

# STANDARDIZATION OF BEST SOIL MEDIA AND TIME OF GUAVA PROPAGATION THROUGH CUTTINGS UNDER JAMMU SUB TROPICS

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## ABSTRACT

Soft wood cuttings of guava treated with 4000 ppm IBA were planted in polybags containing different soil media during June, July, August and September. It was observed that among all the media compositions i.e. vermiculite + FYM (1:1), perlite + FYM (1:1), sand + FYM (1:1), vermiculite + sand + FYM (1:1:1) and perlite + sand + FYM (1:1:1), vermiculite + sand + FYM (1:1:1) showed maximum rooted cuttings (78.69%), number of new shoots per plant (10.42), plant height (26.49 cm), number of leaves per plant (25.08) and stem thickness (1.14 cm) while, cuttings planted in perlite + sand + FYM (1:1:1) took minimum days to sprout (8.95) during 15<sup>th</sup> to 21<sup>st</sup> of August. Therefore it may be concluded that guava cuttings planted in soil media of Vermiculite + sand + FYM (1:1:1) of August was found to be best suitable media for guava propagation.

## INTRODUCTION

Guava (*Psidium guajava* L.) belonging to family Myrtaceae is originated in tropical south America. It is one of the leading fruit crops in India due to wide adaptability to varying soil and climatic conditions (Sharma *et al.*, 2013). It is considered to be one of the exquisite, nutritionally valuable and remunerative crop. Its cultivation is getting popularity due to increasing international trade, better nutritional contents and processing of its value added products (Sharma *et al.*, 2013). Besides its high nutritional value, it bears heavy crop every year and gives good economic returns. This has prompted several farmers to take up guava orcharding on a commercial scale (Singh *et al.*, 2007). Guavas are commercially propagated sexually through seeds. During sexual propagation plants cannot maintain the genetic purity of the variety due to the segregation and recombination of characters. Several methods have been proposed for guava propagation both by sexual (by seed) (Zamiret *et al.*, 2003) and asexual methods (by cutting, layering, budding and grafting). Clonal propagation of guava can be considered to avoid segregation of genetic variety, maintain the quality of fruits and have considerable potential for the improvement of economically important trees within a limited time frame (Giri *et al.*, 2004; Singh *et al.*, 2004). There are several reports, (Ullah *et al.*, 2005; Gautam *et al.*, 2010) which have examined the possibilities of propagation of guava by using stem cutting from seedling originated juvenile stock plants in which genetic segregation is possible. Propagation by cuttings from mature trees may be one of the important

options to avoid the genetic segregation and maintain the quality of variety. Propagation by cuttings has significant advantage, since, in addition to obtaining plants with the same type of tree, will ensure production of economically important tree in just one growing season.

Soil media is considered an integral part of propagation and percentage rooting and quality of roots produced are directly influenced by the medium. Preparation of suitable soil media includes the standardization of texture and nutrient status. Perlite is far the most used rooting substrate in olive producing countries. Media containing vermiculite (soil + organic compost + vermiculite, 1:1:1 v/v) showed the best results with respect to leaf fresh mass (5.028 g), leaf dry mass (0.662 g), root fresh mass (2.562 g) and root dry mass (0.206 g) in papaya (Costa *et al.*, 2008). Perlite + vermiculite (1:1 v/v) resulted in rooting (95 percent) in both years of experiment with highest (10.8) mean number of roots, root length (47 mm), root dry weight (382 mg), root fresh weight (48.3 mg) and number of secondary roots (13) in olive cuttings (Isfendiyaroglu *et al.*, 2009).

Mixtures such as perlite plus peat, coconut fiber or vermiculite have also given good results (Fabbriet *et al.*, 2004 and Sutter, 2005). A suitable selection of soil media components and its ratio will decide the success of the planting medium. In present study was conducted with objective to find out combinations of various soil media for planting guava cuttings and to standardize the best soil media for guava propagation through softwood cuttings.

