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Effect of Budding Height on Success of Patch Budding in Aonla (*Emblica officinalis* Gaertn.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out on one year old aonla rootstocks which were grown into 5×10 inch size black polybags in 2023 at Main Experiment Station of Horticulture, ANDUA&T Kumarganj Ayodhya. The experiment was laid out in Randomized Block Design comprises five treatment combinations consisting 5, 10, 15, 20 and 25 cm budding height from the ground level. The 15 cm height was treated as control. The observations were recorded on days taken for sprouting of bud, survival of buds after 15 DAB and 30 DAB, total sprouting, total died sprouts, total sprouts survival, length of sprout, Diameter of scion, number of determinate shoots, plant height, diameter of rootstocks just below union, diameter of scion just above union, number of leaves on determinate shoots and leaf chlorophyll content. Minimum days for bud sprouting (15.86 days), scion-shoot died percentage (0%) and maximum survival percentage (100%), total sprouting (90%)

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and total sprouts survival (100%) observed when patch budding was done at 25 cm budding height. Maximum length (81.56 cm) of sprouted shoot and diameter (6.03 mm) of scion, number of determinate shoots (85.05) and plant height (106.56 cm), rootstocks diameter (10.95 mm) just above union, diameter (7.53 mm) of scion just above union and number of leaves (92.52) were also recorded at 25 cm budding height. The total leaf chlorophyll content (3.31 mg/g) was found to be maximum at 25 cm budding height. It is concluded that the 25 cm budding height found to be the best for the propagation of aonla using patch budding in the month of June under North India condition on the one year old rootstocks grown in the polybags of 5×10 inch size.

Keywords: Patch budding; budding height; rootstocks; Aonla; emblica officinalis.

1. INTRODUCTION

Aonla (*Emblica officinalis* Gaertn.) is a highly profitable fruit crop that can be cultivated on marginal and saline soils under rainfed conditions in the semi-arid and arid regions. Natural aonla plants can be found growing on hills up to an altitude of 1800 meters above sea level [1]. It is believed to be native to India, Malaysia, Sri Lanka and China, where it thrives and is often found in the wild. In India, it is commercially cultivated in Uttar Pradesh particularly in Pratapgarh, Sultanpur, Azamgarh, Varanasi, Jaunpur, Rai Bareily, Agra and Bareilly districts. It is an ideal fruit crop for planting in wastelands because of its drought tolerance, and low susceptibility to pests and diseases. It covers over 105,000 ha area in the country with 1276000 MT production (MoA & FW, 2022). Due to its resilience, high yield, nutritional and medicinal benefits, and versatility in value-added products, aonla has emerged as a significant fruit in the 21st century [1] which is highly profitable even with minimal care. Aonla fruits significance comes from its high vitamin C content, second only to Barbados cherry. Aonla contains 500-1500 mg of ascorbic acid per 100g of pulp [2], which is twenty times higher than the amount found in oranges. Aonla holds great commercial importance due to its distinct medicinal and industrial benefits. It is employed in Ayurvedic medicine to prepare Chyavanprash and Triphala. Its cultivation is getting expansion because of its hardy nature, medicinal and therapeutic values.

One of the obstacle to expand aonla cultivation is unavailability of quality planting materials of commercially important cultivars. Although the method of propagating of aonla through patch budding has been standardized [3,4,5], but success rate varies significantly across different agroclimatic conditions. Under North Indian conditions, patch budding from mid-May to September offers a good success rate when budding is done on one year old seedling rootstocks of pencil thickness [6].

The height at which budding occurs is crucial for its success and subsequent growth of scion shoot. An increase in budding height could also lead to a decrease in Trunk Cross-Sectional Area (TCA) over time, affecting tree growth annually due to the dwarfing effect [7]. Very little systematic work on this important aspect has yet been done in different region in India. Therefore, looking to the importance the different height in vegetative propagation, present research was taken to find out the best height for patch budding in aonla to get maximum success, survival and growth performance under Northern India condition.

