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Refinement of aonla propagation through budding under hot arid ecosystem

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ABSTRACT

The investigation on refinement of aonla (*Emblica officinalis* Gaertn) propagation through budding under hot arid ecosystem was conducted at Central Institute of Arid Horticulture, Bikaner (Rajasthan) in three consecutive years (2002-2004). The treatment comprised of nine filling mixtures and four sizes of polybags. The cultivar NA 7 was used scion and seeds of *desi* aonla were used for raising of rootstocks. The results revealed that polybags of 25x15 cm size either filled with field sandy soil + pond soil + compost (1:1:1) or field sandy soil + FYM (1:2) gave more than 80 per cent success after patch budding in the month of June, which induced more than 45 cm of budling growth in the month of July. These treatment combinations had also given better seed germination, percentage rootstock survival, height and girth of rootstocks, longer and fibrous root system. Though, the input cost per plant was comparatively higher in these treatments but the overall benefit was more, because of the high rate of budding success. The refinement made by this investigation was that the size of polybags standardized as 25 x 15 cm instead of 40 x 15 cm; thereby the weight of filling mixture reduced considerably (3.25 kg per polybag) i.e. half of the previous practice (6.63 kg per polybag) under wet conditions). The plants are ready for transplanting in the month of August under hot arid ecosystem. The plants are also feasible for transportation due to low weight and uniform in size. Moreover, proper irrigation, nutrition and care of mother block is essential to get the scion shoots in the month of June.

Key words: Arid ecosystem, budding, *Emblica officinalis*, filling mixtures, polybags, refinement

INTRODUCTION

Aonla (*Emblica officinalis* Gaertn) fruits are known as *Amrit Phal* and very popular for its medicinal properties. The fruits are rich source of vitamin-C with cooling effect and laxative and diuretic in nature as mentioned both in *Ayurvedic* and *Unani* system of medicines. The fruits are useful in chronic dysentery, diarrhea, diabetes, dyspepsia, cough, anemia, jaundice etc. The fresh aonla fruits are sour and astringent in taste, hence largely utilized as processed fruit and are in high demand for preparation of various products like morabba, jam, pickle, candy, shreds, mouth freshener etc. The aonla is an important ingredient of chyawanpras, also used in shampoo and hair dyes. The aonla tree is very productive, hardy to various biotic and abiotic stresses and can be grown successfully in various edaphoclimatic conditions. Now, it is being grown through out the country from North to South and East to West. With the development of new cultivars, production technologies, diversified value added products and market demand; the area under aonla cultivation has also increased significantly in last two decades. Simultaneously, the demand for planting materials has also been increased. To meet the demand of vegetatively propagated planting materials, the time and techniques of vegetative propagation have been standardized by different organizations with varying degree of success (Nand, 1; Pandy and Prasad, 2; Pathak *et al*., 3 and Saroj *et al*., 5). At present, aonla is commercially propagated either by budding or by grafting based on locality and personal expertise.

To make available quality planting materials at the doorsteps of the farmers in arid region, the rootstocks raised in polybags (40 x 15 cm) filled with sheep and goat maure + field sandy soil and patch budding of commercial cultivars in the month of July gave > 90 % success under hot arid ecosystem. The seeds sown in the last week of February to first week of March are ready for budding in the month of July; hence about six moth time can be saved than conventional methods (Saroj *et al*., 5). However, it is imperative to mention that even after saving of time in rootstock raising, high degree

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of budding success, safe in transport of polybag raised planting materials; there were some lacunae in this techniques like; more weight of filling mixture (6.63 kg per polybag) under wet conditions, less vigorous rootstocks, poor growth of budlings and low survival under field conditions. Therefore, it was thought to intervene and refine these problems by further experimentation under isoclimatic conditions of Rajasthan.

