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Standardization of Propagation Techniques in Different Cultivars of Aonla (*Emblica officinalis Gaertn*)

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ABSTRACT

The present investigation was carried out at tarai conditions of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The experiment was laid out in split-split plot design with three replications. The experiment consisted of (i) two cultivars viz., NA-7 and Francis (ii) two seasons i.e. spring and rainy season and (iii) four propagation methods viz., cleft grafting, tongue grafting, patch budding and T budding under open field condition. Minimum time (12.42 days) taken for sprouting was obtained in cv. NA-7 during spring season through T budding. Cultivar NA-7 through cleft grafting during rainy season showed maximum rootstock diameter (0.80 cm) and scion diameter (0.75 cm) however, maximum number of leaves (37.00) were obtained in cv. NA-7 during spring season through cleft grafting. It was observed that among all propagation techniques patch budding with cultivar NA-7 was found most adaptable to obtain higher success and survivability of grafts. Mid June to October (rainy season) was found to be the suitable period for aonla propagation.

Key words: *Aonla, Propagation, Patch budding, Rainy season*

INTRODUCTION

Aonla (*Emblica officinalis Gaertn*) or Indian gooseberry is a miracle crop of Indian traditional system as well as modern pharmaceutical world. Aonla is an indigenous plant to tropical south-eastern Asia, particularly in central and south India[5]**.** Aonla is considered as king of medicinal plants and has become popular over the globe due to its excellent nutritive value and great commercial potential[6]. To develop a great genetic wealth of that miracle crop further promotion and conservation of aonla is of uttermost importance. The most of the cultivated varieties of horticultural crops have been developed through selection among wild species with superior characteristics in course of natural hybridization. Naturally, the basic aim of plant propagation is to produce offspring carrying characters similar to their mother plant. Hence, a successful propagation method is the one which is able to transmit all desirable characters of the parent plant to its offspring.

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Aonla is propagated by seeds as well as by the various vegetative methods. In aonla variability can occur in seedling population in respect of fruit size, maturity period and yield per plant. According to Bajpai[2], presently aonla is grown from unknown parentage seed in forest area or naturally by self sown seeds. Therefore, a wide range of variability with respect to yield, quality, growth, size and shape of fruits existed.

Aonla is a cross pollinated crop which results to heterozygosity in plants and hence it requires propagation by vegetative methods to produce true to type and genetically uniform planting material. Large scale multiplication of plants by vegetative means is only possible by using appropriate method of propagation, as they come early into bearing and form true to type plant[8]. In vegetative technique both budding and grafting can be performed. Aonla grafts are generally planted during monsoon (June - July) due to good sap flow. In spring season, if irrigation facility is available, then aonla planting can also be done. Success and survivability of grafts depends upon various factors *viz.*, source of scion, grafting/budding season, method, age of rootstock and climatic factors[9]. Lack of healthy true to type plants of superior cultivars of aonla due to lack of efficient vegetative propagation methods at right time is the biggest bottleneck in the expansion of area under its commercial plantation. Hence, there is a need to standardize propagation techniques under various conditions for its commercial propagation. Therefore, the present investigation was designed to evaluate and standardize the best technique and time for aonla propagation in *tarai* region.

MATERIAL AND METHODS

The experiment was carried out at Medicinal Plants Research and Development Centre, GBPUAT, Pantnagar, during the year 2016-17. The optimum sized aonla seedlings were used as a rootstock for grafting and budding. For raising of rootstock healthy, uniform sized and bold seeds of aonla were collected. The grafting/budding operation was undertaken on mid of February and mid of June on 1 year old seedlings. The scion material was collected from the identified elite types of aonla trees of cultivar NA-7 and Francis from the Horticulture Research Centre, Pantnagar. The experiment was laid out in Split-split plot design having 16 treatments and three replications. Among the propagation methods, cleft grafting (M_1), tongue grafting (M_2), patch budding (M_3) and T-budding (M_4) were adopted, which were performed at two different seasons (S_1- spring season and S_2- rainy season) in two different varieties (V_1- NA-7 and V_2- Francis).