2. MATERIALS AND METHODS

The investigation was carried out at Main Experiment Station of Horticulture, Acharya Narendra Deva University of Agriculture & Technology Kumarganj-Ayodhya, India in 2023 on one year old aonla rootstocks which were grown into 5×10-inch size black polybags filled with the similar mixture of soil and Farm Yard Manures. The experiment consisted four replications and five treatments comprising 5, 10, 15, 20 and 25 cm budding height from the ground level. The 15 cm height was treated as control because most of the budder performe patch budding in aonla at 15 cm height. The scion buds were collected from 25 years old plant of NA-7 variety of aonla and patch budding was done in the month of June. The Vernier Caliper and Meter scale were used to record the diameter and height, respectively. While the observations on sprouting attributes and growth parameters were recorded using following method:

2.1 Days Taken for Sprouting of Buds

The number of days from the budding date to the sprouting of the scion bud was recorded.

2.2 Survival of Buds After 15 DAB and 30 DAB

The survival percentage in the nursery was determined by counting the number of live buds out of the total patched buds at 15 and 30 days after budding.

2.3 Percentage of Total Sprouting

The number of budded plants with green buds that sprouted till July 31st were counted to calculate the bud sprouting percentage. The percentage of bud sprouting was determined using the following formula:

Total sprouting (%) =(No.of budded plants having sprouted buds)/(Total No.of budded plants)×100

2.4 Total Died Sprouted Buds

The number of sprouted buds that died after sprouting was counted to determine the percentage of sprouted scion buds died. The percentage was calculated using the following formula:

Total died sprouted buds (%)=(No. of budded plants of died buds after sprouting)/(Total number of plants of sprouted buds)×100

2.5 Total Sprouts Survival

The percentage of budded plants that ultimately survived was determined by the following formula:

Total sprouts survival (%)=(Survived plants)/(Budding success plants)×100

2.6 Leaf Chlorophyll Content

The 50 mg of finely chopped fresh leaf sample was placed in the test tubes to which 10 ml Dimethyl sulphoxide (DMSO) is added and tubes are covered with aluminium foil and kept in an oven at 65°C for 4 hrs. The absorbance of the chlorophyll solution was read at 663 and 645 nm using Spectrophotometer modal LT-2203. DMSO was used to recorded blank reading [8].

The chlorophyll content of leaves was calculated using following formula:

$$\text{Chl 'a'} = 12.7 \times \mathrm{D}_{663} - 2.69 \times \mathrm{D}_{645} \times \frac{\mathrm{V}}{1000 \times \mathrm{W}}$$

$$\text{Chl 'b'} = 22.9 \times \mathrm{D}_{645} - 4.68 \times \mathrm{D}_{663} \times \frac{\mathrm{V}}{1000 \times \mathrm{W}}$$

$$\text{Total chlorophyll(a + b)} = 20.2 \times \mathrm{D}_{645} + 8.02 \times \mathrm{D}_{663} \times \frac{\mathrm{V}}{1000 \times \mathrm{W}}$$

Where, D (Optical density), V (Final volume of DMSO (ml)), W (Weight of plant tissue (gm)), Chl 'a' (Chlorophyll 'a'), Chl 'b' (Chlorophyll 'b'), Unit (mm/g).

3. RESULTS AND DISCUSSION

3.1 Days Taken for Sprouting of Bud

The data presentenced in Table 1 show that Minimum days (15.86 days) for bud sprouting were observed when plants were budded at 25 cm height (T_5) followed by 18.59 days and 19.33 days at 20 cm height (T_4) and 15 cm budding height (T_2), respectively. Whereas, maximum days (24.37 days) for sprouting were recorded, when budding was performed at 5 cm budding height (T_2). Similar results were reported that maximum days (16.40 days) for bud sprouting required in veneer grafting at 20 cm grafting height during the August month in mango [9]. The proximity of the budding point to source of photosynthates might be the reason of less days taken for sprouting of buds at higher height. The published report reveals that relative humidity is a key factor in bud sprouting and higher humidity, leads to early bud sprouts in guava [10]. These reports are in support that days taken for sprouting of bud is also influenced by the plant species and environmental condition because of these reasons the finding of present studies differ with the earlier published works on other fruits.

