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EFFECT OF MATURITY AND SIZE OF STEM CUTTING ON ROOTING SUCCESS AND GROWTH IN DRAGON FRUIT

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ABSTRACT

Ahsan-Ullah M, Rob MM, Habiba U, Hasan MM, Saha SR (2015) Effect of maturity and size of stem cutting on rooting success and growth in dragon fruit. *Int. J. Sustain. Crop Prod.* 10(4), 10-16.

A study was carried out at BAU Germplasm Center, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during 24 March, 2011 to 24 April, 2012 to investigate the effect of maturity and size of stem cutting on rooting success, days to root initiation, shoot number and plant height in two Dragon fruit varieties. All the treatments showed significant effect on the parameters studied. Shorter time was needed for first root initiation (27.42 days) which also produced taller plant (65.25 cm), primary (4.19 days), secondary (1.98), and tertiary (0.225) shoots number, and percent rooting success (100) by BAU Dragon fal-1. Matured cutting required comparatively shorter time for first root initiation (25.92 days), and produced the highest plant height (66.16 cm), primary (4.03), secondary (1.94), and tertiary (0.22) shoots number, and percent rooting success (100). In respect of stem cutting size, lowest time was required for first root initiation (26.32 days) with the tallest plant height (83.93 cm), primary (4.81), secondary (2.29), and tertiary (0.29) shoots number and percent rooting success (100) by the large cutting. The combined effect of three factors had also significant effect on the studied parameters. Minimum time was required for first root initiation (23.30 days) with the maximum plant height (89.54 cm), primary (5.26), secondary (2.5), and tertiary (0.33) shoots number by BAU Dragon fal-1 with large sized matured cutting.

Key words: *stem cutting, rooting success, growth, dragon fruit*

INTRODUCTION

Dragon fruit (*Hylocereus undatus* Britton et Rose), belonging to the family Cactaceae, is one of the newly introduced exotic fruits in Bangladesh. It is commonly known as strawberry pear, night blooming cereous, pitaya, pitahaya, queen of night, honorable queen and originated in the tropical and subtropical forest region of Mexico and central South America (Mizrahi and Nerd, 1996). It is introduced to Chittagong Hill Tracts(CHT) as well as in Bangladesh few years back (Chakma *et al.* 2014). The plants are fast growing perennial and vine-like cacti. They have triangular (3-sided), green, fleshy, jointed, many branched stems. The plant may reach about 6 meter long. The flower looks beautiful, large, and fragrant and developed into non-climacteric fleshy berry which is oblong and about 11 centimeter thick with red or yellow peel with scales. Seeds are tiny, numerous and black embedded within the pulp. Average fruit weight is 360 g (Luders and McMahon, 2006). The flesh is juicy and delicious in taste. Mature fruit can be processed as juice, sherbets, jam, jelly, ice-cream, candy and pastries. It is well known for its rich nutrient contents specially vitamin C, phosphorus, calcium as well as its antioxidant characteristics (Morton 1987). Fruit contains good amount of calcium (6 mg), phosphorous (19.0 mg) and ascorbic acid (25 mg) per 100 gm pulp. The red-fleshed varieties of Dragon fruit are rich in anti-oxidants. The production technology is easy, less laborious and post-harvest loss is minimum. The pest and disease attack is also minimum. The greatest advantages of this crop is that once planted, it will grow and continues its production for about 20 years and one hectare of land could accommodate about 800 Dragon fal plants. The crop can be grown organically using locally available organic manures and composts as the demand for nitrogen is comparatively less compared to most other crops (Vianna 1964; Godoy and Godoy Junior, 1965; Besagoitia 1980). Propagation of Dragon fal can be performed sexually by seed and asexually by grafting and stem cutting. Among the production methods, asexual by means of stem cutting has already established as easiest, cheapest and convenient to the farmers. The longer the cutting faster is the regeneration rate of new roots which is probably associated with the amount of stored food. In general, better rooting performance is obtained by the cuttings with high carbohydrate content than those with low carbohydrates content (observation). The ability of cuttings to regenerate also varies with the plant species and their varieties. In Bangladesh, very few research works have been done on Dragon fruit propagation and management practices. Besides, no research works are reported on the effect of cutting size, maturity and variety on the rooting success and growth of Dragon fruit. Therefore, the present experiment was under taken to assess the effect of cutting size and maturity on the rooting success, shoot growth, time required for root initiation and plant height in two varieties of Dragon fruit.