MATERIALS AND METHODS

The experiment was conducted in the Nursery Unit, Central Institute for Arid Horticulture, Bikaner (Rajasthan) during 2002-04. The treatment comprised of nine filling mixtures viz., i) field sandy soil (control), ii) field sandy soil + sheep manure (1:1), iii) field sandy soil + sheep manure (2:1), iv) field sandy soil + sheep manure (1:2), v) field sandy soil + FYM (1:1), vi) field sandy soil + FYM (2:1), vii), field sandy soil + FYM (1:2), viii) field sandy soil + compost (2:1) and ix) field sandy soil + pond soil + compost (1:1:1) as well as four size of perforated polybags viz., i) 15x10 cm, ii) 20x10 cm, iii) 25x15 cm and iv) 25x10 cm. The 250µ, transparent and off white colour polybags were used. These polybags were filled with filling mixtures as per treatments for raising of rootstocks. The filled polybags were saturated with water and seeds of *desi* aonla were sown during evening hours on 10th February followed by light irrigation and subsequent mulching by dry grasses.

The data on seed germination was recorded after 20 days of sowing while survival of rootstocks was recorded at 45 days after sowing. The vegetative vigour of rootstocks was recorded after 150 days of sowing. At the same time, 10 plants per treatment were uprooted to record number of roots and length of roots. The patch budding of aonla cultivar NA 7 was done on these rootstocks in the middle of June and shade net was erected over the beds in split manner. The data on percentage success was recorded in the first week of July while the budling height was recorded at the end of July. Thus, about 6 months time was involved from seed sowing to disposal of budded plants. The management practices like; irrigation, weeding, shifting, hardening etc. were the same for all treatments. It is to also mention that budding was planned in the month of June, which is hottest month in the arid region. Therefore, to invigorate the scion shoots, proper irrigation and nutrition of mother block is essential. The experiment was laid out in Completely Randomized Block design with three replications and repeated for three consecutive years. The 100 polybags were considered as treatment unit. The meteorological parameters were also recorded during experimental periods. The pooled data were analyzed using Indo-Stat statistical package in order to assess the critical differences among main treatments (filling mixtures), sub-treatments (size of poly containers) and their interactions. The treatment wise weight of filling mixture, input cost per plant and economics for production of ten thousand plants were also calculated to assess the viability of the technology.

RESULTS AND DISCUSSION

Seed germination and survival of rootstocks: In case of aonla, there is no clonal rootstocks standardized so far and it is commercially propagated on seedling rootstocks. The proper germination of seeds becomes first step of raising of rootstocks, which depend upon seed maturity, health, viability and conditions for germination. In the present investigation, the seed germination of aonla influenced significantly both by filling mixtures and size of polybags (Table 1). Among different filling mixtures, the mean seed germination varied from 77.56 per cent to 84.05 per cent while in different size of polybags the mean germination varied from 73.84 per cent to 89.57 per cent. The maximum seed germination of 91.57 per cent was recorded in 25x15 cm size of polybags filled with field sandy soil + FYM (1:2) followed by 91.27 per cent in field sandy soil + sheep manure (1:1), 91.23 per cent in field sandy soil + pond soil + compost (1:1:1) field sandy soil + sheep manure (2:1) and minimum 71.97 per cent in 15x10 cm size of polybags filled with field sandy soils + compost (2:1). Though, the differences among these treatment combinations were non significant except with control. This indicated that bigger size of polybags coupled with filling mixtures having better moisture storage capacity have influenced seed germination but at marginal level. However, the interaction between filling mixtures and size of polybags were non significant.

Even after germination, there is every possibility that some seedlings die at initial stage. Thus, data on final survival of rootstocks was recorded in all treatment combinations in order to assess the availability of rootstocks for budding. Among filling mixtures, the mean maximum survival of 92.60 per cent was recorded in field sandy soil+ pond soil+compost (1:1:1) followed by 90.46 per cent in field sandy soil+ FYM (1:2) and minimum in control (81.29%). Similarly, size of polybags has also significant influence on survival of rootstocks. The mean maximum survival of rootstocks was recorded in 25x 15 cm (89.11 %) followed by 25x10 cm (86.72%) and minimum in 15x10 cm (81.41%). When both factors were taken into consideration, the maximum rootstocks (95. 50%) were survived when 25x 15 cm size of polybags were filled with field soil+pond soil+compost (1:1:1) closely followed by same size of polybags filled with field sandy soil+ FYM (1:2). Whereas, interaction effect

Table 1. Effect of filling mixture and size of polybags on seed germination and survival of rootstocks of aonla.

