

# SUCCESS AND GROWTH OF SOFTWOOD GRAFTS OF DIFFERENT AONLA (*EMBLICA OFFICINALIS* GAERTN.) VARIETIES AT NURSERY STAGE

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## ABSTRACT

In present investigation minimum days (10.37) for sprouting of grafts and maximum graft success (91.10) per cent was recorded in grafts of variety NA-7. The maximum values of growth parameters like height of sprout (15.50 cm), number of leaves per graft (21.86) and graft diameter (5.43 mm) were also observed in grafts of variety NA-7. The significantly maximum leaf area per leaf (53.95 cm<sup>2</sup>) and leaf area per graft (1089.75 cm<sup>2</sup>) and dry weight of shoot (5.48 g) was recorded in grafts of variety NA-4 (Kanchan). The maximum values of biomass characters like length of shoot (44.53 cm), length of tap root (30.00 cm), number of secondary roots (49.40) and length of secondary roots (22.53 cm), fresh (13.25 g) and dry weight (6.83 g) of roots was recorded in grafts of variety Banarasi. The favorable stionic ratio (close to one) was noticed in grafts of varieties NA-7, Banarasi and Chakaiya. The maximum survival (100.00) percentage was recorded in grafts of varieties NA-7 and Banarasi. Hence, it can be concluded that, considering the overall performance of grafts of different aonla varieties studied, the grafts of varieties NA-7 and Banarasi have performed better for most of the traits under this study.

## INTRODUCTION

Aonla or Indian Gooseberry (*Emblca officinalis* Gaertn.) belonging to the family Euphorbiaceae is one of the important minor sub-tropical deciduous indigenous tree of Indian sub-continent. Aonla is native to tropical region of South-East Asia particularly Central and Southern India (Morton, 1987). It is known for its medicinal and therapeutic properties from the ancient time in India and considered as a wonder fruit for health conscious population. It is the richest source of vitamin C (600 mg/100 g). Aonla fruits have got great potential in processed forms of food items i.e. Ready to Serve (RTS), nectar, squash, syrup, jam, preserve, candy, pickle, sauce, chutney, dehydrated shreds etc. Aonla fruit is acrid cooling refrigerant, diuretic and laxative and hence useful in treating anaemia, diarrhoea, chronic dysentery, jaundice, fever, bronchitis, cough, dyspepsia, diabetes, arteriosclerosis, haemorrhages, leukorrhoea (Singh and Kumar, 1997), asthma, tuberculosis of lungs, scurvy, weakness of memory, cancer, tension, influenza, cold, loss and grayness of hair (Goyal *et al.*, 2008). The fruit is anabolic, antibacterial and resistance building and possess anti carcinogenic, antiemetic, anti oxidative (due to gallic acid), anti-pyretic, anti tumour, anti viral, cardiogenic and expectorant activities (Agarwal and Chopra, 2004, Bakshi *et al.*, 2015). Aonla lowers the risk of cancer, increases red blood cells and haemoglobin. Aonla fruit is one of the main ingredient of Chavanprash and one of the three ingredients of triphala which is useful to treat constipation, headache, enlarge

liver and billousness. In old scriptures, aonla is known as Amritphal.

Aonla is propagated by both sexual (seed) and asexual (vegetative) methods. But the aonla plants raised through seeds do not come true-to-type and there is a high variability. Hence to overcome the disadvantages of seed propagation, multiplication of superior types of aonla has been suggested by adopting vegetative methods like budding, grafting, inarching etc. as the vegetatively propagated fruit trees are true-to type and they come to bearing early (Hartmann *et al.*, 1993). Though shield/patch budding in aonla gives fairly higher percentage of success, it is cumbersome, time and labour consuming process and can only be done on seedling rootstocks of age, more than one year. Softwood grafting is reported to be easy, convenient to practice, involves simple skills and is a quick method of grafting (Kulwal and Tayde, 1989) and more successful than other methods of grafting (Amin, 1978; Panicker and Deasi, 1989; Ram, 1997). Beside this, the grafted plants occupy smaller area with the benefit of accommodation of more plants per unit area and start bearing earlier than the plants raised from seed, providing the owner earlier and much higher economic benefit. At present, very less information is available on softwood grafting in different commercially grown aonla varieties. Keeping this in view, an investigation was undertaken, to study the success, growth performance and survival percentage of softwood grafts of different aonla varieties at nursery stage under shade net house

conditions.