MATERIALS AND METHODS

The experiment was conducted at the BAU Germplasm Center (GPC) of Fruit Tree Improvement Programme (FTIP), Department of Horticulture, Bangladesh Agricultural University, Mymensingh. The experimental area was silty loam in texture belonging to the Old Brahmaputra flood plain of AEZ-9 having non-calcareous dark grey flood plain soil with pH range is 5.5 to 6.8. The experimental area was under the subtropical climate characterized by heavy rainfall during April, 2011 to October, 2011 and scanty rainfall during the rest period of the year. The total rainfall of the locality was 2000 mm during the period of March, 2011 to April, 2012 with

average maximum and minimum temperature of 32.03°C and 25.30°C, respectively. The average relative humidity was 85.61% and average sunshine 152.1 hrs. The three-factor experiment consisting of 12 treatment combinations was laid out in RCBD with 3 replications. The experiment consisted of the following treatments: Factor A: Variety- (a) FTIP BAU Dragon fal-1 (Red fleshed), V_1 and (b) FTIP BAU Dragon fal-2 (White fleshed), V_2; Factor B: Maturity of cutting- (a) Matured (M_1), and Semi-matured (M_2); and Factor C: Size of cutting-(a) Large size having length of 30.13 cm and 109.6 gm weight (S_1), (b) Medium size having length of 18.84 cm and 59.5 gm weight (S_2), and (c) Small size having length of 10.47 cm and 27.92 gm weight (S_3). For each treatment combination 5 cuttings were placed into 5poly bags and planted into each unit plot of a block. Thus in total 2x2x3x3x5=180 cuttings were placed as per treatment of the experiment. The cuttings were placed in poly bag (size10x20 cm) using mixture of soil and compost (50:50) as the growing medium. For the collection of stem cutting healthy and disease free mother plant of around 3 years old were selected. The cuttings were collected as per treatment of the experiment just two days before planting and separated from mother plant by cutting at their segments with the help of secateurs and those were kept in shed for hardening. Then prepared cuttings of Dragon fruit were planted in poly bag on 25th March. 2011. The polybag with the planted cuttings was then placed as per design and layout of the experiment. The cuttings were watered by watering can. Light showering was provided after planting the cuttings and subsequent irrigation was given by watering can as and when necessary. Weeds, whenever appeared were removed very carefully by hand pulling without disturbing the cuttings. There was no incidence of insect and disease infestations in the experimental cuttings. The height of the plant was measured in centimeter from the ground level to the tip of the plant at 30 days interval starting from 30 days after planting. Total height was divided by three to obtain average plant height. Days required to first root initiation were collected by lifting two stem cuttings from poly bag at ten days interval starting from ten days after planting of cuttings. The total number of new shoots of rooted cuttings were counted and recorded. Then the total number of shoots was divided by 3 to find the average number of shoots per cutting. Data were recorded as number of primary (10), secondary (20) and tertiary (30) shoots. After 390 days of planting, 5 cuttings were lifted from each poly bag of a unit plot by cutting the poly bag very carefully without damaging any roots attached with the base of the cutting. The base of the vine cutting with or without roots was washed to remove the adhering soil. After final washing of the cuttings the number of successful rooted cuttings were counted and recorded. Rooting success of the individual treatment was calculated by using the following formula:

$$\text{Rooting success (\%)} = \frac{\text{Number of successful rooted cutting}}{\text{Number of planted cutting per treatment}} \times 100$$

The recorded data were analyzed statistically to find out the variation resulting from experimental treatments using MSTAT package program. The means for all treatments were calculated and analyses of variances of the parameter under study were performed. The means of the parameter were compared by least significant difference test (LSD) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Days to first root initiation