## MATERIALS AND METHODS

Five different combinations of soil media i.e. vermiculite + FYM (1:1), perlite + FYM (1:1), sand + FYM (1:1), vermiculite + sand + FYM (1:1:1) and perlite + sand + FYM (1:1:1) were filled in polybags as shown in figure 2 and four months viz. 15<sup>th</sup> to 21<sup>st</sup> of June, July, August, September were selected for planting softwood cuttings of guava. Soft wood cuttings of guava cv. L-49 were made by removing immature branches from the selected plants which were of 4 to 6 months old. Leaves were removed from only that part which was to be buried in propagation media. Cuttings of uniform size of 15 cm long with diameter 0.4 to 0.7 cm having 4 buds and 2 cut leaves were made by giving basal cut at 0.3 cm below a bud and upper cut about 1.0 cm above the bud. The prepared cuttings were treated with 4000 ppm IBA (Indole Butyric Acid) Siddiqui and Syed (2007). Basal ends at least 2-3 cm were quickly dipped in required strength of hormone. After treatment with specified growth regulator, the treated cuttings were planted in well prepared black polybags at a depth of 6-8 cm containing soil, sand and FYM in ratio 1:1:1 (Shanker, 1999). The observations on the time taken to sprouting were recorded from the date of propagation to the full sprouting and percentage of rooted cuttings, average leaf area, average leaf fresh weight, average leaf dry weight, plant fresh weight, plant dry weight, number of primary roots per rooted cutting, number of secondary roots per rooted cutting, length of

primary root, root fresh weight, root dry weight, chlorophyll percentage were recorded after 90 days of planting cuttings while, plant height, number of new shoots per plant and number of leaves per plant were recorded at 30, 60, 90, 120, 150 and 180 days of planting cuttings.

The experiment was laid out in Factorial Random Block Design. Total number of treatments was 20 and each treatment was replicated thrice. The data were then analyzed as per method of Panse and Sukhtame (2000).

## RESULTS AND DISCUSSION

The perusal of data related to percentage of rooted cuttings presented in Table 1 and graphically (Figure 1) indicates that time, soil media and their interaction had a significant effect on percentage of rooted cuttings of guava. After 90 days of planting highest (78.69 per cent) success was recorded in vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of August which was at par with (77.02 per cent) in vermiculite + sand (1:1) and (76.01 per cent) in perlite + sand + FYM (1:1:1). Results showing the superiority of media containing vermiculite are in consonance with the observation of Hosseninet *al.*, 2004 where they reported that vermiculite has been recorded a positive effect on the rooting of Iranian cultivars when used as a medium component for cuttings. Similar results have been observed by Okaoet *al.*, 2012 and stated that cuttings rooted in vermiculite produced significantly higher number of rooted

**Table 1: Influence of soil media, time of planting cuttings and their interaction effect on percentage of rooted cuttings of guava cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	51.70(61.41)	56.37(68.70)	61.85(77.02)	56.30(69.04)	56.49(69.04)
Perlite + Sand	38.42(38.73)	50.92(60.23)	56.66(69.41)	49.29(57.41)	49.29(56.45)
Sand + FYM	34.18(31.74)	50.92(41.68)	44.28(48.77)	49.29(47.05)	40.48(42.31)
Vermiculite + Sand + FYM	52.05(62.09)	56.71(69.71)	62.75(78.69)	57.60(71.01)	57.28(70.37)
Perlite + Sand+ FYM	50.95(60.20)	55.05(67.01)	61.31(76.01)	54.31(65.81)	55.41(67.22)
Mean	45.46(50.80)	51.79(61.47)	57.37(69.98)	52.16(62.06)	
Factors	S.E. m ( $\pm$ )			C.D (0.05)	
Soil media	0.56			1.60	
Time of planting cuttings	0.56			1.43	
Media x Time	1.12			3.20	

Note: Figures in parenthesis indicate observed values and others are transformed values.

**Table 2: Influence of soil media, time of planting cuttings and their interaction effect on number of days taken to sprouting of guava cuttings cv. L-49**

Time of planting Cuttings Soil media	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	18.51	19.95	16.85	18.86	18.55
Perlite + Sand	10.85	10.16	9.56	9.97	10.13
Sand + FYM	20.18	19.96	16.87	18.86	18.97
Vermiculite + Sand + FYM	11.06	10.27	9.96	10.10	10.35
Perlite + Sand+ FYM	10.27	10.05	8.95	9.94	9.96
Mean	14.19	14.09	12.46	13.56	
Factors	S.E. m ( $\pm$ )			C.D (0.05)	
Soil media	0.17			0.50	
Time of planting cuttings	0.15			0.44	
Media x Time	0.35			0.99	

**Table 3: Influence of soil media, time of planting cuttings and their interaction effect on number of shoots per plant of guava cv. L-49.**