Filling mixture	Seed germination (%) Size of polybags (cm)				Mean	Survival of rootstocks (%) Size of polybags (cm)				Mean
	15x10	20x10	25x15	25x10		15x10	20x10	25x15	25x10	
1. Field sandy soil (Control)	72.00	81.47	83.57	73.20	77.56	74.33	85.00	85.13	80.60	81.29
2. Field sandy soil + Sheep manure (1:1)	75.07	91.17	91.27	77.87	83.84	81.97	85.20	88.83	80.73	84.18
3. Field sandy soil + Sheep manure (2:1)	73.60	90.07	91.00	76.63	82.83	78.67	84.67	86.97	79.67	82.49
4. Field sandy soil + Sheep manure (1:2)	74.67	87.90	90.73	74.07	81.84	80.03	85.50	88.87	82.27	84.17
5. Field sandy soil + FYM (1:1)	76.33	85.67	89.73	73.87	81.40	80.00	80.17	85.73	80.23	81.53
6. Field sandy soil + FYM (2:1)	70.53	83.73	87.47	71.07	78.20	80.20	86.67	86.77	80.27	83.48
7. Field sandy soil + FYM (1:2)	76.00	89.83	91.57	78.80	84.05	87.33	90.67	94.80	89.03	90.46
8. Field sandy soil + Compost (2:1)	71.97	84.80	89.57	72.03	79.59	80.43	88.73	89.40	80.30	84.72
9. Field sandy soil + Pond soil + Compost (1:1:1)	74.43	88.70	91.23	74.03	82.10	89.63	93.83	95.50	91.43	92.60
Mean	73.84	87.04	89.57	74.62		81.41	86.72	89.11	82.73	
	CD (P = 0.05)					CD (P = 0.05)				
Filling mixture (A)	2.16					1.90				
Size of polybags (B)	1.44					1.27				
Interaction (A x B)	NS					NS				

between both the factors was non-significant. The observations suggested that though the differences within the treatments were significant but there is least effect of filling mixtures and size of polybags on germination and survival of rootstocks.

Vigour of rootstocks: The health and proper physiological conditions of rootstocks have direct influence on bud-take and budling growth. Data presented in table 2 indicated that type of filling mixtures and size of polybags used has direct impact on height of rootstocks. By using different filling mixtures, the mean height of rootstocks varied from 37.23 cm to 46.86 cm, and almost similar rootstock height was also obtained by using different sizes of polybags. The maximum 55.73 cm height of rootstock was obtained when 25x15 cm size of polybags was filled with field sandy soil + FYM (1:2) followed by 54.33 cm in the same size of polybags filled with field sandy soil + pond soil + compost (1:1:1) and minimum 30.90 cm in 15x10 cm size of polybags filled with field sandy soil (control). The interaction effect between filling mixture and size of polybags was also significant. It is obvious from the data that merely use of field sandy soil of arid region is not proper to give desired height of rootstocks.

However, girth of rootstock did not vary significantly either with filling mixtures are with size of polybags. Though, the maximum girth of stock (0.73 cm) was obtained when 25x15 cm size of polybags were filled with field sandy soil + pond soil + compost (1:1:1) and minimum 0.43 cm in 15x10 cm size of polybags filled with field sandy soil (control). It is pertinent to mention that the minimum girth of matrix for field budding should be 0.50 cm (Saroj *et al.* 5) and in present study, the girth of rootstocks were 0.50 cm or more in all the treatments except in control, where both height and girth of rootstocks were less than desirable size. In conformity, Singh *et al.* 6 and Tewari *et al.* 7also suggested that the quality of rootstock and scion have direct impact on success of aonla grafting.

Root characters: The root system of polybags raised plant play vital role not only for better plant growth but also for survival of budded plants under field conditions. The root system becomes coiled if under size polybags are used or left for longer period in the nursery. In the present investigation, 10 randomly selected plants / treatment were uprooted for study of their root system but none of them showed coiled roots in any treatment. The length of roots varied significantly under different types of filling mixtures and sizes of polybags (Table 4). Among filling mixtures used, mean maximum root length (29.96 cm) were recorded in field sandy soil + FYM (1:2), followed by 29.08 cm in field sandy soil + pond soil + compost (1:1:1) and minimum 15.24 cm in field sandy soil (control), whereas, the longer roots were recorded in bigger size of polybags. Overall longest roots (36.83 cm) were recorded in 25x15 cm size of polybags filled with field sandy soil + FYM (1:2) followed by 33.80 cm in the same size of polybags filled with field sandy soil + pond soil + compost (1:1:1), 32.20 cm in 20x10 cm size filled with field sandy soil + FYM (1:2) respectively. The smallest size of roots (11.50 cm) was recorded in 15x10 cm size of polybags filled with field sandy soil only (control).

