Evaluation of some rooting substrates and cutting types in propagation of Fig (*Ficus carica*)

R. Ara[1], S.A.K.U. Khan[2], M. A. Mannan[2] and M. A. Rahim[3]

[1]Assistant Regional Seed Certification officer, Seed Certification Agency, Ministry of Agriculture, People's Republic of Bangladesh

[2]Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh

[3] Department of Horticulture, Bangladesh Agricultural University, Mymensingh, Bangladesh

**Email: rubayetara@yahoo.com*

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ABSTRACT

The cultivar (collected from Middle-East countries known as Egyptian common fig) showed cultivation potentials while cultivated by amateur gardeners in Bangladesh and thereby further studies are needed to explore its suitable propagation method for successful commercial cultivation in Bangladesh. Seven rooting substrates and two types of cuttings (semi-hard and hard wood) were used from Egyptian Common fig (Ficus carica) where garden soil was used as control substrate. The experiments were conducted in autumn 2018 and spring 2019 following two factor factorial Completely Randomized Design with three replications obtaining five propagules in each replication. In comparison to the control, quick bud and leaf initiation (about 8 days earlier in autumn and 3 to 4 days earlier in spring) was recorded from semi hard wood cuttings in coco-peat. Delayed bud and leaf initiation than control was observed in hard wood cuttings while sand was used as rooting substrate (about 4 and 1 day delayed in autumn and 8 and 7 days delayed in spring). Irrespective of the season, higher average length of bud, root and shoot; more number of bud, leaf, root and shoot than control (1.14 to 2.56-fold) were recorded in semi-hard wood cuttings in coco-peat. The research revealed that fig can be propagated by semi hard wood cuttings using coco-peat as rooting substrate in spring or autumn in Bangladesh.

Keywords: Hardwood, propagation, rooting substrates, season, semi hard wood, survivability

INTRODUCTION

Fig (*Ficus carica*) is a Mediterranean deciduous and subtropical fruit belonging to the family Moraceae. It is rich in both nutritional and medicinal value (Soni *et al*., 2014). In Bangladesh three species of fig as cluster fig (*Ficus racemosa*), hairy fig (*Ficus hispida*) and creeping fig (*Ficus pumila.*) grow in wild and consumed solely by wild animals and birds. Local people sometimes use *Ficus hispida* as wild vegetable and *Ficus racemosa* as medicinal fruit but *Ficus carica* is not grown here. Recently some varieties of *Ficus carica* have been collected by amateur gardeners and these varieties showed some cultivation potentials (Mehraj *et al*., 2013).

The introduction of fig in Bangladesh could contribute to increase the fruit diversity to the consumers for minimizing the gap between the need and supply of fruit (Siddique *et al*., 2010). But no attempt has been taken for mass and managed cultivation of fig in this country, though the soil and climatic conditions of Bangladesh are suitable for the cultivation of fig (Mehraj *et al*., 2013). This may be due to unavailability of suitable variety or lack of knowledge of cultivation procedure. To introduce a new fruit crop in an area, it is imperative to standardize its cultivation procedure and consequently availability of propagation material to the farmers for its cultivation.To prescribe a suitable propagation technique for fig, an investigation was made on the effect of different rooting substrate and cutting types on successful propagation of fig (*Ficus carica*).

MATERIALS AND METHODS

Experimental site and season

The experiment was conducted at Rangemari village under Batiaghata upazilla, Khulna, Bangladesh in autumn (Mid-August to Mid-October 2018) and spring (Mid-February to Mid-April 2019) (Banglapedia, 2021).Weather data (BMD, 2018 and 2019) of the experimental site during this periodhas been shown in Table 1.