## MATERIALS AND METHODS

The present investigation "Studies on success and growth of softwood grafts in different aonla (*Emblia officinalis* Gaertn.) varieties at nursery stage" was undertaken in 50% shade net house conditions at Department of Horticulture, College of Agriculture, Latur, during February 2014 to January 2015. The experiment consists of evaluation of softwood grafts for success, initial growth and survival of nine different aonla varieties viz. Banarasi, Chakaiya, NA-4 (Kanchan), NA-5 (Krishna), NA-6, NA-7, NA-10, Anand-1 and Anand-2 at nursery stage as treatments and replicated thrice in Completely Randomized Design (CRD). Seeds for raising of rootstock were collected from the fruits of single local aonla tree having healthy growth and high productivity. The vigorously growing rootstocks seedlings of eight months old age having uniform size and thickness were selected for grafting. The scion sticks were selected from the non-flowering shoots of fresh growth having dark green colored leaves, about 15 cm long, straight, smooth, healthy, pest and disease free and of same thickness of rootstock were used for the study. These grafts were placed in polythene bags filled with potting mixture and kept under shade net house conditions. The observations on days required for sprouting and initial graft success were recorded. The growth observations like graft diameter, sprout height and number of leaves, leaf area, survival percentage of grafts, stionic ratio and growth characters like shoot growth in term of length

of shoot and root characters like length of tap root, number of secondary roots and length of secondary roots were recorded. Fresh and dry weight of shoot and roots was recorded at 120 DAG. The final data of each characters recorded during the investigation were analyzed statistically by the method of "Analysis of variance". The significance of various treatments was judged as suggested by Panse and Sukhatme (1967).

## RESULTS AND DISCUSSION

The data presented in Table 1 regarding growth parameters in grafts of different aonla varieties revealed significant variations. Significantly minimum number of days (10.37) were required for sprouting of grafts in grafts of variety NA-7, whereas, the maximum days (14.21) were taken by grafts of variety Anand-2. These variations could be attributed due to genetic makeup of scions which influences the histological as well as the metabolic processes at graft union. The faster physiological development and accelerated meristematic activities in the tissues of variety NA-7 might have helped for faster healing of the graft union which ultimately leads to earlier sprouting of scion as compared to the grafts of other varieties. Variation regarding number of days required for sprouting of aonla grafts has been reported by Mukta (2013), who reported variations ranging from 11.43 to 13.36 days for sprouting of aonla grafts of different varieties. Gurudutta *et al.* (2004) also reported similar results in grafts of different mango varieties. These results are in accordance with the present findings. The maximum success (91.10) per cent of grafts was recorded in grafts of

**Table 1: Variation in growth parameters of grafts of different aonla varieties**

Treatment	Varieties	Days required for sprouting	Initial graft success (%)	Leaf area (cm <sup>2</sup> )	Leaf area per graft (cm <sup>2</sup> )	Diameter of rootstock (mm)	Diameter of scion (mm)	Stionic ratio	Survival Percentage
V <sub>1</sub>	Banarasi	10.70	86.66 (68.58)	40.04	829.46	4.93	5.06	0.97	100.00 (90.00)
V <sub>2</sub>	Chakaiya	10.81	84.44 (66.77)	48.21	712.73	5.13	5.30	0.96	97.43 (80.77)
V <sub>3</sub>	NA-4 (Kanchan)	12.91	75.55 (60.37)	53.95	1089.75	5.10	5.46	0.93	96.96 (79.96)
V <sub>4</sub>	NA-5 (Krishna)	12.70	68.88 (56.09)	35.68	528.77	4.56	5.03	0.90	90.30 (71.85)
V <sub>5</sub>	NA-6	11.97	66.66 (54.73)	28.36	407.73	5.10	5.56	0.91	89.92 (71.49)
V <sub>6</sub>	NA-7	10.37	91.10 (72.64)	27.22	594.45	5.43	5.40	1.00	100.00 (90.00)
V <sub>7</sub>	NA-10	11.35	71.10 (57.48)	32.90	562.79	5.06	5.46	0.92	90.60 (72.15)
V <sub>8</sub>	Anand-1	13.91	64.44 (53.39)	34.45	504.29	4.33	5.03	0.86	89.62 (71.21)
V <sub>9</sub>	Anand-2	14.21	62.20 (52.06)	32.68	490.63	4.36	5.23	0.83	89.25 (70.86)
S.E. ± C.D. at 5 %		0.37	2.66	1.82	43.83	0.04	0.05	0.008	1.35
		1.11	7.99	5.45	131.23	0.14	0.17	0.023	4.06

\* - figures in parentheses are arc sin transformed values

**Table 2: Graft diameter (mm), sprout height (cm) and number of leaves at various growth stages in different aonla varieties**