A statistically significant difference was observed due to varieties, cutting maturity, cutting size and their combined effects in terms of days to first root initiation. In case of white fleshed Dragon fruit (V_2), longer time was required for first root initiation (29.33 days) comparing with red fleshed variety (27.42 days) (Fig. 1A). This variation in time taken for first root initiation might be due to varietal character. Matured stem required shorter time for root initiation (25.92 days) and longer time (30.83 days) was required in semi-matured cutting (Fig. 1B). The higher age and carbohydrate content of matured cutting might be responsible for minimum days for root initiation. Shortest time (26.32 days) was needed by large sized cutting but small cutting required longest time (30.25 days) (Fig. 1C). Highest nutrient content of large size cutting might be the reason for the shortest time required for first root initiation. The maximum time (32.00 days) was required for semi-matured cutting with white variety (V_2M_2) while minimum time (25.18 days) was needed in mature cutting size with red variety (V_1M_1) (Fig. 1D). The maximum time (31.50 days) was required for BAU Dragon fal-2 with small cutting size (V_2S_3) while minimum time (25.65 days) was needed in large cutting with BAU Dragonfal-2 (V_2S_1) (Fig. 1E).

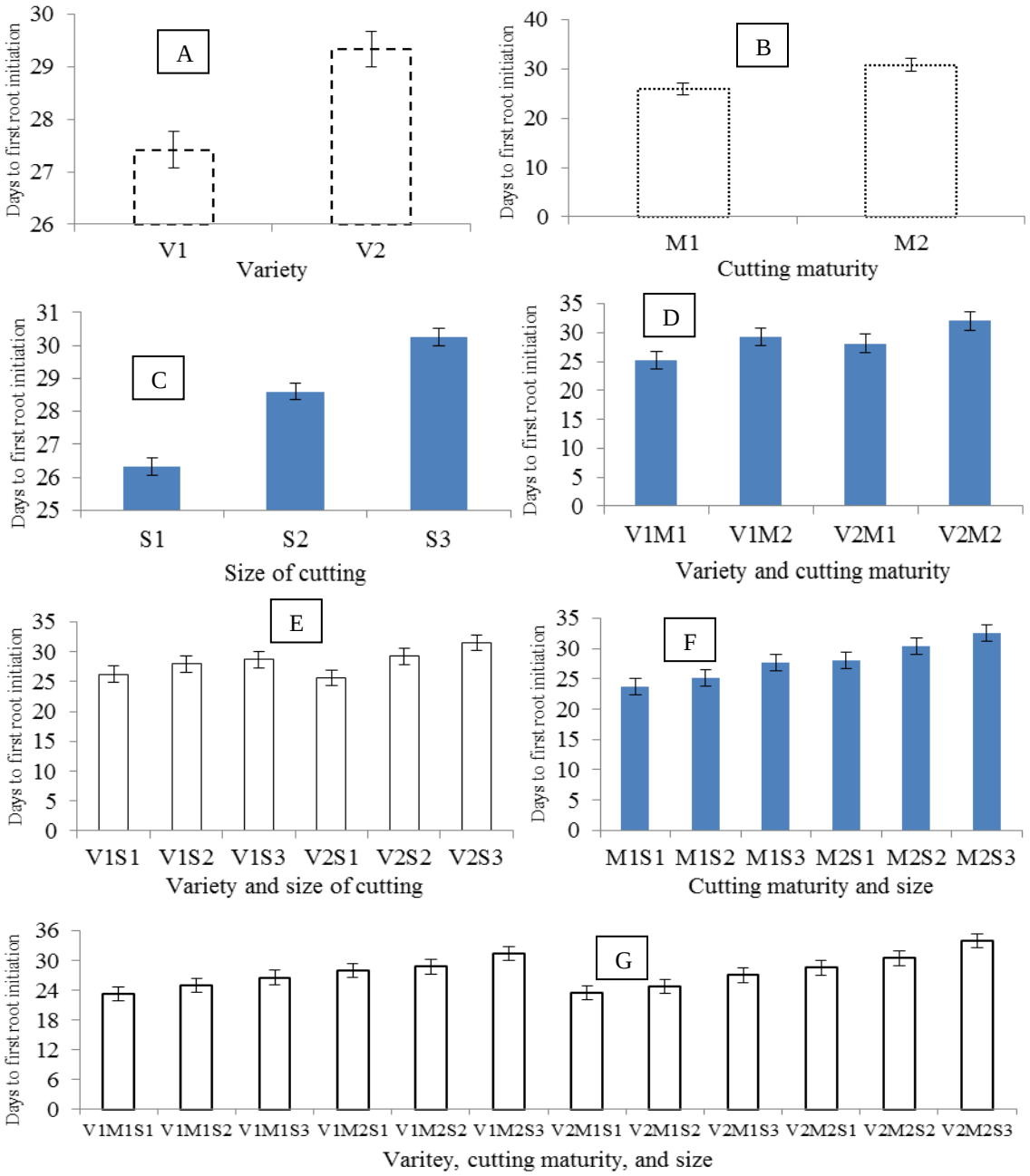

Fig. 1. Individual and combined effect of variety, cutting maturity, and cutting size (A-G) on days to first root initiation in Dragon fruits. Vertical bars indicate $Lsd_{0.05}$

The maximum time(32.50 days) was required for semi-matured cutting with small size (M_2S_3) while minimum time (23.65 days) was needed for root initiation in large cutting size with maturity (M_1S_1) (Fig. 1F). The maximum time (34 days) was required for small and semi-matured cutting with BAU Dagon fal-2 ($V_2M_2S_3$) while minimum time (23.30 days) was required in large and mature cutting with BAU Dagon fal-1($V_1M_1S_1$) (Fig. 1G).

Plant height

Statistically significant difference was found due to varieties, cutting maturity, cutting size and their combined effects in terms of plant height at different days after planting (DAP), especially at 390 DAP. At 390 DAP; the longer plant (65.25 cm) was noticed in BAU Dragon fal-1, whereas the shorter (61.99 cm) was in BAU Dragon fal-2 (Table 1). This difference in plant height might be due to varietal characters. At 390 DAP; the longer plant height (66.16 cm) was noticed in matured stem cutting whereas, the shorter plant height (61.08 cm) was noticed in semi-matured cutting (Table 1). It could be because of age of cutting. This difference in plant height might be due to reservation of carbohydrate in matured cutting resulting growth of plant root and shoot. The highest plant height (83.93 cm) was observed in large cutting size whereas the lowest plant height (43.07 cm) was noticed in small cutting size (Table 1). From the result it is clear that large cutting size enhanced for their growth in term of

plant height than other group of cutting size. It might be due to large area that provided sufficient nutrient for plant growth. At 390 DAP; the longest plant height (67.94 cm) was noticed in matured stem cutting with BAU Dragon fal-1 (V_1M_1), whereas smallest (59.60 cm) plant was found in semi-matured cutting with BAU Dragon fal-2 (V_2M_2) (Table 2A). The longest plant (85.57 cm) was noticed in BAU Dragon fal-1 with large cutting size (V1S1) and shortest plant (41.50 cm) was found in BAU Dragon fal-2 with small cutting size (V_2S_3) (Table 2B). The longest plant (87.42 cm) was noticed in matured cutting with large size (M_1S_1) whereas the shortest plant (41.10 cm) was found in semi-matured cutting with small size (M_2S_3) (Table 2C).

Table 1. Effect of variety, cutting maturity, and size on plant height (cm) at different DAP

Treatments	Plant height (cm) at different days after planting (DAP)												
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**	**390**
V_1	19.97	22.71	26.28	30.56	33.67	38.70	42.86	46.66	49.75	52.45	55.52	60.40	65.25
V_2	19.67	21.96	25.84	29.14	34.37	37.99	41.80	45.46	48.75	51.14	54.25	57.91	61.99
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.16	0.24	0.31	0.69	0.63	1.24	0.46	0.42	0.18	0.38	0.24	0.38	0.20
M_1	19.12	22.25	26.19	30.14	33.63	38.90	42.97	46.80	49.92	52.61	55.97	60.74	66.16
M_2	20.51	22.43	25.93	29.57	34.42	37.80	41.69	45.32	48.58	50.98	53.80	57.57	61.08
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.16	0.24	0.31	0.69	0.63	1.24	0.46	0.42	0.18	0.38	0.24	0.38	0.20
S_1	30.12	33.31	37.50	42.33	45.94	50.79	56.05	61.36	65.73	69.27	73.75	79.22	83.93
S_2	18.83	21.50	25.52	29.32	35.12	39.44	42.82	46.05	49.29	51.79	54.64	59.02	63.86
S_3	10.51	12.19	15.16	17.91	21.01	24.81	28.12	30.76	32.73	34.32	36.27	39.23	43.07
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.19	0.29	0.38	0.86	0.77	1.53	0.57	0.52	0.22	0.46	0.30	0.47	0.25