Table 1: Weather conditions of study area during autumn (Mid- August to Mid-October) and spring (Mid-February to Mid-April) 2018-19 (BMD, 2018 and 2019)

Season	Monthly average max. temperature (°C)	Monthly average min. temperature (°C)	Monthly average relative humidity (%)	Monthly average rainfall (mm)
Autumn (Mid -August to Mid-October, 2018)	33.4	25.73	82	88.76
Spring (Mid-February to Mid-April, 2019)	31.67	20.5	73.33	114

Experimental materials

Cuttings from a 'Common fig' cultivar from Egypt (*Ficus carica)* (Wikimedia, 2020) and locally available rooting substrates, *viz*., garden soil, coco-peat, sand and vermicompost (VC) were used as experimental materials. Two types of cuttings viz. hardwood cuttings (dormant mature firm stems, which does not bend easily) and semi hardwood cuttings (partially mature wood which is reasonably firm and the leaves are of mature size)were taken as described by Ibironke (2013).

Preparation of the experimental materials

The cuttings were made with 4-5 nodes having a length of 12-15 cm. The leaves were removed from the cuttings and were trimmed to the required length by removing the terminal portions just above a bud. The proximal ends of the cuttings were given a slanting cut to expose maximum surface area for effective rooting. Cuttings were washed properly followed by soaking in detergent water for 15 minutes (Reddy *et al*., 2008). The cutting tool was dipped in a mixture of one part bleach and nine parts of water to prevent disease transmission (Ibironke, 2013). Before use, coco-peat was soaked well by water. Then excess water was removed by pressing firmly and kept hanging in a bag for two hours. All the rooting substances except vermicompost were sundried for natural sterilization.

Placement of cuttings in rooting substrates

Cuttings were planted on August 14, 2018 and February 14, 2019 in an inclined position (angle of 45°) in 4" x 3" plastic pots. A single cutting was placed in each pot and five pots with cutting were considered as a replication for a treatment. Watering was done as per requirement and other necessary measures were taken to ensure better care of the cuttings.

Design of experiment and treatments

Two factor factorial Completely Randomized Design (CRD) was followed with four replications for the treatments containing five propagules in each replication. The two factors were as treatment and the seasons (S_1= Autumn and S^2= Spring) of propagation. The all possible combinations of cutting types and rooting substrates were considered as treatments in the study. The treatments were as follows -

T_0 = Semi hard wood cutting (SWC) planted in garden soil (Control for SWC), T_1 = Hardwood cutting (HWC) planted in garden soil (Control for HWC), T_2 = SWC planted in garden soil with 25% vermicompost (VC), T_3 = HWC planted in garden soil with 25% VC, T_4= SWC planted in garden soil with 50% VC, T_5 = HWC planted in garden soil with 50% VC, T_6 = SWC planted in garden soil with 75% VC, T_7 = HWC planted in garden soil with 75% VC, T_8 = SWC planted in 100% VC, T_9 = HWC planted in 100% VC, T_{10} = SWC planted in sand, T_{11} = HWC planted in sand, T_{12} = SWC planted in coco-peat and T_{13} = HWC planted in coco-peat

Nutritional status of the used substrates

All rooting substrates used for the present study was analyzed in the laboratory of Soil Resource Development Institute, Daulatpur, Khulna under the Ministry of Agriculture, Peoples Republic of Bangladesh. The nutritional status of the substrates has been shown in Table 2.

Table 2: Nutritional status of the rooting substrates

Sl. no.	Sample	p^H	Salinity (DSm^{-1})	Organic matter (%)	Organic Carbon (%)	Total Nitrogen (%)	Phosphorus µgm gm^{-1} soil	Potassium mleq. gm^{-1} soil	Sulphur µgm gm^{-1} soil	Zinc µgm gm^{-1} soil or %	Boron µgm gm^{-1} soil
1	GS	8	1.6	4.90	NT	0.178	103.65	0.55	87.37	6.28	1.05
2	Sand	7.5	0.8	2.93	NT	0.120	14.02	0.08	55.75	1.19	0.16
3	GS 50% + VC 50%	6.9	5.2	6.95	NT	0.181	160.01	0.94	105.70	7.31	2.23
4	GS 25% + VC 75%	6.7	6.5	8.31	NT	0.183	161.68	1.16	122.85	7.40	2.33
5	GS 75% + VC 25%	7.0	3.8	5.50	NT	0.179	162.15	0.78	85.92	7.35	2.39
6	VC 100%	6.1	NT	NT	17.6	1.1	0.6	1.2	0.5	<0.1%	NT
7	CP	6.0	NT	NT	22.5	0.5	0.5	0.8	0.5	<0.1%	NT