The observations on number of roots per plant with respect to filling mixtures and size of polybags differ significantly. The interaction effect between filling mixtures and size of polybags also differ significantly. The number of roots per plant was highest in the same treatment combinations where longer length of roots was observed. Since, root system is not only responsible for

Table 2. Effect of filling mixture and size of polybags on vigour of rootstocks.

Filling mixture	Stock height (cm) Size of polybags (cm)				Mean	Stock girth (cm) Size of polybags (cm)				Mean
	15x10	20x10	25x15	25x10		15x10	20x10	25x15	25x10	
1. Field sandy soil (control)	30.90	38.63	42.07	37.33	37.23	0.43	0.49	0.50	0.47	0.47
2. Field sandy soil + Sheep manure (1:1)	35.93	39.90	44.37	39.47	39.92	0.53	0.61	0.66	0.61	0.60
3. Field sandy soil + Sheep manure (2:1)	33.30	36.40	36.60	37.90	36.05	0.49	0.51	0.52	0.50	0.51
4. Field sandy soil + Sheep manure (1:2)	36.20	41.17	47.03	42.33	41.68	0.57	0.63	0.71	0.61	0.63
5. Field sandy soil + FYM (1:1)	38.67	42.93	47.93	41.57	42.78	0.53	0.71	0.70	0.57	0.63
6. Field sandy soil + FYM (2:1)	34.00	41.33	45.07	41.23	40.41	0.50	0.60	0.63	0.55	0.57
7. Field sandy soil + FYM (1:2)	39.40	51.97	55.73	40.33	46.86	0.62	0.71	0.76	0.65	0.69
8. Field sandy soil +Compost (2:1)	31.57	40.53	41.63	36.60	37.58	0.50	0.60	0.63	0.55	0.57
9. Field sandy soil + Pond soil + Compost (1:1:1)	36.63	50.70	54.33	41.10	45.69	0.57	0.70	0.73	0.58	0.63
Mean	35.18	42.62	46.09	39.76		0.53	0.62	0.65	0.56	
	CD (P = 0.05)					CD (P = 0.05)				
Filling mixture(A)	0.83					NS				
Size of polybags(B)	0.55					NS				
Interaction (A x B)	1.66					NS				

Table 3. Effect of filling mixture and size of polybags on root characters.

Filling mixture	Root length (cm) Size of polybags (cm)				Mean	No. of roots Size of polybags (cm)				Mean
	15x10	20x10	25x15	25x10		15x10	20x10	25x15	25x10	
1. Field sandy soil (control)	11.50	14.93	19.13	15.40	15.24	5.97	7.50	8.60	7.47	7.38
2. Field sandy soil + Sheep manure (1:1)	17.40	23.70	27.73	20.60	22.36	6.77	8.10	10.33	8.33	8.38
3. Field sandy soil + Sheep manure (2:1)	16.67	19.60	21.57	18.50	19.08	6.87	7.80	8.60	7.83	7.78
4. Field sandy soil + Sheep manure (1:2)	19.93	26.67	27.30	20.83	23.53	7.90	9.03	10.63	8.17	8.93
5. Field sandy soil + FYM (1:1)	19.97	23.57	27.93	21.03	23.13	7.37	10.00	11.03	8.33	9.18
6. Field sandy soil + FYM (2:1)	18.30	21.27	24.90	18.60	20.77	7.87	9.03	9.67	8.07	8.66
7. Field sandy soil + FYM (1:2)	19.40	32.20	36.83	31.40	29.96	8.77	10.63	14.07	9.20	10.67
8. Field sandy soil +Compost (2:1)	19.67	25.83	30.13	22.97	24.58	7.50	8.20	9.27	7.83	8.20
9. Field sandy soil + Pond soil + Compost (1:1:1)	22.60	30.90	33.80	29.00	29.08	9.57	12.10	13.90	11.50	11.77
Mean	18.35	24.23	27.70	22.04		7.62	9.16	10.68	8.53	
	CD (P = 0.05)					CD (P = 0.05)				
Filling mixture(A)	0.87					0.41				
Size of polybags(B)	0.58					0.27				
Interaction (A x B)	1.74					0.81				

anchorage but also absorb the water nutrients, thus, long and fibrous root system is the pre-requisite for better plant growth and field establishment of budded plants.