Time of planting cuttings	After 30 days			After 60 days			After 90 days			Mean	C.D (0.05)	S.E.m(±)	C.D (0.05)								
	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>					Mean	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean		
Soil media	2.16	2.14	2.52	2.44	2.31	3.49	3.90	4.21	4.08	3.92	4.61	4.76	5.24	4.80	4.85						
Vermiculite + Sand	1.95	2.02	2.13	2.15	2.06	3.19	3.72	4.00	3.85	3.69	3.91	4.00	4.41	4.16	4.12						
Perlite + Sand	2.06	1.89	2.02	2.05	2.00	3.31	3.44	3.74	3.58	3.52	3.70	3.80	3.99	3.90	3.85						
Sand + FYM	2.11	2.45	2.55	2.46	2.39	4.12	4.28	4.88	4.64	4.48	4.94	5.14	5.34	5.24	5.16						
Vermiculite + Sand + FYM	2.06	2.05	2.46	2.16	2.18	3.39	3.77	4.12	3.88	3.79	4.13	4.22	4.82	4.77	4.49						
Perlite + Sand + FYM	2.07	2.11	2.34	2.25	2.18	3.50	3.82	4.19	4.01	4.26	4.38	4.76	4.57	4.57	4.49						
Mean																					
Factors	S.E. m (±)												C.D (0.05)			S.E.m(±)			C.D (0.05)		
Soil media	N.S												0.01			0.01			0.01		
Time of planting cuttings	N.S												0.01			0.01			0.01		
Media x Time	N.S												0.01			0.01			0.01		

**Table 3: Cont.....**

Time of planting cuttings	After 120 days			After 150 days			After 180 days			Mean	C.D (0.05)	S.E. m (±)	C.D (0.05)								
	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>					Mean	June 15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug 15 <sup>th</sup> -21 <sup>st</sup>	Sep 15 <sup>th</sup> -21 <sup>st</sup>	Mean		
Soil media	6.04	6.08	7.74	7.58	6.86	7.99	8.08	8.49	8.08	8.22	8.58	9.59	10.10	10.00	9.57						
Vermiculite + Sand	4.90	5.93	5.68	5.59	5.53	6.58	6.98	7.12	6.98	6.94	8.09	8.28	9.29	9.14	8.70						
Perlite + Sand	4.58	5.00	4.87	4.80	4.82	5.88	5.99	6.78	5.99	6.31	6.66	7.11	7.30	7.21	7.07						
Sand + FYM	7.30	7.88	7.80	7.61	7.65	8.37	8.58	8.97	8.58	8.70	8.67	10.00	10.42	10.19	9.82						
Vermiculite + Sand + FYM	5.18	6.07	5.72	5.65	5.66	7.30	7.59	8.08	7.59	7.66	8.39	8.75	9.58	9.27	9.00						
Perlite + Sand + FYM	5.60	6.19	6.37	6.25	5.66	7.23	7.45	7.89	7.45	7.66	8.08	8.74	9.34	9.16	9.00						
Mean																					
Factors	S.E. m (±)												C.D (0.05)			S.E. m (±)			C.D (0.05)		
Soil media	0.01												0.01			0.04			0.10		
Time of planting cuttings	0.01												0.01			0.04			0.10		
Media x Time	0.01												0.02			0.09			0.22		

**Table 4: Influence of soil media, time of planting cuttings and their interaction effect on plant height (cm) of guava cv. L-49.**

Time of planting cuttings Soil media	After 30 days			After 60 days			After 90 days			Mean	S.E. m (±)	C.D (0.05)
	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>			
Vermiculite + Sand	13.10	13.43	14.67	14.36	14.89	16.59	15.05	16.40	19.40	17.23		
Perlite + Sand	10.07	10.43	12.07	12.17	12.30	14.49	13.10	13.40	17.37	15.02		
Sand + FYM	9.00	9.33	10.20	11.18	11.87	13.80	12.02	12.24	15.43	13.54		
Vermiculite + Sand + FYM	13.80	14.70	15.77	14.85	15.96	17.57	16.40	17.37	21.17	18.56		
Perlite + Sand + FYM	12.40	12.77	14.80	13.39	13.86	15.33	14.04	14.10	19.23	16.12		
Mean	11.67	12.13	13.50	13.29	13.77	15.55	14.12	14.70	18.52	17.04		
Factors	S.E. m (±)									C.D (0.05)		C.D (0.05)
Soil media	N.S									0.11		0.54
Time of planting cuttings	N.S									0.11		0.48
Media x Time	N.S									0.22		1.07