3.2 Survival of Bud After 15 DAB and 30 DAB

The data presented in Table 2 showed that a statistically significant difference was found on bud survival percentage. The maximum survival percentage (95 %) was recorded at 15 DAB at 25 cm budding height (T_5) followed by 90 percent survival 30 DAB at 25 cm budding height (T_5). While minimum survival percentage (70 %) was recorded 15 DAB at 5 cm budding height (T_2) followed by (50 %) 30 DAB at 5 cm budding height (T_2). The findings indicate that survival of

buds decreased with time which might be fluctuation in environment and interference of physiological factors in the healing of the plants.

Table 1. Effect of budding height on days taken for bud sprouting

Treatments	Days taken for bud sprouting
T_1- Control (15 cm)	19.33
T_2 - 5 cm	24.37
T_3 - 10 cm	19.50
T_4 - 20 cm	18.59
T_5 - 25 cm	15.86
SEm ±	0.37
CD at 5%	1.15

Table 2. Effect of budding height on bud survival

Treatments	Bud survival (%)	
	15 DAB	30 DAB
T_1- Control (15 cm)	80	75
T_2 - 5 cm	70	50
T_3 - 10 cm	73	60
T_4 - 20 cm	90	84
T_5 - 25 cm	95	90
SEm ±	1.85	1.44
CD at 5%	5.75	4.48

3.3 Total Sprouting

The data presented in Table 3 reveals that the highest sprouting (90 %) was observed at 25 cm budding height (T_5) followed by 80 percent and 70 percent at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. While, lowest (45%) was recorded at 5 cm budding height (T_2). The effect of budding height was significant on bud sprouting in comparison to control. The result aligns with the discoveries in Bael [11] and in Ber [12]. In addition to proximity of buds to source, the basipetal and acropetal movement of hormones might also have influenced on the sprouting of buds.

3.4 Total Died Sprouts

The data presented in Table 3 show that lowest rate (0%) of sprouts scion-shoot died percentage has been observed at 25 cm budding height (T_5) followed by 6.25% and 15% at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. While 5 cm budding height (T_2) has shown highest (30%) sprouts scion-shoot died percentage after 60 days of budding. These results are in close conformity that after ninety days of grafting, the lowest mortality rate (19.17%) was noted at 6 cm height of rootstock in Mango [13].

3.5 Total Sprouts Survival

Data presented in Table 3 reveals that maximum sprouts survival (100 %) was found at 25 cm budding height (T_5) followed by 93.75 percentage and 85 percentage at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. While minimum sprouts survival (70%) was found at 5 cm height (T_2). The highest survival rate (80%) at 15 cm rootstock height was reported in soursop [14]. Earlier work reported that in veneer grafting, the highest survival percentage (78.50%) was recorded in August at 20 cm grafting height in Mango [9]. These reports confirm that height affects the survival percentage of buds and grafts.

3.6 Length of Sprout

The data outlined in Table 4 indicates that maximum (81.56 cm) length of sprouted shoot was found at 25 cm budding height (T_5) 90 DAB followed by 79.18 cm and 75.50 cm at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. Whereas, minimum (72.86 cm) length of sprouted shoot was found at 5 cm budding height (T_2) 90 DAB. The distance of budding point from source of photosynthate and phytohormones including the osmotic pressure with gravitational force might be the reason of variation in performance of scion shoots. The maximum (16.27cm) shoot length was reported on 15th September at 60 cm height in mango [15]. The observed maximum (39.72 cm) scion shoot length has also been reported at 15 cm grafting height in Nagpur Mandarin [16]. These reports indicate that budding and grafting height influence the performance of the scion which are in support of present investigation.

3.7 Diameter of Scion

Data presented in Table 5 reveals that the diameter of the scion after 90 DAB was maximum (6.03 mm) at 25 cm budding height (T_5) followed by 5.86 mm and 5.28 mm at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. While minimum (3.37 mm) diameter of scion was recorded at 5 cm budding height (T_2). The present results indicate that scion diameter is directly proportional to proximity of budding point to apical buds and

leaves on the rootstocks. This might be due to more rapid diversion of food from source to sink.