Table 2. Combined effect of (A) variety and cutting maturity, (B) variety and cutting size, (C) cutting maturity and size, and (D) variety, cutting maturity and size on plant height (cm) at different DAP

(A)

Variety × Maturity	Plant height (cm) at different days after planting (DAP)												
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**	**390**
V_1M_1	19.78	23.25	26.64	31.38	34.17	40.48	44.61	48.29	50.88	53.62	56.57	62.23	67.94
V_1M_2	20.16	22.18	25.93	29.75	33.18	36.93	41.11	45.02	48.62	51.28	54.48	58.57	62.56
V_2M_1	18.47	21.25	25.74	28.90	33.09	37.32	41.33	45.30	48.95	51.60	55.38	59.26	64.39
V_2M_2	20.87	22.68	25.94	29.39	35.65	38.66	42.27	45.62	48.55	50.68	53.12	56.56	59.60
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.22	0.34	0.43	0.99	0.89	1.76	0.66	0.60	0.26	0.53	0.34	0.54	0.28

(B)

Variety × Size	Plant height (cm) at different days after planting (DAP)												
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**	**390**
V_1S_1	30.81	34.79	38.25	43.55	45.78	52.27	57.29	61.98	65.24	69.27	74.12	80.22	85.57
V_1S_2	19.07	21.75	25.84	30.34	33.98	38.76	42.40	46.28	50.28	52.81	55.24	60.25	65.55
V_1S_3	10.02	11.59	14.76	17.80	21.27	25.09	28.89	31.71	33.73	35.27	37.22	40.75	44.65
V_2S_1	29.43	31.83	36.76	41.10	46.09	49.31	54.80	60.74	66.23	69.28	73.38	78.22	82.30
V_2S_2	18.60	21.26	25.20	28.31	36.27	40.13	43.24	45.82	48.30	50.77	54.04	57.80	62.18
V_2S_3	11.00	12.80	15.57	18.02	20.76	24.54	27.36	61.98	31.73	33.37	35.33	37.71	41.50
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.27	0.41	0.53	1.21	1.09	2.15	0.80	0.73	0.31	0.65	0.412	0.66	0.35

(C)

Maturity × Size	Plant height (cm) at different days after planting (DAP)												
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**	**390**
M_1S_1	28.48	32.24	36.78	41.85	45.25	51.33	57.35	63.38	67.73	71.26	76.39	82.23	87.42
M_1S_2	18.66	21.70	25.70	29.83	33.89	39.29	42.24	45.31	48.28	51.31	54.74	59.80	66.03
M_1S_3	10.24	12.80	16.09	18.74	21.75	26.09	29.32	31.71	33.75	35.26	36.79	40.21	45.05
M_2S_1	31.75	34.38	38.23	42.80	46.62	50.26	54.75	59.34	63.74	67.28	71.11	76.21	80.45
M_2S_2	19.01	21.31	25.34	28.82	36.36	39.60	43.40	46.80	50.30	52.27	54.53	58.25	61.70
M_2S_3	10.78	11.59	14.24	17.09	20.27	23.54	26.93	29.82	31.71	33.39	35.76	38.25	41.10
Sig. level	**	**	**	**	**	*	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.20	0.30	0.39	0.89	0.80	1.58	0.59	0.54	0.23	0.48	0.31	0.48	0.25

(D)