**Table 4: Cont.....**

Time of planting cuttings Soil media	After 120 days			After 150 days			After 180 days			Mean	S.E. m (±)	C.D (0.05)
	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>	June 15 <sup>th</sup> ..21 <sup>st</sup>	July 15 <sup>th</sup> ..21 <sup>st</sup>	Aug 15 <sup>th</sup> ..21 <sup>st</sup>			
Vermiculite + Sand	15.61	18.37	21.38	17.48	19.17	23.59	20.10	18.05	20.13	20.97		
Perlite + Sand	13.70	14.27	19.20	16.19	17.37	20.26	18.24	17.20	18.16	19.44		
Sand + FYM	13.33	12.48	17.59	15.37	16.15	19.16	17.22	16.59	17.20	18.56		
Vermiculite + Sand + FYM	16.58	19.49	23.39	20.21	18.38	25.38	22.41	20.53	21.22	22.85		
Perlite + Sand + FYM	14.17	16.15	20.19	17.97	18.07	22.18	20.05	18.20	19.15	20.43		
Mean	15.88	16.15	20.35	17.08	18.18	22.11	19.99	18.11	19.17	20.99		
Factors	S.E. m (±)									C.D (0.05)		C.D (0.05)
Soil media	0.01									0.18		0.20
Time of planting cuttings	0.01									0.16		0.17
Media x Time	0.01									0.37		0.39

**Table 5: Influence of soil media, time of planting cuttings and their interaction effect on stem thickness (cm) of guava cv.L-49.**

Time of planting cuttings Soil media	After 30 days			After 60 days			After 90 days			Mean	S.E. m ( $\pm$ )	C.D (0.05)								
	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>	Mean 15 <sup>th</sup> 21 <sup>st</sup>	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>				Mean 15 <sup>th</sup> 21 <sup>st</sup>	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>	Mean 15 <sup>th</sup> 21 <sup>st</sup>		
Vermiculite + Sand	0.71	0.79	0.86	0.84	0.80	0.94	0.96	1.03	0.98	0.98	0.96	0.97	1.04	1.01	1.00					
Perlite + Sand	0.69	0.77	0.83	0.81	0.77	0.89	0.92	0.98	0.95	0.93	0.92	0.95	0.92	0.96	0.95					
Sand + FYM	0.65	0.74	0.80	0.77	0.74	0.86	0.86	0.96	0.95	0.91	0.88	0.91	0.98	0.94	0.93					
Vermiculite + Sand + FYM	0.73	0.81	0.89	0.86	0.82	0.95	0.98	1.03	1.00	0.99	0.98	0.99	1.07	1.04	1.02					
Perlite + Sand + FYM	0.68	0.76	0.83	0.80	0.77	0.92	0.95	0.99	0.97	0.96	0.93	0.96	0.99	0.99	0.97					
Mean	0.69	0.77	0.84	0.81	0.77	0.91	0.93	0.98	0.97	0.96	0.93	0.96	1.00	1.00	0.97					
Factors	S.E. m ( $\pm$ )														S.E. m ( $\pm$ )			C.D (0.05)		
Soil media	N.S														0.01			0.01		
Time of planting cuttings	N.S														0.01			0.01		
Media x Time	N.S														0.01			0.02		

**Table 5: Cont.....**

Time of planting cuttings Soil media	After 120 days			After 150 days			After 180 days			Mean	S.E. m ( $\pm$ )	C.D (0.05)								
	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>	Mean 15 <sup>th</sup> 21 <sup>st</sup>	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>				Mean 15 <sup>th</sup> 21 <sup>st</sup>	June 15 <sup>th</sup> 21 <sup>st</sup>	July 15 <sup>th</sup> 21 <sup>st</sup>	Aug 15 <sup>th</sup> 21 <sup>st</sup>	Sep 15 <sup>th</sup> 21 <sup>st</sup>	Mean 15 <sup>th</sup> 21 <sup>st</sup>		
Vermiculite + Sand	0.98	1.00	1.06	1.04	1.02	1.00	1.02	1.07	1.06	1.04	1.03	1.04	1.09	1.07	1.06					
Perlite + Sand	0.95	0.98	1.01	0.99	0.98	0.96	1.01	1.04	1.02	1.01	0.99	1.07	1.06	1.03	1.04					
Sand + FYM	0.90	0.96	1.00	0.97	0.96	0.94	1.00	1.04	1.01	1.00	0.96	1.01	1.06	1.04	1.02					
Vermiculite + Sand + FYM	1.00	1.00	1.09	1.05	1.04	1.04	1.04	1.11	1.07	1.06	1.05	1.06	1.14	1.10	1.08					
Perlite + Sand + FYM	0.94	0.98	1.01	0.99	0.98	0.97	1.03	1.05	1.02	1.02	1.03	1.07	1.07	1.06	1.05					
Mean	0.95	0.98	1.01	1.01	0.98	0.98	1.02	1.06	1.04	1.02	1.02	1.05	1.08	1.06	1.05					
Factors	S.E. m ( $\pm$ )														S.E. m ( $\pm$ )			C.D (0.05)		
Soil media	0.01														0.01			0.01		
Time of planting cuttings	0.01														0.01			0.01		
Media x Time	0.01														0.01			0.03		