GS = Garden soil, VC = Vermicompost, CP = Coco-peat, NT = Not tested

Observations recorded

Data were collected on growth and morphological characteristics like days to bud and leaf initiation (observations made regularly); number of buds, leaves,; length of buds, leaves, roots and shoots and leaf width were measured in millimeter using simple measuring scale (starting from one month of planting, observations made weekly for six weeks and final data that recorded at eighth week were analyzed). Length of buds was measured from the base on the stem to the tip and leaf length from the base of the petiole to the leaf apex along the midrib. The most spacious part of leaf blades were considered as leaf width. After 12 week of planting the cuttings, two of them were pulled out from each replication to count the number of roots and measure the length from stem-root junction to the root tip. Data on survivability of cutting were also recorded during this time. The height from the collar to the tip of the highest leaf was considered as shoot length.

Statistical analysis

Collected data were subject to two way analysis of variance (ANOVA) by Statistical Tool for Agricultural Research (STAR) (IRRI, 2013). The effects of various treatments and their interactions were assessed within ANOVA and the level of significance was tested by Least Significant Differences (Fisher's LSD) following significant ($P \leq 0.01$) F test. The assumptions on normality of data and homogeneity of variance were checked to ensure the validity of analysis.

RESULTS AND DISCUSSION

Days required for bud and leaf initiation

Irrespective of the season, significant ($P \leq 0.01$) variation in days required for bud and leaf initiation was observed due to different combinations of rooting substrates and cutting types (Table 3). Early bud and leaf initiation was recorded in semi hard wood cuttings planted in coco-peat (T_{12}) (for bud initiation- 5.5 days earlier; and for leaf initiation- 6.33 days earlier than control). However, semi hard wood cuttings planted in garden soil with 50% vermicompost (T_4) also showed early bud emergence and leaf initiation in comparison to the control (for bud initiation- 5 days earlier; and for leaf initiation- 4.33 days earlier than control, T_0).

Table 3: Days required for bud and leaf initiation in fig (*Ficus carica*) cuttings according to the rooting substrates and cutting types in two seasons (autumn and spring)

Treatments	Days to bud initiation			Days to leaf initiation		
	S_1	S_2	Season mean	S_1	S_2	Season mean
T_0	12.00 bc	7.00 fg	9.5 C	17.67 ab	10.33 de	14.00 B
T_1	9.67 cd	9.00 ef	9.17 CD	14.00 b-d	11.67 c-e	12.84 BC
T_2	11.33 bc	10.00 de	10.67 BC	17.67 ab	14.33 a-c	16.00 AB
T_3	12.67 b	11.00 c-e	11.84 BC	19.33 a	16.33 ab	17.83 A
T_4	5.33 e	3.67 h	4.50 F	11.00 d	8.33 ef	9.67 C
T_5	7.33 de	6.00 gh	6.67 D-F	12.67 cd	10.67 de	11.67 BC
T_6	14.00 ab	10.67 c-e	12.34 B	20.00 a	15.33 ab	17.67 A
T_7	13.33 b	11.67 c-e	12.50 B	18.67 a	15.67 ab	17.17 AB
T_8	13.00 b	13.00 a-c	13.00 B	18.33 ab	17.00 ab	17.67 A
T_9	11.33 bc	14.67 ab	13.00 B	20.00 a	17.67 a	18.84 A
T_{10}	13.00 b	12.00 b-d	12.50 B	15.67 a-c	13.67 b-d	14.67 B
T_{11}	16.33 a	15.67 a	16.00 A	18.67 a	17.67 a	18.17 A
T_{12}	4.67 e	3.33 h	4.00F	9.67 d	5.67 f	7.67 C
T_{13}	6.67 e	5.33 gh	6.00EF	11.33 cd	8.33 ef	9.83 C
Treatment mean	10.76A	9.08B		16.05A	13.05B	

