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Studies on seasonal influence on rooting of cuttings in kiwi (*Actinidia deliciosa*) under Kodaikanal condition

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Abstract

In kiwi variety 'Hayward', softwood, hardwood and semi-hardwood cuttings were prepared during different months (January - December) in two years. The cuttings were treated uniformly with IBA 300 PPM and planted in the poly bag (1:1:1 peat: sand: FYM). The observations on days to 50% sprouting, number of roots, root length (cm), shoot length (cm) and survival percentage were recorded. Based on the pooled data of two years in softwood cuttings, 50% sprouting was earlier in cuttings prepared during May (39.55). Semi-hard wood cuttings prepared in April and May had taken 37.10 and 38.17 days for 50% sprouting. Hardwood cuttings had lower days for 50% sprouting (43.43) in April followed by May (46.95). The cuttings viz., semi hardwood, hard wood and softwood prepared during March month recorded significantly more number of roots (7.18, 8.42, 5.96). Higher root length was observed in softwood cuttings (10.49 cm, May), semi-hard wood cuttings (23.06 cm, June) and hard wood cuttings (9.01 cm, January). The longest shoots were observed in all three groups of cuttings prepared in March (7.63 cm, 9.92 cm, 6.12 cm). Among the three types of cutting semi-hard wood cuttings prepared in June, July (63.36%, 62.19%) had more survival percentage. Among In this experiment it was observed that semi-hardwood cuttings recorded higher vales for number of roots (8.42), root length (23.06), shoot length (10.48 cm), survival percentage (63.36%) and earlier days for 50% sprouting (37.10).

Keywords: *Actinidia deliciosa*, clonal propagation, cuttings, season

Introduction

Kiwi fruit originated in China and also known as "China's miracle fruit" and "Horticulture wonder of New Zealand". Now commercialized on large scale in USA, Italy, China, Japan, Germany and Australia. In India it was introduced during 1960's and commercialized in mid and low hills of Himachal Pradesh during 1990's as well as in other hill states Jammu and Kashmir, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland, Nilgiri hills and upper Kodaikanal hills of south India (Pandey and Tripathy, 2014) [7].

Kiwi (*Actinidia deliciosa*) belongs to the family Actinidiaceae, a cross pollinated crop and dioecious in nature. Kiwi plant is a vigorous woody training vine generally supported on 'T' trellis system. A vigorous vine may well cover up an area of 10-15 feet broad 18-24 feet length and 9-12 feet height (Morton, 1987) [6]. Kiwi fruit has gained popularity in recent years because of its delicious fruits with unique blend of taste and high nutritive and medicinal value.

Kiwifruit is rich in minerals particularly in phosphorus (20-40 mg/100 g), potassium (230-380 mg/100 g), calcium (25 - 60 mg/100 g), and magnesium (14 - 27 mg/100 g) and possesses high content of ascorbic acid (300mg/100g) in fresh weight of edible portion. Vitamin A and B1 (thiamine) are also present in sufficient quantities (Pandey and Tripathy, 2014) [7]. Kiwi fruit extract was found to inhibit melanoma, a type of skin cancer (Collins *et al* 2001) [3]. Fruits contain carteriolsteine (Cho *et al.*, 2004) [2] and folic acid (Morton, 1987) [6].

Kiwi plants can be propagated both sexually and asexually. Sexual propagation is mostly done to produce root stock for budding and grafting. It is commercially propagated through cuttings, grafting and budding on a seedling rootstock. Among them propagation through cuttings is the most popular, easiest, time saving and economical method of propagation. Various forms of stem cuttings, such as hardwood, semi-hardwood and softwood are used for the propagation. Rooting of cuttings was strongly influenced by planting time and growth hormones (Kumar and Sharma, 2002) [5].

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The kiwi cuttings planted in February in soil media of silt: Clay: FYM at the ratio of 2:1:1 had better growth and development under the agro climatic condition of Swat in Pakistan. Maximum survival percentage (29.16%), number of roots per plant (13.31) and plant height (40.42 cm) was recorded for the cuttings planted on 20th Feb (Irshad *et al.*, 2014) [4].