Variety × Maturity × Size	Plant height (cm) at different days after planting (DAP)												
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**	**390**
$V_1M_1S_1$	29.54	34.24	37.30	43.50	44.70	53.32	59.32	64.50	67.20	71.25	76.30	83.21	89.54
$V_1M_1S_2$	19.62	23.21	27.30	32.42	36.54	42.31	45.21	48.25	51.20	53.35	55.21	61.30	67.70
$V_1M_1S_3$	10.18	12.30	15.32	18.23	21.27	25.81	29.31	32.14	34.26	36.27	38.21	42.20	46.60
$V_1M_2S_1$	32.08	35.35	39.21	43.61	46.87	51.23	55.27	59.47	63.28	67.29	71.94	77.23	81.60
$V_1M_2S_2$	18.53	20.30	24.38	28.27	31.42	35.21	39.59	44.32	49.37	52.27	55.27	59.20	63.40
$V_1M_2S_3$	9.87	10.89	14.20	17.38	21.27	24.37	28.47	31.28	33.21	34.28	36.24	39.30	42.70
$V_2M_1S_1$	27.43	30.25	36.27	40.21	45.81	49.34	55.38	62.27	68.26	71.28	76.48	81.25	85.31
$V_2M_1S_2$	17.70	20.20	24.10	27.25	31.24	36.27	39.27	42.37	45.36	49.27	54.28	58.30	64.36
$V_2M_1S_3$	10.30	13.30	16.87	19.25	22.24	26.37	29.34	31.28	33.25	34.25	35.38	38.23	43.50
$V_2M_2S_1$	31.43	33.42	37.25	42.00	46.38	49.29	54.23	59.21	64.21	67.28	70.29	75.20	79.30
$V_2M_2S_2$	19.50	22.32	26.30	29.37	41.31	44.00	47.21	49.28	51.24	52.27	53.80	57.30	60.00
$V_2M_2S_3$	11.70	12.30	14.28	16.80	19.28	22.71	25.39	28.37	30.21	32.50	35.28	37.20	39.50
Sig. level	**	**	**	**	**	**	**	**	**	**	**	**	**
$Lsd_{0.05}$	0.28	0.43	0.55	1.25	1.13	2.24	0.83	0.76	0.33	0.68	0.43	0.68	0.36

The longest plant (89.54 cm) was noticed in large size of matured Dragon fruit with BAU Dagon fal-1 ($V_1M_1S_1$) since, the shortest (39.50 cm) was recorded in small cutting of semi-matured Dragon fruit with BAU Dagon fal-1 ($V_1M_2S_3$) (Table 2D).

Shoot number

Variation in number of primary, secondary and tertiary shoots was significant because of varieties, cutting maturity, cutting size and their combined effects in Dragon fruit. The BAU Dragon fal-1 produced higher number of primary (4.19), secondary (1.98) and tertiary (0.23) shoots comparing primary (3.73), secondary (1.67) and tertiary (0.19) in BAU Dragon fal-2 (Table 3). This difference in shoot number might be due to varietal characters. The higher number of primary (4.03), secondary (1.94) and tertiary (0.223) shoots was found in the matured cutting while lower primary (3.98), secondary (1.71) and tertiary (0.19) shoot number was in semi-matured cutting (Table 3). This difference in plant height might be due to reservation of carbohydrate in matured cutting resulting growth of plant root and shoot. The maximum number of primary (4.81), secondary (2.29) and tertiary (0.295) shoot was found in the large size of cutting, whereas minimum primary (3.07), secondary (1.41) and tertiary (0.125) shoot number was observed in small size of cutting (Table 3).

Table 3. Effect of variety, cutting maturity, and size on shoot number in Dragon fruit

Variety	Shoot number			Cutting maturity	Shoot number			Cutting size	Shoot number		
	1^0	2^0	3^0		1^0	2^0	3^0		1^0	2^0	3^0
V_1	4.19	1.98	0.23	M_1	4.03	1.94	0.223	S_1	4.81	2.29	0.295
V_2	3.73	1.67	0.19	M_2	3.89	1.71	0.192	S_2	4.00	1.78	0.202
-	-	-	-	-	-	-	-	S_3	3.07	1.41	0.125
Sig. level	**	**	**	Sig. level	**	**	**	Sig. level	**	**	**
$Lsd_{0.05}$	0.05	0.05	0.02	$Lsd_{0.05}$	0.05	0.05	0.02	$Lsd_{0.05}$	0.06	0.07	0.03

Table 4. Interaction effect of variety and cutting maturity, variety and cutting size, and cutting maturity and size on shoot number in Dragon fruit