LSD ($P \leq 0.01$) for days to bud initiation: to compare treatment at each level of season= 2.69; to compare season at each level of treatment= 1.54; for days to leaf initiation: to compare treatment at each level of season = 3.49; to compare season at each level of treatment = 2.00; n = 3 replications.* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Least Significant Difference (LSD) Test.S_1= Autumn and S_2= Spring; T_0 = Semi hard wood cutting (SWC) planted in garden soil (Control for SWC), T_1 = Hardwood cutting (HWC) planted in garden soil (Control for HWC), T_2 = SWC planted in garden soil with 25% vermicompost (VC), T_3 = HWC planted in garden soil with 25% VC, T_4= SWC planted in garden soil with 50% VC, T_5 = HWC planted in garden soil with 50% VC, T_6 = SWC planted in garden soil with 75% VC, T_7 = HWC planted in garden soil with 75% VC, T_8 = SWC planted in 100% VC, T_9 = HWC planted in 100% VC, T_{10} = SWC planted in sand, T_{11} = HWC planted in sand, T_{12} = SWC planted in coco-peat and T_{13} = HWC planted in coco-peat.

More or less similar observation was recorded in the hard wood cuttings planted in garden soil with 50% vermicompost (T_5). On the other hand, much delayed bud (6.83 days) and leaf (5.33 days) initiation than control (T_1) was found when hard wood cuttings were planted in sand only (T_{11}). The spring season significantly ($P \leq 0.01$) enhanced both of the bud and leaf initiation (1.68 days and 3.00 days earlier respectively).

Cutting is the main method used for the fig tree propagation. Growth factors of cuttings are directly influenced by factors like cutting type and rooting media (Antunes *et al*., 2003, Magesa *et al*., 2018). Coco-peat is a medium with small sized particle which ensures high moisture retention. It has a suitable range of pH (6.0 to 6.7) for supporting the cuttings to sprout early (Awang *et al*., 2009). In the current study, earliest bud and leaf initiation was observed in semi hard wood cuttings planted in coco-peat and garden soil with 50% vermicompost.

The result is in conformity with Sharath and Bhoomika (2018) who reported that vermicompost could be a definitive source of plant growth regulators produced by interactions between microorganisms and earthworms, which could contribute significantly to enhance plant growth. Similar result was reported by Verma *et al*. (2017) while they worked on marjorum and oregano to observe the effect of vermicompost on vegetative propagation. On the other hand, most delayed bud and leaf formation was recorded in the current study

Table 4: Number of buds, leaves and roots obtained from different types of cuttings and rooting substrates in two seasons of propagation of fig (*Ficus carica*)

Treatments	No. of bud			No. of leaf			Number of root		
	S_1	S_2	Season mean	S_1	S_2	Season mean	S_1	S_2	Season mean
T_0	1.33	2.00	1.67 CD	3.33 b	3.67 d-f	3.5 BC	32.67 c-e	32.67 cd	32.67F-H
T_1	1.00	1.00	1.00 D	3.67 b	3.33 d-f	3.5 BC	24.33 ef	24.33d-f	24.33H
T_2	1.33	2.33	1.83 B-D	3.33 b	5.67 b-d	4.33 B	30.33de	31.00 c-e	31.00F-H
T_3	1.33	1.67	1.50 CD	3.00 b	3.00 d-f	3.00BC	30.33 de	30.33 c-e	30.33GH
T_4	3.00	3.00	3.00 AB	4.33 ab	7.00 bc	4.5 B	64.67 a	71.33 a	68.00B
T_5	2.00	1.67	1.83 B-D	4.00 b	5.00 c-e	4.5 B	41.67 bc	56.67 b	49.17D
T_6	1.33	1.67	1.50 CD	3.00 b	4.67 c-f	3.84 BC	37.00 cd	37.00 c	37.00EF
T_7	1.33	1.33	1.33 CD	3.67 b	3.67 d-f	4.17 B	29.33 de	29.33 c-e	29.33H
T_8	1.00	1.00	1.00 D	3.33 b	3.33 d-f	3.33 BC	17.67 fg	21.67 ef	19.67I
T_9	1.33	1.00	1.17 CD	2.33 b	2.33 ef	2.33 C	13.00 g	16.33 f	14.67I
T_{10}	1.33	1.67	1.50 CD	2.67 b	3.33 d-f	3.00 BC	13.33 g	17.33 f	15.33I
T_{11}	1.00	1.00	1.00 D	2.00 b	2.00 f	2.00 C	11.67 g	15.67 f	13.67I
T_{12}	3.33	3.33	3.33 A	7.00 a	12.00 a	9.5 A	71.67 a	81.33 a	76.5A
T_{13}	2.33	2.33	2.33 A-C	3.33 b	8.00 b	5.67 B	50.33 b	60.67 b	55.5C
Treatment mea	1.62NS	1.7 NS		3.50NS	4.79NS		33.48NS	37.55 NS	