Ali Omer *et al.* (2004) [1] concluded that the cutting date significantly affected rooting ability. The semi-hard wood cuttings taken in July had better rooting ability in terms of main root numbers, the mean length of the longest 5 roots and rooting area and rooting percentage.

Research on the time of preparation of cuttings, size and from which portion the cuttings are to be taken are meager under Indian conditions.

In Kodaikanal kiwi was introduced during 2010 and it was found economically viable. In and around Kodaikanal region there is a great demand for true to type kiwi plants. Therefore the experiment was designed to standardize the time of preparation of kiwi cuttings and to find suitable economic form of cuttings.

Materials and Methods

Experiment was taken in the Horticultural Research Station, Kodaikanal during 2015-17. About ten years old plants of 'Hayward' cultivar having uniform vigour growth available in station were selected for taking cuttings. Experimental design was FRBD with month of cutting preparation (Jan - Feb) as

factor 1 and type of cuttings (softwood, semi hard wood and hard wood) as factor 2. The experiment was replicated thrice with 20 cuttings per treatment. Softwood cuttings of 10 - 15 cm length with 4 to 5 nodes and hardwood and semi-hardwood cuttings of 15 - 20 cm length with 4 to 5 nodes were selected and planted in the poly bags containing media 1:1:1 of peat soil: sand : FYM. The observations on days to 50% sprouting, number of roots, root length (cm) and survival percentage were recorded. Since kiwi is a shy rooter the number of roots and root length were recorded three months after planting and survival percentage was calculated four months after planting respectively. The study was conducted for two seasons for confirmation of results. Data were subjected statistical analysis in AGRES package version 5.0.

Results and Discussion

Seasonal influence on rooting of cuttings in kiwi (I year & II year)

The results on three different types of cuttings on various parameters are presented in Table 1-7. There is a significant difference in all the parameters observed. Softwood cuttings recorded lower days for 50% sprouting in May preparation (38.43 - I year; 40.66 -II year) in both years. However, in semi-hard wood cuttings lower number of days to 50% sprouting was noticed in April preparation (I year - 35.64; II year - 38.56) followed by May (I year - 36.65; II year - 39.68) days during first and second year respectively. Similarly, hardwood cuttings had

Table 1: Seasonal influence on rooting of cuttings in kiwi for days to 50% sprouting

Month of planting (T)	I Year				II Year			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	50.21	48.65	57.54	52.13	53.73	53.00	58.98	55.24
Feb	55.23	53.87	55.40	54.83	52.13	51.79	57.98	53.97
Mar	45.65	42.75	50.63	46.34	49.13	46.88	53.43	49.81
Apr	43.87	35.64	42.53	40.68	46.70	38.56	44.32	43.19
May	38.43	36.65	45.92	40.33	40.66	39.68	47.98	42.77
June	40.62	42.68	47.65	43.65	43.09	46.37	48.76	46.07
Jul	45.41	43.82	49.43	46.22	42.50	41.94	51.54	45.33
Aug	56.85	54.43	58.62	56.63	61.67	59.96	59.84	60.49
Sep	50.65	52.63	56.92	53.40	54.22	57.42	58.76	56.80
Oct	51.43	52.54	53.74	52.57	55.09	57.32	55.54	55.98
Nov	50.32	50.72	57.92	52.99	49.31	48.71	56.73	51.58
Dec	53.42	52.09	55.54	53.68	57.83	57.34	56.24	57.14
Mean	48.51	47.21	52.65	49.46	50.50	49.92	54.18	51.53
	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
T	0.59		1.18		0.61		1.21	
C	0.30		0.59		0.32		0.64	
T X C	1.03		2.05		1.13		2.25	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

Table 2: Seasonal influence on rooting of cuttings in kiwi for number of roots

Month of planting (T)	I Year				II Year			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	5.64	6.54	5.56	5.91	6.26	5.26	4.17	5.23
Feb	6.85	7.85	6.74	7.15	6.71	5.69	4.61	5.67
Mar	6.77	8.88	6.56	7.40	7.58	7.95	5.35	6.96
Apr	5.63	8.50	6.24	6.79	6.25	7.44	4.93	6.21
May	5.48	7.42	5.25	6.05	6.08	6.24	3.83	5.38
June	6.71	7.59	4.87	6.39	7.45	6.42	3.41	5.76
Jul	6.57	7.44	4.22	6.08	6.44	5.29	2.14	4.62
Aug	6.74	7.21	4.84	6.26	7.55	6.08	3.42	5.68
Sep	5.68	7.17	4.97	5.94	6.30	5.96	3.52	5.26
Oct	6.52	6.89	4.21	5.87	7.24	5.65	2.67	5.19
Nov	4.50	5.53	4.20	4.74	4.41	3.42	2.12	3.32
Dec	4.54	5.81	4.85	5.07	5.08	4.51	3.43	4.34