The observations were recorded on various parameters *viz*., days taken for bud sprouting, per cent graft take, length of bud sprout, number of leaves per graft, diameter of scion, diameter of rootstock, stock scion ratio and success per cent of graft. After grafting/budding operation, the buds were observed regularly for its greening till it was sprouted or dried and after computing mean, it was calculated as graft take percentage. Numbers of leaves developed per graft were recorded, 120 days after grafting operation. Scion diameter and rootstock diameter of randomly selected five observational plants was recorded separately in each treatment with the help of vernier calliper and recorded in centimetre. In successful grafts, the stock to scion ratio was recorded 120 days after grafting operation. The grafts were under observation regularly up to 120 days after grafting operation and after computing the mean, it was recorded as final survival of grafts in percentage. The significant effect of different factors was calculated at 5% level of significance.

RESULTS AND DISCUSSION

Days taken for bud sprout: Data demonstrated in Table1 indicate that among the four methods of propagation, minimum days (7.50) taken for bud sprout were reported in T budding which was statistically superior over all other methods *viz.*, tongue grafting (15.83 days), cleft grafting (15.58 days) and patch budding (15.17 days). The two cultivars

were observed in this experiment, between them cv. NA-7 took minimum days (12.42) for bud sprout over cv. Francis (14.63 days). This varietal difference might be attributed with the genotypic differences. Sprouting of buds was also significantly influenced by the seasonal conditions. Kholia, *et al.*[13], also reported the similar finding. Rainy season grafts recorded minimum number of days (11.63) for bud sprouting and statistically superior over spring season (15.42 days).The rainy season provides favourable environmental conditions like warm weather and higher relative humidity which increases meristematic activity of cells. Singh *et al.*[20], also reported that relative humidity is a key factor in bud sprouting and higher humidity, leads to early bud sprouts in guava. The interaction of variety x season x method of propagation showed no significant effect on days taken for bud sprout.

Number of leaves: The data on number of leaves per graft were collected 120 days after grafting which showed that the influence of different methods of propagation was significant; cleft grafting was recorded statistically superior, having maximum number of leaves (33.17) over other methods. It might be due to availability of 3-4 buds on scion wood, used for cleft grafting instead of single bud used for patch budding and T-budding. The similar finding was also obtained by Jadia *et al*.[12], and Rani *et al*.[15], in guava. The effect of varieties was found non significant but cv. NA-7 showed maximum number of leaves (27.63) over cv. Francis (25.29 leaves). Regarding season of propagation, and the interaction of variety x season x method of propagation, their influence over number of leaves was noticed non significant.

Graft-take percentage: In case of propagation methods, highest percentage of graft take or bud sprout (75.00%) was obtained by both, patch budding and cleft grafting whereas, T budding recorded lowest percentage (38.33%). Success of patch budding in bud sprout was observed it is possibly due to the larger area of bark and cambium tissues in patch, which can easily come in contact between stock and scion after budding operation. Chandra *et al*.[4] also reported similar results in pomegranate. The effect of variety on per cent graft take was non significant. Seasonal influences on per cent graft take reported significant, the maximum graft-take percentage (71.67%) was observed during rainy season and minimum (59.17%) in spring season. The success in rainy season might be due to the congenial weather conditions for bud sprout which hasten the rate of multiplication of the cambium cells by activating the cambium cells of bud or scion. Similar findings were also reported by Singh[19]. in tamarind and Rani *et al.*[15], in guava. The effect of interaction *viz.*, variety x season x method of propagation on graft take percentage was significant. Among the interactions, complete success (100%) was associated with both of the varieties, NA-7 and Francis during rainy season through patch budding but the minimum (33.33%) was recorded in Francis during rainy season by tongue grafting.

Length of bud sprout: The observations on bud spout length was recorded in patch and T budding having scion with single bud. The bud sprout length was significantly affected by propagation methods, patch budding recorded maximum sprout length (27.10 cm) which was statistically superior over T budding (13.43 cm). Variety does not impart any significant effect on bud sprout length. Season had significant effect and maximum bud sprout length (28.34 cm) was recorded during rainy season which was statistically superior to spring season (12.18 cm). It might be due to good sap flow between stock and scion which promotes early and rapid growth of cells as well as makes suitable climatic conditions which affect the graft or bud survival. In the rainy season, due to good flow of sap, bark slips freely and both the stock and scion are physiologically active which promotes a good cambium connection. Similar findings were also reported by Hussain *et al*.[10], in Italian olive. Better performance of patch budding over

another method could be due to the larger bark area and cambium tissues in patch taken from scion, which can easily, came in contact with rootstock tissues that promotes rapid supply of nutrients and moisture in the graft union and positively affect the physiological condition of the plants and promotes better growth of the plant. The interaction of variety x season x method of propagation had significant effect on sprout length.