Budding success and length of budling: Data presented in table 4 indicated that there was significant variation in budding success among different filling mixtures and different sizes of polybags. The mean budding success among various filling mixtures varied from 30.48 to 63.17 per cent. Similarly, it is varied from 40.81 to 68.80 per cent among different sizes of polybags. The interaction effect between filling mixtures and polybags with respect to success of budding was also found significant. The highest success of budding (82.22%) was obtained in 25x15 cm size of polybags filled with field sandy soil + FYM (1:2) followed by (80.50%) same size of polybags filled with field sandy soil + pond soil + compost (1:1:1), though, the differences were non-significant. The minimum budding success (26.73%) was obtained in 15x10 cm size of polybags filled with field sandy soil only. However, 68.17 - 71.80 per cent budding success was obtained in 25x15 cm size of polybags filled with field sandy soil + FYM (1:1), field sandy soil + FYM (2:1), field sandy soil + sheep manure (1:2), field sandy soil + compost (2:1) and field sandy soil + sheep manure (1:1). Contrary to this, higher budding success was obtained by Pathak *et al* 3 under sub-tropical conditions in the month of June-July and Saroj *et al* 2000 under arid conditions in the month of July. The reasons of comparatively low success in the month of June were due to very low rainfall, high temperature and low relative humidity as depicted in Fig.1.

Under arid conditions, July-September is the ideal time for transplanting, thus, vegetatively propagated plants of desired height should be ready in the nursery by this time. In this context, some plant standards have

Table 4. Effect of filling mixture and size of polybags on budding success and budling growth.

Filling mixture	Budding success (%) Size of polybags (cm)				Mean	Length of budling (cm) Size of polybags (cm)				Mean
	15x10	20x10	25x15	25x10		15x10	20x10	25x15	25x10	
1. Field sandy soil (control)	26.73	28.50	38.53	28.13	30.48	13.03	17.53	22.17	16.70	17.36
2. Field sandy soil + Sheep manure (1:1)	39.50	41.63	68.17	40.23	47.38	17.53	23.10	27.33	22.40	22.59
3. Field sandy soil + Sheep manure (2:1)	37.50	42.40	66.83	47.90	48.66	14.60	18.83	20.60	17.33	17.84
4. Field sandy soil + Sheep manure (1:2)	44.10	54.90	71.63	58.05	57.17	20.07	24.73	28.40	24.53	24.43
5. Field sandy soil + FYM (1:1)	45.00	60.40	71.80	60.37	59.39	18.50	22.53	28.77	21.90	22.93
6. Field sandy soil + FYM (2:1)	42.77	51.00	70.60	49.50	53.47	17.03	21.57	22.17	19.03	19.95
7. Field sandy soil + FYM (1:2)	44.67	67.17	82.22	65.37	64.85	38.00	41.23	46.90	40.53	41.67
8. Field sandy soil +Compost (2:1)	41.10	48.77	68.90	51.35	52.53	16.33	19.63	25.37	20.10	20.36
9. Field sandy soil + Pond soil + Compost (1:1:1)	45.90	63.87	80.50	62.40	63.17	41.40	45.20	48.00	44.30	44.73
Mean	40.81	50.96	68.80	51.48		21.83	26.04	29.97	25.20	
	CD (P = 0.05)					CD (P = 0.05)				
Filling mixture(A)	1.33					0.91				
Size of polybags(B)	0.89					0.61				
Interaction (A x B)	2.67					1.83				