Mean	5.97	7.24	5.21	6.14	6.45	5.83	3.63	5.30
	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
T	0.51		1.01		0.61		1.21	
C	0.25		0.51		0.24		0.48	
T X C	0.88		1.75		0.91		1.81	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings earlier days to 50% sprouting in April (42.53; 44.32) and May (45.92; 47.98) month plantings both in first and second year.

In the first year more number of roots was observed in the February planting in softwood cuttings (6.85) and hard wood cuttings (6.74) respectively, whereas in March planting in semi hard wood cuttings (8.88). In the second year more number of roots was observed in the March planting in all the cuttings (7.58, 7.95, 5.35). Higher root length was observed in May planting for softwood cuttings (9.94 cm; 11.03 cm), in June planting for semi- hard wood cuttings (22.80 cm; 23.31 cm) during first and second years respectively. Whereas, hard wood cuttings prepared in February (8.95 cm) in the first year and in January (9.48 cm) in second year recorded higher values. Higher shoot length was observed in March planting for all the cuttings in first year (7.20 cm, 9.36 cm, 5.77 cm) and second year (8.06 cm, 10.48 cm, 6.46 cm) respectively.

Survival percentage is the most important character which decides the success in propagation. In the first and second year higher survival percentage in softwood cuttings were observed in March planting, (54.65% 61.21%) and April planting (56.73% and 62.97%) respectively. In semi-hard wood cuttings June, July planting (60.05%; 62.82%) in first year and May, June planting (65.09%; 66.66%) in the second year recorded more survival percentage. Hard wood cuttings

had more survival percentage in January and February planting (42.87% & 44.65%) in first year and January and March planting (45.59% & 43.51) in second year.

Results on pooled data of two years

Pooled data analysis of two years revealed that in softwood cuttings, lower number of days to 50% sprouting was recorded in May planting (39.55), whereas, in semi-hard wood cuttings it was noticed in April (37.10), May (38.17) month planting. Hardwood cuttings had lower days for 50% sprouting in April (43.43) followed by May (46.95) month plantings. More number of roots was observed in the March month planting in all the cuttings (7.18, 8.42, 5.96). Javel *et al.* (2015) also reported pencil size of dormant cuttings planted during March month recorded minimum number of days to 50% sprouting and more number of roots in February planting. Higher root length was observed in May planting for softwood cuttings (10.49 cm), in June planting for semi- hard wood cuttings (23.06 cm) and in January planting for hard wood cuttings (9.01 cm). Higher shoot length was observed in March planting for all the cuttings respectively (7.63 cm, 9.92 cm, 6.12 cm).

Table 3: Seasonal influence on rooting of cuttings in kiwi for root length

Month of planting (T)	I Year				II Year			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	8.79	19.21	8.54	12.18	9.76	19.32	9.48	12.85
Feb	8.44	21.81	8.95	13.07	8.27	19.37	8.77	12.14
Mar	8.57	20.15	8.33	12.35	9.60	20.57	9.33	13.17
Apr	8.82	20.5	7.32	12.21	9.79	20.76	8.13	12.89
May	9.94	20.12	7.51	12.52	11.03	20.33	8.34	13.23
June	6.94	22.80	6.87	12.20	7.70	23.31	7.63	12.88
Jul	7.58	20.65	6.22	11.48	7.43	18.24	6.10	10.59
Aug	7.28	18.64	7.87	11.26	8.15	18.88	8.81	11.95
Sep	6.15	17.55	6.66	10.12	6.83	17.48	7.39	10.57
Oct	6.83	15.04	5.87	9.25	7.58	14.69	6.52	9.60
Nov	6.62	13.62	5.57	8.60	6.49	11.35	5.46	7.77
Dec	6.20	12.87	5.28	8.12	6.94	12.41	5.91	8.42
Mean	7.68	18.58	7.08	11.11	8.30	18.06	7.66	11.34
	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
T	0.56		1.11		0.62		1.23	
C	0.28		0.55		0.31		0.62	
T X C	0.96		1.92		1.12		2.23	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

