	34.72	22.87	36.59	27.99	16.19	
				LSD (P=0.05)			
			2006	2007	Pooled		
Method of orchard establishment			0.68	0.92	0.75		
Method of propagation			0.68	0.92	0.75		
Orchard establishment x propagation			1.52	2.05	1.67		

rootstock results in better plant growth due to undisturbed root system, better nutrient availability and soil-water-air relationship. Another reason for increased growth associated with *in situ* and transplanting of one month old polythene raised seedling may be early sprouting and early completion of bud sprouting under these treatments, which provide the budlings/grafts with longer period for growth. Poor plant growth under *ex situ* nursery raised grafts/budlings treatment might be due to disturbed/damaged root system during uprooting resulting in inadequate and imbalanced nutrient uptake by the plants, and tip drying after transplanting. The critical examination of data further revealed that the growth in aonla budlings/grafts is positively correlated with the nutrient status of leaves as the methods of orchard establishment which gave highest values of growth parameters also recorded with highest values of NPK nutrients in leaves.

Similarly, the growth of the budlings/grafts was influenced significantly by different methods of vegetative propagation. Among the different methods of propagation, chip budding recorded the maximum growth of budlings in terms of scion shoot length, diameter of budlings/grafts just above the union, number of branchlets, number of leaves and leaf area (36.59 cm; 0.73 cm; 27.21; 909.99 and 0.60 cm^2) closely followed by patch budding

Table 2. Effect of method of orchard establishment and propagation on diameter of scion shoot just above the graft/ bud union

Method of orchard establishment		Propagation method					
		Patch budding	Shield budding	Chip budding	Forkert budding	Wedge grafting	Mean
In-situ raising of seedlings / rootstocks	2006	0.78	0.63	0.83	0.61	0.96	0.76
	2007	0.80	0.63	0.85	0.62	0.96	0.77
	Mean	0.79	0.63	0.84	0.61	0.96	0.77
Transplanting of one month old seedlings /rootstock raised in poly bags	2006	0.75	0.65	0.82	0.63	0.98	0.77
	2007	0.76	0.67	0.84	0.64	0.99	0.78
	Mean	0.75	0.66	0.83	0.63	0.98	0.77
Transplanting of one year old seedlings / rootstock raised in poly tubes	2006	0.71	0.63	0.73	0.61	0.99	0.73
	2007	0.73	0.65	0.74	0.62	1.00	0.75
	Mean	0.72	0.64	0.74	0.62	1.00	0.74
Transplanting of *ex situ* raised grafts/ budlings in poly bags	2006	0.68	0.58	0.68	0.58	0.99	0.70
	2007	0.69	0.59	0.70	0.58	0.99	0.71
	Mean	0.69	0.58	0.69	0.58	0.99	0.71
Transplanting of *ex situ* raised grafts / budlings in nursery.	2006	0.61	0.49	0.57	0.53	0.97	0.63
	2007	0.63	0.51	0.58	0.53	0.98	0.65
	Mean	0.62	0.50	0.57	0.53	0.98	0.64
Mean	2006	0.71	0.60	0.73	0.59	0.98	
	2007	0.72	0.61	0.74	0.60	0.98	
	Mean	0.71	0.60	0.73	0.59	0.98	
				LSD (P=0.05)			
			2006	2007	Pooled		
Method of orchard establishment			0.02	0.02	0.02		
Method of propagation			0.02	0.02	0.02		
Orchard establishment x propagation			0.04	0.04	0.04		

Table 3. Effect of method of orchard establishment and propagation on number of branchlets

Method of orchard establishment		Propagation method					
		Patch budding	Shield budding	Chip budding	Forkert budding	Wedge grafting	Mean
In-situ raising of seedlings / rootstocks	2006	26.67	25.33	29.17	20.50	12.00	22.73
	2007	27.79	26.62	31.89	21.62	12.64	24.11
	Mean	27.23	25.98	30.53	21.06	12.32	23.42
Transplanting of one month old seedlings /rootstock raised in poly bags	2006	31.33	26.50	31.00	22.83	12.83	24.90
	2007	34.17	28.34	32.45	23.68	13.75	26.48
	Mean	32.75	27.42	31.72	23.26	13.29	25.69
Transplanting of one year old seedlings / rootstock raised in poly tubes	2006	24.17	21.83	25.50	17.33	10.30	19.83
	2007	25.12	23.22	27.62	17.93	10.80	20.94
	Mean	24.64	22.52	26.56	17.63	10.55	20.38
Transplanting of *ex situ* raised grafts/ budlings in poly bags	2006	20.00	20.83	24.33	17.17	9.33	18.33
	2007	21.75	21.88	25.42	18.39	9.92	19.47
	Mean	20.87	21.35	24.87	17.78	9.63	18.90
Transplanting of *ex situ* raised grafts / budlings in nursery.	2006	18.33	19.50	21.83	16.00	8.00	16.73
	2007	20.05	21.06	22.85	17.24	8.68	17.98
	Mean	19.19	20.28	22.34	16.62	8.34	17.35
Mean	2006	24.10	22.80	26.37	18.77	10.49	
	2007	25.78	24.22	28.05	19.77	11.16	
	Mean	24.94	23.51	27.21	19.27	10.83	
				LSD (P=0.05)			
			2006	2007	Pooled		
Method of orchard establishment			2.03	2.15	1.05		
Method of propagation			2.03	2.15	1.05		
Orchard establishment x propagation			NS	NS	2.34		

(34.72cm; 0.71 cm; 24.94; 826.88 and 0.57 cm^2). Whereas, forkert budding and wedge grafting gave poor growth performance. The results of the present study with respect to the effect of method of propagation are in line with the findings of earlier workers (Sharma *et al.,* 2000; Parmar *et al.*,1998), who recorded higher growth of budlings in terms of scion shoot length and diameter of scion shoot just above the graft union with chip budding and patch budding, The poor growth of budlings under forkert budding have also been reported by Nayak and Sen (2000).