LSD ($P \leq 0.01$) for bud no: to compare treatment at each level of season = 1.25; to compare season at each level of treatment = NS; for leaf no: to compare treatment at each level of season = 2.85, to compare season at each level of treatment = 1.63; for root no: to compare treatment at each level of season = 10.67, to compare season at each level of treatment = 6.10; n = 3 replications.* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Least Significant Difference (LSD) Test.S_1= Autumn and S_2= Spring; T_0 = Semi hard wood cutting (SWC) planted in garden soil (Control for SWC), T_1 = Hardwood cutting (HWC) planted in garden soil (Control for HWC), T_2 = SWC planted in garden soil with 25% vermicompost (VC), T_3 = HWC planted in garden soil with 25% VC, T_4= SWC planted in garden soil with 50% VC, T_5 = HWC planted in garden soil with 50% VC, T_6 = SWC planted in garden soil with 75% VC, T_7 = HWC planted in garden soil with 75% VC, T_8 = SWC planted in 100% VC, T_9 = HWC planted in 100% VC, T_{10} = SWC planted in sand, T_{11} = HWC planted in sand, T_{12} = SWC planted in coco-peat and T_{13} = HWC planted in coco-peat

Table 5: Effect of the combination of cutting types and rooting substrates on bud length, leaf length and leaf width in sprouted cutting of fig (*Ficus carica*)

Treatments	Bud length (mm)			Leaf length (mm)			Leaf width (mm)		
	S_1	S_2	Season mean	S_1	S_2	Season mean	S_1	S_2	Season mean
T_0	4.00	4.33	4.17A-D	30.00	33.67	31.83 CD	31.00	31.33	31.17 D-F
T_1	4.00	4.47	4.23A-D	33.00	38.00	35.50 C	31.67	35.33	33.50 DE
T_2	4.33	4.60	4.47A-D	33.33	36.67	35.00 C	33.33	34.67	34.00 DE
T_3	4.33	4.73	4.53A-D	34.00	35.33	34.67 C	33.67	33.67	33.67 DE
T_4	4.00	4.50	4.25 A-D	48.00	55.67	51.83 AB	47.00	54.00	50.50 B
T_5	4.00	4.27	4.13 B-D	44.33	50.33	47.33 B	44.00	48.00	46.00 BC
T_6	4.00	4.33	4.17A-D	27.67	33.67	30.67 CD	29.00	32.00	30.50 D-F
T_7	4.67	4.87	4.77A-C	34.67	39.33	37.00 C	36.00	36.67	36.33 CD
T_8	3.67	4.00	3.83B-D	21.00	28.67	24.83 D	22.00	26.33	24.17 EF
T_9	3.33	3.67	3.50CD	21.67	26.67	24.17 D	20.00	24.33	22.17 F
T_{10}	4.33	4.67	4.50 A-D	28.67	33.67	31.17 CD	25.00	30.00	27.50 D-F
T_{11}	3.00	3.17	3.08D	29.67	34.00	31.83 CD	29.00	32.33	30.67 D-F
T_{12}	5.33	6.07	5.70 A	59.00	62.67	60.83 A	59.67	61.67	60.67 A
T_{13}	5.00	5.23	5.12 AB	48.00	53.33	50.67 B	45.67	52.67	49.17 B
Treatment mean	4.14NS	4.49NS		35.22 B	40.12 A		34.79 B	38.07 A	

LSD ($P \leq 0.01$) for bud length: to compare treatment at each level of season = 1.55; to compare season at each level of treatment = 0.33; for leaf length: to compare treatment at each level of season = 9.12, to compare season at each level of treatment = 1.97; for leaf width: to compare treatment at each level of season= 10.05, to compare season at each level of treatment = 2.20; n = 3 replications.

* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Least Significant Difference (LSD) Test.

S_1= Autumn and S_2= Spring; T_0 = Semi hard wood cutting (SWC) planted in garden soil (Control for SWC), T_1 = Hardwood cutting (HWC) planted in garden soil (Control for HWC), T_2 = SWC planted in garden soil with 25% vermicompost (VC), T_3 = HWC planted in garden soil with 25% VC, T_4= SWC planted in garden soil with 50% VC, T_5 = HWC planted in garden soil with 50% VC, T_6 = SWC planted in garden soil with 75% VC, T_7 = HWC planted in garden soil with 75% VC, T_8 = SWC planted in 100% VC, T_9 = HWC planted in 100% VC, T_{10} = SWC planted in sand, T_{11} = HWC planted in sand, T_{12} = SWC planted in coco-peat and T_{13} = HWC planted in coco-peat

Table 6: Root and shoot length of the fig (*Ficus carica*) cuttings planted in different rooting substrates

Treatments	Root length (mm)			Shoot length (mm)		
	S_1	S_2	Season mean	S_1	S_2	Season mean
T_0	27.00 cd	27.00 cd	27.00 DE	52.33	60.67	56.50 D
T_1	20.67 de	20.67 cd	20.67 EF	42.33	49.00	45.67 E
T_2	27.00 cd	27.00 cd	27.00 DE	56.00	62.33	59.17 D
T_3	24.33cd	24.67 cd	24.50 E	43.00	47.67	45.34 E
T_4	37.67 b	66.00 ab	51.84 B	93.33	98.67	96.00 B
T_5	29.67 c	61.67 ab	45.67C	80.33	89.33	84.83 C
T_6	30.00 c	30.00 c	30.00 D	44.00	52.00	48.00 E
T_7	27.33cd	27.33 cd	27.33DE	33.33	43.33	38.33 F
T_8	10.67 f	17.33 d	14.00 F	34.67	39.33	37.00 F
T_9	13.67 ef	16.33 d	15.00 F	32.00	36.67	34.33F
T_{10}	12.67 f	23.33 cd	18.00 F	26.67	28.00	27.33G
T_{11}	10.67 f	21.67 cd	16.17F	23.33	24.67	24.00 G
T_{12}	48.67 a	71.00 a	59.84 A	98.33	107.33	102.83 A
T_{13}	37.67 b	57.67 b	47.67C	85.67	90.67	88.17 C
Treatment mean	25.55 B	35.55 A		53.2B	59.26 A	

LSD ($P \leq 0.01$) for root length: to compare treatment at each level of season = 7.24, to compare season at each level of treatment = 4.14; for total shoot length: to compare treatment at each level of season = 5.14, to compare season at each level of treatment = 1.11; n = 3 replications.

* Means with the same lower-case or upper-case letter in rows or columns are not significantly different at $P \leq 0.01$ by the Least Significant Difference (LSD) Test.S_1= Autumn and S_2= SpringT_0 = Semi hard wood cutting (SWC) planted in garden soil (Control for SWC), T_1 = Hardwood cutting (HWC) planted in garden soil (Control for HWC), T_2 = SWC planted in garden soil with 25% vermicompost (VC), T_3 = HWC planted in garden soil with 25% VC, T_4= SWC planted in garden soil with 50% VC, T_5 = HWC planted in garden soil with 50% VC, T_6 = SWC planted in garden soil with 75% VC, T_7 = HWC planted in garden soil with 75% VC, T_8 = SWC planted in 100% VC, T_9 = HWC planted in 100% VC, T_{10} = SWC planted in sand, T_{11} = HWC planted in sand, T_{12} = SWC planted in coco-peat and T_{13} = HWC planted in coco-peat

in sand irrespective of cutting types and seasons. Similar findings were reported by Manila *et al*. (2017) where the lowest percentage of sprouted cuttings of pomegranate (*Punica granatum*) was recorded when planted in sand only.