Treatment	Varieties	Diameter of scion (mm)				Sprout height (cm)				Number of leaves			
		Days after grafting				Days after grafting				Days after grafting			
		30	60	90	120	30	60	90	120	30	60	90	120
V <sub>1</sub>	Banarasi	4.23	4.50	4.83	5.06	6.10	10.23	13.16	14.50	10.66	15.33	17.73	20.73
V <sub>2</sub>	Chakaiya	4.53	4.80	5.13	5.30	1.53	4.56	6.53	7.26	7.33	11.00	13.20	14.73
V <sub>3</sub>	NA-4 (Kanchan)	4.63	5.00	5.30	5.46	3.80	7.76	10.63	11.76	10.26	15.33	17.33	20.26
V <sub>4</sub>	NA-5 (Krishna)	4.26	4.60	4.83	5.03	2.83	4.73	6.76	7.60	6.46	11.06	13.46	14.80
V <sub>5</sub>	NA-6	4.66	5.00	5.33	5.56	2.96	6.26	8.16	9.46	6.13	10.46	12.66	14.33
V <sub>6</sub>	NA-7	4.43	4.80	5.13	5.40	6.20	10.40	13.53	15.50	12.33	17.33	19.40	21.86
V <sub>7</sub>	NA-10	4.53	4.90	5.26	5.46	4.43	8.36	11.36	12.48	8.33	12.46	15.66	17.06
V <sub>8</sub>	Anand-1	4.16	4.50	4.83	5.03	2.13	4.70	6.66	7.46	6.40	10.53	13.06	14.60
V <sub>9</sub>	Anand-2	4.33	4.76	5.03	5.23	2.00	4.63	6.63	7.43	7.73	10.86	13.73	15.00
S.E. ± C.D. at 5 %		0.07	0.08	0.05	0.05	0.08	0.13	0.10	0.12	0.56	0.65	0.69	0.67
		0.21	0.26	0.14	0.17	0.25	0.40	0.29	0.38	1.70	1.96	2.07	2.02

**Table 3: Influence of different scion varieties of aonla on biomass characters.**

Treatment	Varieties	Length of shoot (cm)	length of tap root (cm)	Number of secondary roots	Length of Secondary root (cm)	Shoot: root ratio (Length basis)	Fresh weight of shoot (g)	Fresh weight of root (g)	Shoot: root Ratio (Fresh weight basis)	Dry weight of shoot (g)	Dry weight of root (g)	Shoot: root Ratio (Dry weight basis)
V <sub>1</sub>	Banarasi	44.53	30.00	49.40	22.53	1.48	11.98	13.25	0.90	4.89	6.83	0.71
V <sub>2</sub>	Chakaiya	33.80	24.86	36.40	16.13	1.35	11.05	11.08	0.99	4.62	4.88	0.94
V <sub>3</sub>	NA-4 (Kanchan)	38.26	26.46	40.73	17.80	1.44	12.82	13.23	0.96	5.48	6.10	0.89
V <sub>4</sub>	NA-5 (Krishna)	29.60	23.33	30.33	15.60	1.26	8.71	9.34	0.93	3.36	4.32	0.77
V <sub>5</sub>	NA-6	35.13	28.20	45.66	20.40	1.24	7.63	12.47	0.61	2.60	5.55	0.46
V <sub>6</sub>	NA-7	42.60	26.06	39.60	15.93	1.63	10.87	12.44	0.87	4.24	5.98	0.70
V <sub>7</sub>	NA-10	41.00	22.53	22.46	10.53	1.81	9.59	7.57	1.26	3.85	2.93	1.31
V <sub>8</sub>	Anand-1	29.20	24.86	33.33	15.20	1.17	8.48	9.50	0.89	3.08	4.02	0.76
V <sub>9</sub>	Anand-2	32.20	23.06	26.40	13.33	1.39	7.72	8.34	0.92	2.77	3.63	0.76
S.E. ±		0.93	0.77	0.85	0.72	0.04	0.40	0.47	0.05	0.13	0.13	0.02
C.D at 5 %		2.78	2.30	2.55	2.16	0.12	1.22	1.41	0.17	0.40	0.39	0.08