3.8 Number of Determinate Shoots

The data presented in Table 6 recommends that maximum (85.05) number of determinate shoots were recorded at 25 cm budding height (T_5) 90 DAB followed by 81.38 and 79.35 at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. While minimum (72.45) number of determinate shoots were recorded at 5 cm budding height (T_2). The number of determinate shoots is increased with length of the indeterminate shoots. The maximum number (5.0) of determinate shoots were recorded in the second week of September followed by the budding performed in fourth week of September (3.4). However, the minimum (1.5) shoots were observed during the second week of October in aonla [17]. This supports that month of propagation of fruit trees and growth of indeterminate shoot both influence the performance of scion-shoot.

3.9 Plant Height

The data presented in Table 7 indicate that maximum (106.56 cm) plant height was recorded at 25 cm budding height (T_5) followed by 99.18 cm and 90.50 cm at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively 90 DAB. While minimum (77.86 cm) plant height was recorded at 5 cm budding height (T_2). The published work reveals reported that maximum height (9.63 cm, 10.43 cm, 12.17 cm and 14.86 cm) of the graft was noted at 30, 60, 90, and 120 days after grafting at 15 cm compared to 5 cm and 10 cm [18]. The other researchers observed that maximum (56.18 cm) plant height at 15 cm height of rootstocks in Nagpur Mandarin [16]. These published works are in support that grafting and budding height influenced the performance of plant height after propagation.

3.10 Diameter of Rootstocks Just Below Union

The data presented in Table 8 intimates that rootstocks diameter varied significantly with the budding height. The maximum (10.95 mm) rootstock diameter was recorded at 25 cm budding height (T_5) followed by 10.43 mm and 9.98 mm at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively 90 DAB. While minimum (6.80 mm) rootstock diameter was recorded at 5 cm budding height (T_2). The maximum girth (2.46 cm) below the union at 90 DAG at 25 cm rootstock height and minimum girth (2.27 cm) was noted at 90 DAG at10 cm height in Jackfruit [19]. Similarly, the maximum stock girth (9.33 mm) was measured at 60 cm grafting height and the minimum stock girth (8.55 mm) was measured at 20 cm rootstock height in Mango [15]. There earlier published works indicate that stock girth influenced by the height of propagation in fruits which are in support of the results of the present investigation.

3.11 Diameter of Scion Just above Union

Data pertaining in Table 9 show that maximum (7.53 mm) diameter of scion just above union at 25 cm budding height (T_5) followed by 7.14 mm and 7.03 mm at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively 90 DAB. While minimum (4.98 mm) diameter of scion just above union noted at 5 cm budding height (T_2). The maximum girth (2.80 cm) above the union on 90 DAG was reported at 15 cm rootstock height and minimum girth (2.60 cm) on 90 DAG at 10 cm height in Jackfruit [19]. The maximum diameter (0.90 cm) above 2.5 cm of the graft union at 15 cm grafting height was also reported in Nagpur Mandarin [6]. These published research are in supports of the findings of the present investigation.

Table 3. Effect of budding height on sprouting attributes

Treatments	Sprouting attributes 60 Days After Budding (DAB)		
	Total Sprouting (%)	Total Died Sprouts (%)	Total Sprouts Survival (%)
T_1- Control (15 cm)	70.00	15.00	85.00
T_2 - 5 cm	45.00	30.00	70.00
T_3 - 10 cm	50.00	20.00	80.00
T_4 - 20 cm	80.00	6.25	93.75
T_5 - 25 cm	90.00	0.00	100
SEm ±	1.42	0.34	1.46
CD at 5%	4.43	1.06	4.55

Table 4. Effect of budding height on sprout length (cm)

Treatments	Sprout length (cm) (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	5.63	12.53	20.46	27.89	35.14	43.97	51.32	60.50	69.32	75.50
T_2 - 5 cm	2.56	9.87	16.59	22.06	30.35	38.31	47.66	57.51	65.19	72.86
T_3 - 10 cm	4.65	11.76	18.63	25.43	32.52	41.12	49.50	59.11	68.96	77.35
T_4 - 20 cm	6.08	13.87	21.59	29.16	37.65	45.38	53.76	62.15	71.34	79.18
T_5 - 25 cm	6.81	14.56	22.41	30.75	39.33	47.21	56.13	65.42	73.65	81.56
SEm ±	0.11	0.25	0.40	0.54	0.69	0.85	1.01	1.19	1.35	1.50
CD at 5%	0.35	0.78	1.23	1.68	2.16	2.65	3.15	3.70	4.22	4.67