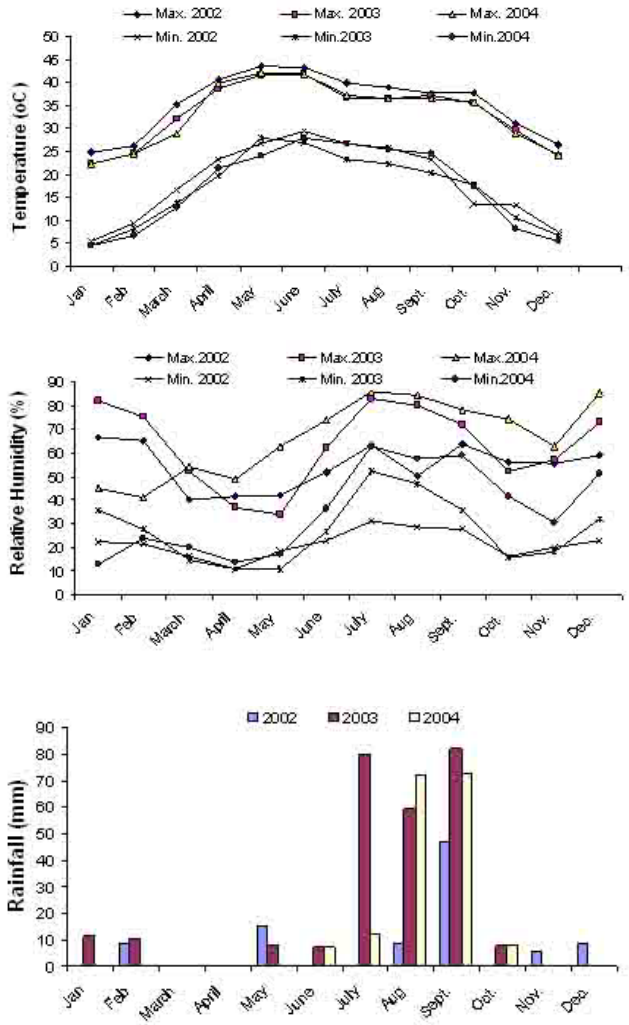

Fig. 1. Meteorological data during 2002-2004.

been suggested for arid fruits by Saroj (4), wherein, about 45 cm plant height is optimum for aonla. In the present investigation, the length of budling growth varied significantly in different filling mixtures and size of polybags. More than 45 cm growth of budling was obtained in 25x15 cm size of polybags filled either with field sandy soil + pond soil + compost (1:1:1) and field sandy soil + FYM (1:2) or 25x10 cm size of polybags filled with field sandy soil + pond soil + compost (1:1:1). Whereas, in rest of the treatment combinations; the plants were under sized at the time of plantation. It is also pertinent to mentioned that these under sized plants can not be utilized for planting in the next rainy season as there is every possibility of root coiling in polybag raised plants.

Weight of filling mixture, input cost and economics: For easy and safe transportation; less weight and uniform and optimum size of polybag raised budded plants are essential. Data presented in Table 5 indicate that the weight of filling mixture of 25 x 10 cm polybags either with field sandy soil + FYM (1:2) or with field sandy soil + pond soil + compost (1:1:1) was about a half i.e. 3.35 kg and 3.25 kg respectively than previous practice of 40 x 15 cm size of polybags filled with field sandy soil + sheep and goat manure (1:3) i.e. 6.63 kg under wet conditions. The weight of filling mixtures in all the treatment combinations was comparatively low before saturation.

The input cost involvement was calculated based on prevailing rate of inputs like cost of polybag, cost of seed, cost of filling mixtures, wages of labours and mali, irrigation, transportation etc. The cost of land, scion shoots and management of mother block was not included in the input cost as these are integral part of

Table 5. Weight of filling mixtures, input cost and income under different treatment combinations.