The interactions between method of orchard establishment and method of propagation were also observed to be significant, and chip budding performed on seedlings/rootstock raised through transplanting of one month old polythene raised seedlings exhibited the maximum length of scion shoot (41.45 cm), diameter (0.83 cm), number of branchlets (31.72), number of leaves (1127.82) and leaf area (0.69 cm^2). Whereas, *ex situ* nursery raised seedlings x wedge grafting recorded the lowest values of these growth parameters.

Higher growth of budlings under treatment combination, transplanting of one month old polythene raised seedlings x chip budding, may be attributed to better establishment of seedlings, formation of quick and strong bud union, early initiation and

Table 4. Effect of Method of orchard establishment and propagation on number of leaves per budlings/ grafts

Method of orchard establishment		Propagation Method					
		Patch budding	Shield budding	Chip budding	Forkert budding	Wedge grafting	Mean
In-situ raising of seedlings / rootstocks	2006	931.61	845.94	1032.33	635.50	354.00	759.88
	2007	979.61	894.47	1135.43	678.82	372.92	812.25
	Mean	955.60	870.21	1083.88	657.16	363.46	786.06
Transplanting of one month old seedlings /rootstock raised in poly bags	2006	1097.33	882.83	1095.89	711.78	383.50	834.27
	2007	1210.44	955.19	1159.75	747.65	411.11	896.83
	Mean	1153.89	919.01	1127.82	729.71	397.30	865.55
Transplanting of one year old seedlings / rootstock raised in poly tubes	2006	813.05	698.67	865.39	516.33	297.61	638.21
	2007	845.15	742.92	937.61	534.39	311.87	674.39
	Mean	829.10	720.79	901.50	525.36	304.74	656.30
Transplanting of *ex situ* raised grafts/ budlings in poly bags	2006	621.67	623.50	776.15	476.28	255.28	550.57
	2007	676.06	654.64	810.44	510.18	271.33	584.53
	Mean	648.87	639.07	793.30	493.23	263.31	567.55
Transplanting of *ex situ* raised grafts / budlings in nursery.	2006	522.50	523.71	628.84	423.22	205.50	460.75
	2007	571.38	565.17	658.06	456.1	223.01	494.74
	Mean	546.94	544.44	643.45	439.66	214.25	477.75
Mean	2006	797.23	714.93	879.72	552.62	299.18	
	2007	856.53	762.48	940.26	585.43	318.05	
	Mean	826.88	738.70	909.99	569.02	308.61	
				LSD (P=0.05)			
			2006	2007	Pooled		
Method of orchard establishment			64.16	68.57	33.24		
Method of propagation			64.16	68.57	33.24		
Orchard establishment x propagation			NS	153.33	74.32		

Table 5. Effect of method of orchard establishment and propagation on leaf area

Method of Orchard Establishment		Propagation Method					
		Patch budding	Shield budding	Chip budding	Forkert budding	Wedge grafting	Mean
In-situ raising of seedlings / rootstocks	2006	0.66	0.51	0.77	0.44	0.40	0.56
	2007	0.68	0.52	0.79	0.45	0.41	0.57
	Mean	0.67	0.51	0.78	0.45	0.40	0.56
Transplanting of one month old seedlings /rootstock raised in poly bags	2006	0.68	0.58	0.68	0.54	0.40	0.57
	2007	0.69	0.60	0.70	0.54	0.42	0.59
	Mean	0.69	0.59	0.69	0.54	0.41	0.58
Transplanting of one year old seedlings / rootstock raised in poly tubes	2006	0.64	0.47	0.61	0.45	0.37	0.51
	2007	0.65	0.49	0.62	0.43	0.38	0.51
	Mean	0.65	0.48	0.62	0.44	0.38	0.51
Transplanting of *ex situ* raised grafts/ budlings in poly bags	2006	0.45	0.46	0.50	0.42	0.42	0.45
	2007	0.46	0.47	0.51	0.39	0.42	0.45
	Mean	0.45	0.46	0.50	0.40	0.42	0.45
Transplanting of *ex situ* raised grafts / budlings in nursery.	2006	0.39	0.34	0.39	0.35	0.32	0.36
	2007	0.42	0.40	0.42	0.37	0.36	0.39
	Mean	0.40	0.37	0.41	0.36	0.34	0.38
Mean	2006	0.56	0.47	0.59	0.44	0.38	
	2007	0.58	0.50	0.61	0.44	0.40	
	Mean	0.57	0.48	0.60	0.44	0.39	
				LSD (P=0.05)			
			2006	2007	Pooled		
Method of orchard establishment			0.02	0.02	0.02		
Method of propagation			0.02	0.02	0.02		
Orchard establishment x propagation			0.04	0.04	0.03		

completion of bud sprouting, better nutrient uptake and ample growing period which must have favored higher growth under chip and patch method of propagation. These findings are in line with the findings of Kumari *et al.* (2004), who also reported higher number of shoots, leaf number and average length of determinate shoots with *in situ* budding.

Based on these results, transplanting one month old seedlings/ rootstocks raised in poly bags and performing chip budding next year during last week of June can be recommended for the rehabilitation of wastelands on a commercial scale for the economic utilization of such wastelands through aonla cultivation.

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