variety NA-7 and it was at par with varieties Banarasi and Chakaiya, while, the minimum success (62.20) per cent was observed in grafts of variety Anand-2. This could be due to quicker formation of callus at the grafted portion resulting in the faster healing of graft combination due to faster developmental processes like cell division and cell elongation resulting in early emergence of leaves with more leaf area that leads to the production of more quantum of carbohydrates required for the early growth and development of grafts in the varieties NA-7, Banarasi and Chakaiya and resulting into higher success percentage in grafts of these varieties. At 120 DAG, significantly maximum diameter of rootstock (5.43 mm), stionic ratio (1.00), survival per cent (100.00) with minimum leaf area (27.22 cm<sup>2</sup>) was recorded in variety NA-7. The favorable stionic ratio (close to one) indicates the better compatibility of stock with scion. The good stock-scion compatibility helps in better transfer of food material from leaf to other plant parts like stem and roots. Similar findings have also been reported by Roshan *et al.* (2013) in aonla, Das *et al.* (2006) in sapota and Ram *et al.* (2012) in mango.

Perusal of data presented in Table 2 regarding scion diameter, sprout height and number of leaves in grafts of different aonla varieties showed significant differences. At 30 and 120 DAG significantly highest scion diameter was observed in grafts of variety NA-6 (4.66 mm and 5.56 mm), whereas it was lowest (4.16 mm and 5.03 mm) in grafts of variety Anand-1. At 60 DAG, the maximum graft diameter (5.00 mm) was observed in grafts of varieties NA-6 and NA-4 (Kanchan), while, the minimum graft diameter (4.50 mm) was found in grafts of varieties Anand-1 and Banarasi. At 90 DAG, the maximum graft diameter (5.33 mm) was observed in grafts of variety NA-6 whereas, the minimum graft diameter (4.83 mm) was found in grafts of varieties Banarasi, NA-5 (Krishna) and Anand-1. The significantly maximum sprout height was resulted in grafts of variety NA-7 (6.20 cm, 10.40 cm, 13.53 cm and 15.50 cm) at 30, 60, 90 and 120 DAG respectively, while the minimum grafts height were recorded in grafts of variety Chakaiya at all stages of growth.

Significantly maximum number of leaves recorded in grafts of variety NA-7 (12.33, 17.33, 19.40 and 21.86) which was at par with variety Banarasi and minimum number of leaves was recorded in grafts of variety NA-6 (6.13, 10.46, 12.66 and

14.33) at 30, 60, 90 and 120 DAG respectively. The production of maximum number of leaves might be attributed due to the genetic makeup of variety which stimulates faster growth of grafts. These results are in accordance with the findings of Ghosh *et al.* (2010) in sapota and Mukta (2013), Roshan *et al.* (2013) in aonla.

Perusal of data presented in Table 3 regarding biomass characters in grafts of different aonla varieties at 120 DAG showed significant differences. Significantly maximum shoot length (44.53 cm), number of secondary roots (49.40), length of secondary root (22.53 cm) and length of tap root (30.00 cm) was recorded in grafts of variety Banarasi. Minimum number of secondary roots (22.46), length of secondary root (10.53 cm) and length of tap root (22.53 cm) was recorded in grafts of variety NA-10 while minimum shoot length (29.20 cm) was recorded in grafts of variety Anand-1. The highest shoot: root ratio (1.81) was recorded in grafts of variety NA-10 and it was followed by variety NA-7, while, the minimum (1.17) was recorded in grafts of variety Anand-1. The maximum length of tap root in variety Banarasi may be due to need of more water and nutrients for faster vegetative growth which might have forced the higher root activity that might have resulted into better root growth in grafts of this variety. These results are in accordance with the findings of Roshan *et al.* (2013) and Sharma *et al.* (2015).

The maximum fresh weight of shoot (12.82 g) and dry weight of shoot (5.48 g) was recorded in grafts of variety NA-4 (Kanchan) while, the minimum fresh weight of shoot (7.63 g) and dry weight of shoot (2.60 g) was observed in grafts of variety NA-6. The production of maximum fresh weight of shoot in grafts of variety NA-4 (Kanchan) may be due to maximum number of leaves and maximum leaf area resulting in more production of carbohydrate required for vegetative growth of plant, resulting in more shoot weight. The similar results regarding fresh weight of shoots in sapota grafts has been reported by Hussain and Bhukhari (1997). The fresh weight of roots (13.25 g) and dry weight of roots (6.83 g) was recorded in grafts of variety Banarasi, whereas, the minimum was observed in grafts of variety NA-10. Significantly highest shoot: root ratio (fresh weight basis) (1.26 g) and dry weight basis (1.31 g) was recorded in grafts of variety NA-10, which was followed by variety Chakaiya, while, the minimum (0.61 g

and 0.46 g, respectively) was recorded in grafts of variety NA-6. Similar trend of result is also reported by Aswar (2013) in sapota.

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