Table 5. Effect of budding height on diameter (mm)

Treatments	Scion diameter (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	0.60	1.18	1.62	2.19	2.74	2.98	3.50	4.12	4.77	5.28
T_2 - 5 cm	0.28	0.75	1.15	1.69	2.05	2.52	2.98	2.52	2.89	3.37
T_3 - 10 cm	0.42	0.96	1.47	1.93	2.38	2.80	3.21	3.66	4.05	4.65
T_4 - 20 cm	0.96	1.48	2.02	2.45	2.87	3.14	3.83	4.39	5.28	5.86
T_5 - 25 cm	1.04	1.63	2.14	2.61	3.09	3.75	4.32	4.91	5.56	6.03
SEm ±	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10
CD at 5%	0.05	0.08	0.11	0.14	0.16	0.19	0.22	0.25	0.29	0.32

Table 6. Effect of budding height on number of determinate shoots

Treatments	Number of determinate shoots (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	4.29	11.31	17.40	25.62	35.54	44.02	52.93	62.87	70.82	79.35
T_2 - 5 cm	2.95	9.33	14.46	22.50	30.75	39.16	47.65	56.36	64.18	72.45
T_3 - 10 cm	3.83	10.75	16.04	23.65	33.48	42.83	51.44	60.31	68.25	76.95
T_4 - 20 cm	4.74	11.52	18.11	26.25	36.19	45.56	55.13	64.19	72.25	81.38
T_5 - 25 cm	5.94	13.08	19.86	28.25	38.56	48.16	57.94	67.30	75.68	85.05
SEm ±	0.09	0.22	0.34	0.47	0.69	0.86	1.04	1.21	1.31	1.54
CD at 5%	0.28	0.69	1.07	1.47	2.14	2.68	3.23	3.79	4.27	4.80

Table 7. Effect of budding height on plant height (cm)

Treatments	Plant height (cm) (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	20.63	27.53	35.46	42.89	50.14	58.97	66.32	75.50	84.32	90.50
T_2 - 5 cm	7.56	14.87	21.59	27.59	37.35	43.31	52.66	62.51	70.94	77.86
T_3 - 10 cm	14.65	21.76	28.63	35.43	42.52	51.12	59.50	69.11	78.96	87.35
T_4 - 20 cm	26.08	33.87	41.59	49.16	57.65	65.38	73.76	82.15	91.34	99.18
T_5 - 25 cm	31.81	39.56	47.41	55.75	64.33	72.21	81.13	90.42	98.65	106.56
SEm ±	0.47	0.60	0.74	0.89	1.04	1.19	1.35	1.52	1.69	1.83
CD at 5%	1.46	1.88	2.32	2.76	3.23	3.71	4.20	4.74	5.26	5.71

Table 8. Effect of budding height on diameter of rootstocks just below union

Treatments	Rootstock diameter (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	5.96	6.80	7.02	7.56	7.95	8.41	8.93	9.19	9.51	9.98
T_2 - 5 cm	4.95	5.25	5.76	6.05	6.52	7.09	7.55	5.80	6.13	6.80
T_3 - 10 cm	5.46	5.87	6.25	6.97	7.33	7.82	8.16	8.45	8.72	9.14
T_4 - 20 cm	6.51	7.07	7.36	7.83	8.12	8.58	8.97	9.56	9.94	10.43
T_5 - 25 cm	6.65	7.44	7.92	8.45	8.99	9.38	9.83	10.06	10.52	10.95
SEm ±	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.17	0.18
CD at 5%	0.37	0.41	0.43	0.46	0.48	0.51	0.53	0.51	0.53	0.56

Table 9. Effect of budding height on diameter of scion just above union

Treatments	Scion diameter (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	1.06	3.10	3.54	4.05	4.50	4.89	5.23	5.78	6.37	7.03
T_2 - 5 cm	0.42	1.06	2.18	2.49	2.74	3.08	3.47	3.93	4.41	4.98
T_3 - 10 cm	0.66	1.40	2.49	2.61	2.93	3.77	3.94	4.29	4.84	5.24
T_4 - 20 cm	1.54	3.78	4.06	4.59	5.01	5.33	5.83	6.04	6.83	7.14
T_5 - 25 cm	2.96	4.08	4.47	4.94	5.19	5.58	6.03	6.50	7.08	7.53
SEm ±	0.04	0.06	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.13
CD at 5%	0.12	0.20	0.22	0.25	0.27	0.29	0.32	0.34	0.38	0.40