Variety × Cutting maturity	Shoot number			Variety × Cutting size	Shoot number			Cutting maturity × Size	Shoot number		
	1^0	2^0	3^0		1^0	2^0	3^0		1^0	2^0	3^0
V_1M_1	4.18	2.06	0.24	V_1S_1	5.23	2.40	0.32	M_1S_1	4.73	2.35	0.32
V_1M_2	4.20	1.90	0.21	V_1S_2	4.05	2.00	0.22	M_1S_2	4.10	2.02	0.23
V_2M_1	3.60	1.82	0.21	V_1S_3	3.30	1.55	0.14	M_1S_3	2.85	1.47	0.13
V_2M_2	3.86	1.52	0.17	V_2S_1	4.40	2.18	0.28	M_2S_1	4.90	2.23	0.29
-	-	-	-	V_2S_2	3.95	1.57	0.19	M_2S_2	3.90	1.55	0.18
-	-	-	-	V_2S_3	2.85	1.27	0.11	M_2S_3	3.30	1.35	0.13
Sig. level	**	**	**	Sig. level	**	**	**	Sig. level	**	**	**
$Lsd_{0.05}$	0.07	0.08	0.03	$Lsd_{0.05}$	0.12	0.13	0.05	$Lsd_{0.05}$	0.12	0.13	0.05

The highest number of primary (4.73), secondary (2.35) and tertiary (0.315) shoots was found in mature cutting with BAU Dragon fal-1 (V_1M_1) and the primary (3.30), secondary (1.35) and tertiary (0.125) shoot number was found in semi-matured cutting of BAU Dragon fal-2 (V_2M_2) (Table 4). The highest number of primary (5.23),

secondary (2.40) and tertiary (0.315) shoot was found in BAU Dragon fal-1 with large cutting size (V_1S_1) and the lowest number of primary (2.85), secondary (1.27) and tertiary (0.110) shoots was recorded in BAU Dragon fal-2 with small cutting (V_2S_3) (Table 4). The highest number of primary (4.73), secondary (2.35) and tertiary (0.315) shoots was found in mature cutting with large size (M_1S_1) and the lowest primary (3.30), secondary (1.35) and tertiary (0.125) shoots was in semi-matured stem cutting with small size (M_2S_3) (Table 4). The highest number of primary (5.26), secondary (2.50) and tertiary (0.330) shoots was found in large sized and matured cutting with BAU Dagon fal-1 ($V_1M_1S_1$) and the lowest primary (3.30), secondary (1.21) and tertiary (0.120) shoots number was in small size and semi-matured cutting with BAU Dagon fal-2 ($V_2M_2S_3$) (Table 5).

Table 5. Combined effect of variety, cutting maturity, and size on shoot number in Dragon fruit

Variety × Cutting maturity × Size	**Shoot number**		
	Primary (1^0)	**Secondary (2^0)**	**Tertiary (3^0)**
$V_1M_1S_1$	5.26	2.50	0.330
$V_1M_1S_2$	4.20	2.10	0.240
$V_1M_1S_3$	3.10	1.60	0.150
$V_1M_2S_1$	5.20	2.30	0.300
$V_1M_2S_2$	3.90	1.90	0.200
$V_1M_2S_3$	3.50	1.50	0.130
$V_2M_1S_1$	4.20	2.20	0.300
$V_2M_1S_2$	4.00	1.94	0.220
$V_2M_1S_3$	2.60	1.34	0.100
$V_2M_2S_1$	4.60	2.16	0.250
$V_2M_2S_2$	3.90	1.20	0.150
$V_2M_2S_3$	2.10	1.21	0.120
Sig. level	**	**	**
$Lsd_{0.05}$	0.16	0.18	0.07

Percent rooting success

The difference rooting success (%) of two different varieties of Dragon fruit was found significant in respect of varieties, cutting maturity, cutting size and their combined effects. The higher rooting success (100%) was observed in BAU Dragon fal-1 and lower (98.90%) was found in BAU Dragon fal-2 (Table 6). The rooting success was higher (100%) in matured stem cutting but the lower (98.90%) success was recorded in semi-matured cutting (Table 6). The successful rooting was highest (100%) in large sized cutting and lowest (98.36%) was found in small sized (Table 6).