Number of buds, leaves and roots

In comparison to the control, 1.66, 6.00 and 43.83 more buds, leaves and roots respectively were recorded from semi hard wood cuttings planted in coco-peat (T_{12}) which is statistically similar to semi hard wood cuttings planted in 50% vermicompost with garden soil (T_4). In case of leaf number the result was followed by hard wood cuttings planted in coco-peat (T_{13}) (5.67), semi hard wood cuttings planted in 50% vermicompost with garden soil (T_4)(4.5) and 50% vermicompost with garden soil (T_5) (4.5). However, semi hard wood cuttings planted in 50% vermicompost with garden soil (T_4) produced 35.33 more roots than control. The effect of seasonal variation was not significant for the number of bud, leaf and root (Table 4). Similar findings was reported by Nawarathna *et al*. (2020) while they studied the rooting and survivability performance of different cutting types of *Momordica dioica*in different rooting substrates.

Semi hard wood cuttings contain shorter internodes that mean more number of nodes in the same length compared to hard wood cuttings. Nodes reserve food which accelerates the growth of plants. So, more nodes imply possibility of more buds and leaves and consequently more roots. Similar findings were described by Alikhani *et al*. (2011). Coco-peat produced highest number of

Table 7: Survivability of rooted fig (*Ficus carica*) cuttings in respect of cutting types and rooting substrates in two seasons

Season	Cutting types	Substrates						
		Sb_0	Sb_1	Sb_2	Sb_3	Sb_4	Sb_5	Sb_6
Season I	SWC	+++++	+++++	+++++	+++	++	-	+++++
(Autumn)	HWC	+++++	+++++	+++++	++	-	-	+++++
Season 2	SWC	+++++	+++++	+++++	+++++	++	++	+++++
(Spring)	HWC	+++++	+++++	+++++	+++++	++	++	+++++

Single '+' sign = 20% survived cuttings, '-' = Cuttings not survivedSWC= Semi hard wood cutting and HWC= Hardwood cutting, Sb_0 = Garden soil (Control), Sb_1 = Garden soil with 25% vermicompost, Sb_2 = Garden soil with 50% vermicompost, Sb_3 = Garden soil with 75% vermicompost, Sb_4 = 100% vermicompost, Sb_5 = Sand and Sb_6 = Coco-peat

buds, leaves and roots and garden soil with 50% vermicompost produced second highest as these are the substrates which increase soil porosity as well as soil aeration. Similar findings were reported by Shamsuddin *et al*. (2021). On the contrary, low nutrient content and low water retention capacity of sand inhibited number of buds, leaves and roots. Torkashvanda and Shadparvar (2012) demonstrated the similar results from their study conducted on the effect of rooting substrates on China rose.

Bud Length, Leaf Length and Leaf Width

Semi hard or hard wood cuttings planted in coco-peat (T_{12} or T_{13}) showed statistically similar longest bud (5.70 and 5.12 mm respectively). However, these treatments were significantly different from others. In case of leaf length and leaf width statistical similarity was observed between T_4, T_{12} and T_{13} and dissimilarity between control and other treatments (Table 5).

Longer and wider leaves were observed in T_{12} (29 mm longer and 29.5 mm wider than control) followed by T_4 (20 mm longer and 19.33 mm wider than control). Minimum length of bud (3 mm) and leaf (31.83 mm) was observed in T_{11} while the minimum leaf width was recorded in T_9 (22.17 mm) (Table 5).

In consideration to the seasons, the spring enhanced the length of bud and leaf and width of leaf, though no significant variation was observed for bud length in these seasons. The variation in the quality of the root and shoot characteristics by using various rooting substrates can be accredited to the direct consequence of the medium on the basal portion of the cutting (Hwang and Jeong, 2007). Coco-peat plays a vital role in spreading the canopy and increasing the leaf area through improving the physical and chemical properties of soil (Awang *et al*., 2009) which is in compliance with the results from the current study.