Treatment combinations*	Wt. of filling mixture (kg)	Wt. of wet filling mixture (kg)	Input cost/ plant (Rs.)	Income (Rs.)
F1 P1	0.99	1.15	3.00	-3270
F1 P2	2.74	3.17	3.25	-4000
F1 P3	3.17	4.22	3.50	3530
F1 P4	1.33	1.51	3.30	-4870
F2 P1	0.73	0.87	3.20	7500
F2 P2	1.12	2.74	3.30	8630
F2 P3	2.31	3.55	3.80	30170
F2 P4	0.96	1.20	3.60	4230
F3 P1	0.67	0.86	3.30	4500
F3 P2	1.69	2.31	3.60	6400
F3 P3	2.43	3.10	3.90	27630
F3 P4	0.88	1.13	3.80	9900
F4 P1	0.78	0.97	4.00	4100
F4 P2	2.22	2.75	4.25	12400
F4 P3	3.21	3.85	4.50	26630
F4 P4	1.05	1.28	4.35	14550
F5 P1	0.78	0.93	3.45	10500
F5 P2	2.15	2.59	3.70	23400
F5 P3	2.87	3.56	3.95	32300
F5 P4	1.04	1.28	3.65	23870
F6 P1	0.92	1.07	3.20	10770
F6 P2	2.29	2.73	3.50	16000
F6 P3	3.17	3.45	3.70	33600
F6 P4	1.09	1.29	3.40	15500
F7 P1	0.71	0.92	4.20	26700
F7 P2	1.88	2.35	4.40	23170
F7 P3	2.56	3.35	4.50	37220
F7 P4	0.83	1.15	4.30	22370
F8 P1	0.81	0.95	3.25	8500
F8 P2	2.31	2.79	3.35	15270
F8 P3	3.28	3.83	3.70	31900
F8 P4	1.09	1.30	3.40	17350
F9 P1	0.78	0.89	4.00	5900
F9 P2	2.12	2.86	4.20	21870
F9 P3	2.74	3.25	4.50	35500
F9 P4	0.96	1.16	4.40	18400
Previous practice**	4.88	6.63	4.42	22700
Mean	1.77	2.13	3.59	15405.64
Range	0.67-4.88	0.86-6.63	3.00-4.50	-4870-37220
Sd±	1.02	1.32	0.45	11520.84

*F1 - Field sandy soil, F2 - Field sandy soil + sheep manure (1:1), F3 - Field sandy soil + sheep manure (2:1), F4 - Field sandy soil + sheep manure (1:2), F5 - Field sandy soil + FYM (1:1), F6 - Field sandy soil + FYM (2:1), F7 - Field sandy soil + FYM (1:2), F8- Field sandy soil + compost (2:1) and F9 - Field sandy soil + pond soil + compost (1:1:1)

P1-15x10 cm polybag, P2-20x10 cm polybag, P3-25x15 cm polybag and P4-25x10 cm polybag

**Previous practice - 40 x 15 cm polybags filled with soil + sheep manure (3:1)

nursery. It is obvious that in those treatments were proportion of field sandy soil was more the cost per plant was less. The maximum cost per plant (Rs.4.5/-) was in field sandy soil + pond soil + compost (1:1:1) closely followed by (Rs 4.2) field sandy soil + FYM (1:2) and minimum cost per plant (Rs.3.0/-) in control (field sandy soil only). In rest of the treatments, the cost per plant varied between Rs.3.6/- to Rs.4.0/-. The study suggested that the cost per plant may not be the only criterion for selection of desired treatment but cost involved as well as budding success both must be taken into consideration while assessing the economic viability of the appropriate treatment. Thereby, the highest income (Rs.37220/-) was obtained in 25 x 15 cm size of polybags filled with field sandy soil + FYM (1:2) followed by (Rs.35500/-) field sandy soil + pond soil + compost (1:1:1)

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REFERENCES

1. Nand, D. 1962. Budding in aonla (*Phyllanthus emblica*). *Sci. Culture*, **28**: 486.
2. Pandy, I.C. and Prasad, K.S. 1980 Propagation of aonla by budding. *Prog. Hort.* **17**: 345-46.
3. Pathak, R.K., Ojha, C.M., Dwivedi, R. and Hari Om. 1991. Studies on effect of method and duration of budding in aonla. *Indian J. Hort.* **47**: 207-12.
4. Saroj, P.L. 2004. Nursery management in arid ecosystem. **In**: *Advances in Arid Horticulture*, Vol. 1 pp.233-252. International Book Distributing Company, Lucknow.
5. Saroj, P.L., Nath, V. and Vashishtha, B.B. 2000. Effect of polycontainers on germination, seedling vigour, root characters and budding success in aonla. *Indian J. Hort*. **57**: 300-04.
6. Singh, K., Singrot, R.S. and Chauhan, K.S. 1981. Effect of budding height and diameter of rootstock on budding success and budling growth of ber. *Haryana J. Hort.* **10**: 69-71.
7. Tewari, R.K. and Bajpai, C.K. 2002. Studies on quality parameters of scion and rootstock on success of grafting in aonla. *Indian J.Agrof.* **4**: 138-140.

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