Rootstock diameter: The rootstock diameter was observed in cleft and tongue grafting. The cleft grafting gave maximum rootstock diameter (0.74 cm) and was found statistically superior over tongue grafting (0.66 cm). In both of the varieties, maximum rootstock diameter (0.71 cm) was obtained in cv. NA-7 which was statistically superior over cv. Francis (0.68 cm). The differences among both the varieties may be related to their efficiency for callus formation and differentiation of parenchymal cells in vascular system. Ratna[16] reported the similar outcomes in sapota. Regarding to the season, rainy season gave maximum rootstock diameter (0.74 cm) as compared to spring season (0.66 cm). The maximum rootstock diameter recorded in rainy season grafting might be due to the hasty cell elongation and cell division at that time which promotes the growth of plant as well as diameter of rootstock. Result was in corroboration with finding of Bhadra[3] in carambola and Islam and Rahim[11]. in mango. The effect of interaction, *viz.*, variety x season x method of propagation on rootstock diameter was significant. Similar result was also reported by Reshma *et al.*[17] in guava**.**

Scion diameter: The data indicated that scion diameter varied significantly by the effect of season and method of propagation. Regarding method of propagation, cleft grafting recorded maximum scion diameter (0.71 cm) than tongue grafting (0.63 cm) possibly due to the formation of good graft union and rapid healing of cambium cells .There was no significant effect of variety on scion diameter. Season of propagation influenced the scion diameter significantly and maximum scion diameter (0.70 cm) was noticed during rainy season and minimum in spring season (0.64 cm).The result was similar with the results of Singh *et al*.[21] in mango. The significant difference in scion diameter can also occur due to the growing stage of scion which encourages the maximum scion diameter with respect to temperature and relative humidity presented in the atmosphere. The effect of interaction, *viz.*, variety x season x method of propagation had no significant effect on scion diameter.

Stock scion ratio: Success of grafts is associated with the compatibility of stock and scion and their union formation. The grafts having stock-scion ratio near to 1 have higher chances of success. The Table 1 demonstrates that the influence of variety, season and method of propagation on the ratio between rootstock and scion diameter had no significant effect. Regarding to the propagation methods, cleft grafting gave better stock scion ratio (1.04) as compared to tongue grafting (1.06). In both of the varieties, cv. Francis (1.03) gave better ratio as compared to cv. NA-7 (1.07). In case of season, rainy season showed maximum (1.06) stock scion ratio but the optimum ratio (1.04) was reported in spring season. The influence of interaction of variety x season x method of propagation had non significant effect but the, optimum ratio (1.01) was observed in cv. Francis during rainy season by both cleft and tongue grafting.

Success per cent: The data signified that the success per cent of aonla grafts was influenced by variety, season and method used for propagation. Among the different propagation methods, patch budding gave maximum success (51.67%) and was found statistically superior over all other methods. This variation in different methods could be due to improper graft union and this problem can occur either due to cellular disturbances at the graft union or lack of callus formation which results into poor cambium continuity between stock and scion. Malik *et al.*[14] also reported the similar results in khirni. Achim[1]. also suggested that success per cent was affected by the methods used for propagation and stimulation of callus

tissues**.** Regarding varieties, cv. NA-7 gave maximum success per cent (48.33%) and was statistically superior over cv. Francis (34.17%). The different success rates of aonla varieties may be due to presence of different level of endogenous phytochemicals and physiological stage of scions at the time of grafting. Ghosh[7] . reported similar result in ber. Response of season over success of aonla grafts was found significant and highest success per cent (48.33%) was observed in rainy season whereas, minimum (34.17%) in spring season. Temperature plays an important role for enhancing cell activity which is important for a good graft union[18]. The interaction *viz.*, variety x season x method of propagation had no significant effect over success per cent of aonla grafts but, the highest success (86.67%) was recorded in cv. NA-7 during rainy season by patch budding and minimum (13.33%) in cv. Francis during rainy season by cleft and tongue grafting.