Table 4: Seasonal influence on rooting of cuttings in kiwi for shoot length

Month of planting (T)	I Year				II Year			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	6.51	8.18	5.23	6.64	7.23	9.08	5.81	7.37
Feb	6.75	9.02	5.56	7.11	6.62	8.84	5.45	6.97
Mar	7.20	9.36	5.77	7.44	8.06	10.48	6.46	8.33
Apr	6.64	8.73	4.88	6.75	7.37	9.69	5.42	7.49
May	6.61	8.65	4.60	6.62	7.34	9.60	5.11	7.35
June	6.95	8.83	5.23	7.00	7.71	9.80	5.81	7.77
Jul	6.87	8.28	5.33	6.83	6.73	8.11	5.22	6.69
Aug	5.93	8.57	5.18	6.56	6.64	9.60	5.80	7.35
Sep	5.81	8.01	5.43	6.42	6.45	8.89	6.03	7.12
Oct	5.50	7.84	5.11	6.15	6.11	8.70	5.67	6.83
Nov	5.63	7.63	4.87	6.04	5.52	7.48	4.77	5.92

Dec	5.26	7.82	4.68	5.92	5.89	8.76	5.24	6.63
Mean	6.31	8.41	5.16	6.62	6.81	9.09	5.57	7.15
T	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
C	0.50		1.01		0.71		1.42	
T X C	0.25		0.50		0.45		0.90	
	0.87		1.74		1.12		2.25	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

Table 5: Seasonal influence on rooting of cuttings in kiwi for survival percentage

Month of planting (T)	I Year				II Year			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	48.45	52.56	42.87	47.96	53.78	58.34	45.59	52.57
Feb	52.63	50.43	44.65	49.24	51.58	49.42	41.76	47.59
Mar	54.65	55.74	40.63	50.34	61.21	62.43	43.51	55.72
Apr	56.73	55.90	38.63	50.42	62.97	62.05	40.88	55.30
May	46.22	58.64	33.65	46.17	51.30	65.09	35.35	50.58
June	45.40	60.05	35.50	46.98	50.39	66.66	37.41	51.49
Jul	42.63	62.82	36.54	47.33	41.78	61.56	33.81	45.72
Aug	42.52	56.43	31.28	43.41	47.62	63.20	33.03	47.95
Sep	40.74	55.34	30.39	42.16	45.22	61.43	31.73	46.13
Oct	43.83	48.61	30.25	40.90	48.65	53.96	31.58	44.73
Nov	38.04	42.20	36.18	38.81	37.28	41.36	33.46	37.37
Dec	40.72	43.72	32.40	38.95	45.61	48.97	34.29	42.96
Mean	46.05	53.54	36.08	45.22	49.78	57.87	36.87	48.17
T	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
C	1.80		3.58		2.12		4.31	
T X C	0.90		1.79		1.31		2.65	
	3.11		6.20		2.76		5.53	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

Table 6: Seasonal influence on rooting of cuttings in kiwi (Pooled mean of two years)