Length of root and shoot

The longest roots and shoots were recorded in semi hard wood cuttings planted in coco-peat (T_{12}) (32.84 mm and 46.33 mm longer than control) followed by semi hard wood cutting planted in the mixture of garden soil and 50% vermicompost (T_4) ; though, statistically similar root length was observed from the treatmentsT_5 and T_{13} (Table 6). The cuttings showed statistically significant ($P \leq 0.01$) variations for shoot length while they were planted in different rooting media. Irrespective of the cutting types, shortest length of root and shoot was found in the cuttings planted in sand only (T_{10} and T_{11}) (root length from 16.17 to 18.00 mm; shoot length from 24.00 to 27.33 mm). Length of root and shoot was found to be influenced by the seasonal variations having longer roots and shoots in spring (9.55 mm and 6.03 mm longer root and shoot respectively in spring than autumn).Sand is very poor in nutrient content and vermicompost adds slow releasing nutrients to soil and these become available through microbial activities in combination with soil.

Swarts *et al*. (2018) also reported significantly increased rooting percentage, rooting quality, budding leaves and survival percentage in heel cuttings of *Lobostemon fruticosus* (L) planted in coco peat during spring.

Survivability of rooted cuttings

During autumn none of the rooted hard wood cuttings survived while they were planted in substrates containing only vermicompost (Sb_4) or sand (Sb_5). However, none of the rooted semi hard wood cuttings survived in sand (Sb_4). On the other hand, minimum decease of the rooted semi hard or hard wood cuttings was recorded during spring from any of the rooting media (Table 7). Though irrespective of the cutting types, a lower rate of survivability (40%) was recorded while only vermicompost (Sb_4) and sand (Sb_5) were used as media in spring. On the other hand, a moderate rate of survivability (40 to 60%) was recorded in autumn while the cuttings were planted in garden soil with 75% vermicompost (Sb_3).

Similar results were documented by Blouin *et al*. (2019) where they observed improved soil functioning with the addition of vermicompost and its maximum positive effect on plant growth when they used 30% to 50% vermicompost of the total soil volume. They also stated that the best original material to be used for vermicompost production was cattle manure which was same as in the present experiment.

Initial vigor of plantlets has great impact on survivability and further growth of the plant (Via and Lande, 1985). More number and large size of leaves and roots enhance the percentage of survivability which has been reflected from the current study.

Similar findings were delineated by Lakshanthi and Seran (2019), Sudarjat *et al*. (2018) and Dahale *et al*. (2018).The phenotypic expression of a plant is the sum of its genotype and the interaction of genotype and environment (Via and Lande, 1985).

All of growth and morphological characters of the studied plant materials showed a negative trend regarding the increment of the amount of applied vermicompost over 50%. This may be due increased availability of nutrients in the rooting substrates as displayed in Table 2. Wilson (1988) stated that increased nutrient level sometime limits plant growth. These may also be the cause of low survivability rate of saplings grown in vermicompost in the current study (Table 7).

Again, all of the parameters did comparatively well in spring than autumn. The optimum monthly average temperature (26.09°C) and monthly average relative humidity (73.33%) during spring favored vigorous growth, development and survivability of fig (*Ficus carica)* cuttings.

Findings by Nava *et al*. (2014) support the result obtained from current study. Similar result was also reported by Siddique *et al*. (2010) when investigation was done on some minor fruit cuttings.

CONCLUSION

The current study was conducted to observe the effect of cutting types and rooting substrates on the performance of cutting during autumn and spring. Two factor factorial Completely Randomized Design (CRD) was followed with four replications for the treatments containing five propagules in each replication. From the study it was observed that semi hard wood cuttings performed better in respect of growth parameters when they were planted in coco-peat and 50% vermicompost with garden soil. In these two rooting substrates hard wood cuttings also performed good but sand was observed as worst media for all types of cuttings. Both Autumn and Spring seasons are suitable for propagation of fig (*Ficus carica*) in Bangladesh but Spring is better in respect of all growth, morphological characteristics and survivability due to its moderate temperature and low relative humidity.

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