Table 6. Effect of variety, cutting maturity, and size on % rooting success in Dragon fruit

Variety	**% rooting success**	**Cutting maturity**	**% rooting success**	**Cutting size**	**% rooting success**
V_1	100	M_1	100.00	S_1	100.00
V_2	98.40	M_2	98.90	S_2	100.00
-	-	-	-	S_3	98.36
Sig. level	**	Sig. level	**	Sig. level	**
$Lsd_{0.05}$	0.28	$Lsd_{0.05}$	0.54	$Lsd_{0.05}$	0.65

Table 7. Combined effect of variety and cutting maturity, variety and cutting size, and cutting maturity and size on % rooting success in Dragon fruit

Variety × Cutting maturity	**% rooting success**	**Variety × Cutting size**	**% rooting success**	**Cutting maturity × size**	**% rooting success**
V_1M_1	100.00	V_1S_1	100.00	M_1S_1	100.00
V_1M_2	100.00	V_1S_2	100.00	M_1S_2	100.00
V_2M_1	100.00	V_1S_3	100.00	M_1S_3	100.00
V_2M_2	97.81	V_2S_1	100.00	M_2S_1	100.00
-	-	V_2S_2	100.00	M_2S_2	100.00
-	-	V_2S_3	96.72	M_2S_3	96.72
Sig. level	**	Sig. level	**	Sig. level	**
$Lsd_{0.05}$	0.76	$Lsd_{0.05}$	0.92	$Lsd_{0.05}$	0.92

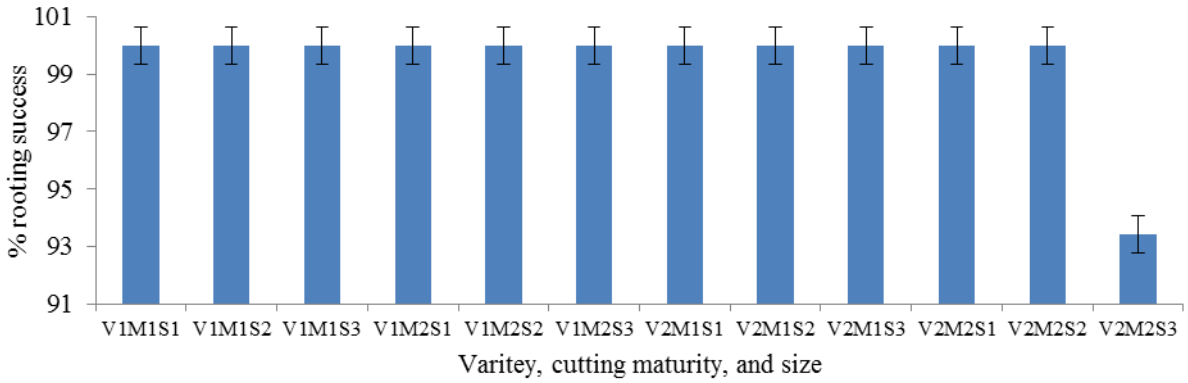

Fig. 2. Interaction among variety, cutting maturity and size (G) on % rooting success in Dragon fruit. Vertical bars indicate $Lsd_{0.05}$

The highest rooting success (100%) was observed from the all maturity and variety except white semi-matured cutting (97.81) (Table 7). This might be due to carbohydrate contain in the stem cutting. The highest rooting success (100%) was observed from the all variety and cutting size except BAU Dragon fal-2 with small cutting (96.76%) (Table 7). The highest rooting success (100%) was observed from the all maturity and size of cutting exceptsemi-matured cutting of small sized (96.72%) (Table 7). The rooting success was highest (100%) in all combination of variety, cutting maturity, and size except small and semi-matured cutting of BAU Dagon fal-2 (93.44%) (Fig. 2).

CONCLUSION

The experimental results were significantly influenced by the varieties of Dragon fruit considering all parameters. BAU Dragon fal-1, matured and large sized stem cutting provided maximum plant height, rooting success and shoot number with minimum days required for first root initiation under single and combined effects. It may be concluded that matured and large sized cuttings of red Dragon fruit are performed best for propagation of Dragon fruit considering rooting success and vegetative growth.

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