Month of planting (T)	Days to 50% sprouting				Number of Roots				Root Length (cm)			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	51.97	50.83	58.26	53.69	5.95	5.90	4.87	5.57	9.28	19.27	9.01	12.52
Feb	53.68	52.83	56.69	54.40	6.78	6.77	5.68	6.41	8.36	20.59	8.86	12.60
Mar	47.39	44.82	52.03	48.08	7.18	8.42	5.96	7.19	9.09	20.36	8.83	12.76
Apr	45.29	37.10	43.43	41.94	5.94	7.97	5.59	6.50	9.31	20.63	7.73	12.56
May	39.55	38.17	46.95	41.56	5.78	6.83	4.54	5.72	10.49	20.23	7.93	12.88
June	41.86	44.53	48.21	44.87	7.08	7.01	4.14	6.08	7.32	23.06	7.25	12.54
Jul	43.96	42.88	50.49	45.78	6.51	6.37	3.18	5.35	7.51	19.45	6.16	11.04
Aug	59.26	57.20	59.23	58.56	7.15	6.65	4.13	5.98	7.72	18.76	8.34	11.61
Sep	52.44	55.03	57.84	55.10	5.99	6.57	4.25	5.60	6.49	17.52	7.03	10.35
Oct	53.26	54.93	54.64	54.28	6.88	6.27	3.44	5.53	7.21	14.87	6.20	9.43
Nov	49.82	49.72	57.33	52.29	4.46	4.48	3.16	4.03	6.56	12.49	5.52	8.19
Dec	55.63	54.72	55.89	55.41	4.81	5.16	4.14	4.70	6.57	12.64	5.60	8.27
Mean	49.51	48.56	53.42	50.50	6.21	6.53	4.42	5.72	7.99	18.32	7.37	11.23
	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
T	1.12		2.24		0.47		0.95		0.43		0.85	
C	0.56		1.12		0.23		0.47		0.21		0.42	
T X C	1.94		3.88		0.82		1.65		0.74		1.48	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

In softwood cuttings higher survival percentage was observed in April planting (59.85%) whereas, in June, July planting (63.36%, 62.19%) in semi-hardwood cuttings. But the hardwood cuttings had more survival percentage in January planting (44.23%). Ali Omer *et al.* (2004) [1] also stated that rooting percentage was 76.6% in semi hardwood cuttings taken during July and 63.3% in cuttings taken during August. Based on the two years data it is inferred that, the softwood cuttings prepared during April had more survival percentage.

Semi-hardwood cuttings had higher survival percentage in June and July month preparation. However, hardwood cuttings had higher survival percentage in January and February month preparation; hence the vine lopping from the pruned portion during dormant period can be utilized for propagation purpose. Among the three types of cuttings semi-hardwood cuttings recorded higher values for number of roots, root length, shoot length, survival percentage and less number of days for 50% sprouting.

Table 7: Seasonal influence on rooting of cuttings in kiwi (Pooled data of two years)

Month of planting (T)	Shoot length (cm)				Survival percentage (%)			
	SW	SHW	HW	T mean	SW	SHW	HW	T mean
Jan	6.87	8.63	5.52	7.01	51.12	55.45	44.23	50.27
Feb	6.69	8.93	5.51	7.04	52.11	49.93	43.21	48.42
Mar	7.63	9.92	6.12	7.89	57.93	59.09	42.07	53.03
Apr	7.01	9.21	5.15	7.12	59.85	58.98	39.76	52.86
May	6.98	9.13	4.86	6.99	48.76	61.87	34.50	48.38
June	7.33	9.32	5.52	7.39	47.90	63.36	36.46	49.24
Jul	6.80	8.20	5.28	6.76	42.21	62.19	35.18	46.53
Aug	6.29	9.09	5.49	6.96	45.07	59.82	32.16	45.68
Sep	6.13	8.45	5.73	6.77	42.98	58.39	31.06	44.14
Oct	5.81	8.27	5.39	6.49	46.24	51.29	30.92	42.82
Nov	5.58	7.56	4.82	5.99	37.66	41.78	34.82	38.09
Dec	5.58	8.29	4.96	6.28	43.17	46.35	33.35	40.96
Mean	6.56	8.75	5.36	6.89	47.92	55.71	36.48	46.70
	S.Ed		C.D at 0.05%		S.Ed		C.D at 0.05%	
T	0.19		0.39		1.48		2.96	
C	0.09		0.19		0.74		1.48	
T X C	0.33		0.67		2.57		5.12	

SW = softwood cuttings, SHW = Semi -hardwood cuttings, HW= Hardwood cuttings

Conclusion

Overall conclusion drawn from the results of the present study is that semi hardwood cuttings of Kiwi cultivar “Hayward” showed good results for earlier sprouting, root and shoot length, rooting and survival percentage. Among the different type of cuttings and the season of collection, semi hardwood cuttings collected during June and July has higher survival percentage and performing propagation during this season was found to be suitable for successful planting material production.

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