Table 10. Effect of budding height on number of leaves on determinate shoots

Treatments	Number of leaves (DAB)									
	28 DAB	35 DAB	42 DAB	49 DAB	56 DAB	63 DAB	70 DAB	77 DAB	84 DAB	90 DAB
T_1- Control (15 cm)	16.25	22.98	28.49	36.38	45.56	54.69	63.72	71.50	80.16	89.49
T_2 - 5 cm	14.32	19.14	25.81	31.23	40.21	48.59	57.86	66.47	75.24	83.55
T_3 - 10 cm	15.50	21.58	27.74	34.89	43.16	51.37	60.52	69.55	77.59	86.02
T_4 - 20 cm	17.18	24.30	30.25	38.73	47.92	56.36	64.54	72.90	81.07	90.15
T_5 - 25 cm	19.05	25.59	32.11	40.60	49.56	57.42	66.93	73.32	84.40	92.52
SEm ±	0.33	0.45	0.57	0.71	0.89	1.05	1.22	1.37	1.55	1.72
CD at 5%	1.01	1.40	1.77	2.24	2.77	3.27	3.81	4.28	4.83	5.35

3.12 Number of Leaves on Determinate Shoots

The present data in Table 10 express that the maximum (92.52) number of leaves were observed at 25 cm budding height (T_5) followed by 90.15 and 89.49 at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively 90 DAB. However, minimum (83.55) number of leaves noted at 5 cm budding height (T_2). The more number of leaves at higher height might be because of availability of more photosynthates and plant hormones. The earlier research also recorded the maximum (16.47) leaves on 30th August at 60 cm height and the minimum (8.36) number of leaves at 60 cm heights in Mango [15].

3.13 Leaf Chlorophyll Content at 60 DAB

The data presented in Table 11 show that maximum (3.31 mg/g) total leaf chlorophyll content was observed at 25 cm budding height (T_5) followed by 2.86 mg/g and 2.75 mg/g at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. Whereas, minimum (2.49 mg/g) total leaf chlorophyll content was recorded at 5 cm budding height (T_2). Maximum (2.30 mg/g) leaf chlorophyll 'a' content was

Table 11. Effect of budding height on leaf chlorophyll content of leaves

Treatments	Chlorophyll content (mg/g) at 60 DAB		
	Chlorophyll 'a'	Chlorophyll 'b'	Total chlorophyll
T_1- Control (15 cm)	1.91	0.84	2.75
T_2 - 5 cm	1.68	0.81	2.49
T_3 - 10 cm	1.78	0.83	2.61
T_4 - 20 cm	1.94	0.93	2.86
T_5 - 25 cm	2.30	1.01	3.31
SEm ±	0.04	0.02	0.06
CD at 5%	0.12	0.06	0.17

observed at 25 cm budding height (T_5) followed by 1.94 mg/g and 1.91 mg/g at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. Whereas, minimum (1.68 mg/g) leaf chlorophyll 'a' content was recorded at 5 cm budding height (T_2). Maximum (1.01 mg/g) leaf chlorophyll 'b' content was observed at 25 cm budding height (T_5) followed by 0.93 mg/g and 0.84 mg/g at 20 cm budding height (T_4) and 15 cm budding height (T_1), respectively. Whereas, minimum (0.81 mg/g) leaf chlorophyll 'b' content was recorded at 5 cm budding height (T_2). In present studies, the highest total chlorophyll content was recorded in the leaves of scion shoot at 25 cm height which might be due to more exposure to the sun light intensity and more uptake of nutrients due to osmotic pressure build up by transpiration because of more leaves.

4. CONCLUSIONS

It is concluded on the basis of the result in present investigation that the 25 cm budding height is best for the propagation of aonla using patch budding in the June month under North India condition on the one-year-old rootstocks grown in the polybags of 5×10 inch.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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