Table 1: Effect of variety, season and propagation techniques on different growth parameters of aonla

	Days taken to sprouting	**Number of leaves**	**Graft take %**	**Length of bud sprout(cm)**	**Rootstock diameter (cm)**	**Scion diameter (cm)**	**Stock: scion**	**Success%**
Method of Grafting/Budding								
M_1 (Cleft grafting)	15.18	33.17	75.00	-	0.70	0.71	1.04	43.33
M_2 (Tongue grafting)	15.83	25.50	73.33	-	0.66	0.63	1.06	35.00
M_3 (Patch budding)	15.17	31.83	75.00	27.10	-	-	-	51.67
M_4 (T budding)	7.50	15.33	38.33	13.43	-	-	-	35.00
SE(m)±	0.29	2.20	4.25	0.50	0.00	0.01	0.02	4.95
CD at 5%	0.59	4.55	8.77	1.15	0.01	0.02	N.S.	10.22
Cultivar								
V_1 (NA-7)	12.42	27.63	69.17	19.89	0.71	0.67	1.07	48.33
V_2 (Francis)	14.63	25.29	61.67	20.63	0.68	0.66	1.03	34.17
SE(m)±	0.17	2.14	2.50	0.46	0.00	0.02	0.04	3.00
CD at 5%	0.72	N.S.	N.S.	N.S.	0.01	N.S.	N.S.	12.93
Season of Grafting/Budding								
S_1 (Spring)	11.63	24.71	59.17	12.18	0.74	0.64	1.04	34.17
S_2 (Rainy)	15.42	28.21	71.67	28.34	0.66	0.70	1.06	48.33

Table 2: Interaction effect of variety, season and propagation methods on different growth parameters of aonla

		M1		M2		M3		M4		SE(m)±	CD at 5%
		S1	S2	S1	S2	S1	S2	S1	S2		
Days for bud sprout	V1	13.67	15.00	14.33	15.00	15.33	12.67	0.00	13.33	0.00	N.S.
	V2	16.00	17.67	16.33	17.67	17.33	15.33	0.00	16.67		
Number of leaves	V1	37.00	30.00	31.33	28.33	31.33	32.33	0.00	30.67	1.91	N.S.
	V2	35.67	30.00	30.67	11.67	31.67	32.00	0.00	30.67		
Graft take%	V1	93.33	53.33	93.33	73.33	53.33	100.00	0.00	86.67	1.67	4.63
	V2	93.33	60.00	93.33	33.33	46.67	100.00	0.00	66.67		
Bud sprout	V1	-	-	-	-	21.80	30.33	0.00	27.43	0.57	1.57
	V2	-	-	-	-	26.93	29.33	0.00	26.27		
Rootstock diameter	V1	0.68	0.80	0.61	0.76	-	-	-	-	0.00	0.01
	V2	0.76	0.71	0.59	0.67	-	-	-	-		
Scion diameter	V1	0.67	0.75	0.60	0.69	-	-	-	-	0.02	N.S.
	V2	0.71	0.70	0.58	0.67	-	-	-	-		
Rootstock:Scion	V1	1.02	1.04	1.02	1.18	-	-	-	-	0.04	N.S.
	V2	1.08	1.01	1.03	1.01	-	-	-	-		
Success%	V1	80.00	26.67	60.00	33.33	26.67	86.67	0.00	73.33	3.73	N.S.
	V2	53.33	13.33	33.33	13.33	20.00	73.33	0.00	66.67		

CONCLUSION

The results obtained through the experiment revealed that, there was significant impact on aonla grafts due to source of scion, season of grafting/budding and propagation techniques. Among the two different sources of scion, variety NA-7 gave better performance in both the growing seasons. The research was conducted in the open field condition and among all the propagation methods *viz.*, cleft grafting, tongue grafting, patch budding and T budding, the patch budding proved most successful; practiced during rainy season under tarai conditions. In interaction, the treatment combination, cv. NA-7 with patch budding gave highest final survival percentage of grafts in rainy season.

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