**Table 6: Influence of soil media, time of planting cuttings and their interaction effect on average leaf fresh weight (g) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	0.34	0.36	0.42	0.38	0.37
Perlite + Sand	0.30	0.35	0.39	0.35	0.35
Sand + FYM	0.28	0.34	0.36	0.34	0.33
Vermiculite + Sand + FYM	0.36	0.39	0.43	0.40	0.39
Perlite + Sand+ FYM	0.31	0.36	0.41	0.36	0.36
Mean	0.32	0.36	0.40	0.36	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.01		
Media x Time	0.01		0.02		

**Table 7: Influence of soil media, time of planting cuttings and their interaction effect on average leaf dry weight (mg) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	21.95	22.94	26.90	23.78	23.87
Perlite + Sand	20.34	21.73	24.35	22.87	22.32
Sand + FYM	19.93	20.64	24.17	22.68	21.85
Vermiculite + Sand + FYM	22.60	24.64	27.00	23.98	24.55
Perlite + Sand+ FYM	21.70	22.71	26.02	23.78	23.55
Mean	21.30	22.53	25.69	23.41	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.14		0.39		
Time of planting cuttings	0.12		0.35		
Media x Time	0.27		0.78		

**Table 8: Influence of soil media and time of planting cuttings on average leaf area (cm<sup>2</sup>) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	18.84	19.54	22.16	20.18	20.18
Perlite + Sand	18.76	19.46	22.14	20.17	20.13
Sand + FYM	18.70	19.41	22.14	20.13	20.09
Vermiculite + Sand + FYM	18.87	19.60	22.17	20.18	20.20
Perlite + Sand+ FYM	18.80	19.49	22.14	20.17	20.15
Mean	18.79	19.50	22.15	20.16	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.02		
Media x Time	0.01		0.04		

**Table 9: Influence of soil media, time of planting cuttings and their interaction effect on average plant fresh weight (g) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	3.92	4.56	4.68	4.62	4.45
Perlite + Sand	3.33	4.13	4.48	4.17	4.02
Sand + FYM	3.29	4.04	4.39	4.10	3.95
Vermiculite + Sand + FYM	4.01	4.64	4.78	4.72	4.54
Perlite + Sand+ FYM	3.47	4.16	4.66	4.23	4.13
Mean	3.60	4.31	4.60	4.37	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.01		
Media x Time	0.01		0.02		

**Table 10: Influence of soil media, time of planting cuttings and their interaction effect on average plant dry weight (g) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	0.16	0.16	0.18	0.17	0.17
Perlite + Sand	0.13	0.14	0.17	0.20	0.16
Sand + FYM	0.11	0.13	0.15	0.14	0.13
Vermiculite + Sand + FYM	0.20	0.21	0.23	0.19	0.20
Perlite + Sand+ FYM	0.14	0.15	0.17	0.16	0.16
Mean	0.15	0.16	0.18	0.17	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.01		
Media x Time	0.01		0.02		

**Table 11: Influence of soil media, time of planting cuttings and their interaction effect on number of primary roots per rooted cuttings of guava cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	4.97	5.12	5.25	5.18	5.13
Perlite + Sand	4.78	4.91	5.06	5.02	4.94
Sand + FYM	4.11	4.86	4.98	4.95	4.72
Vermiculite + Sand + FYM	5.06	5.20	5.26	5.20	5.18
Perlite + Sand+ FYM	4.86	4.92	5.12	5.09	5.10
Mean	4.75	5.00	5.13	5.09	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.04		0.11		
Time of planting cuttings	0.03		0.09		
Media x Time	0.07		0.21		

**Table 12: Influence of soil media, time of planting cuttings and their interaction effect on number of secondary roots per rooted cutting of guava cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June 15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	9.24	9.28	9.34	9.31	9.29
Perlite + Sand	8.95	9.03	9.08	9.04	9.02
Sand + FYM	8.81	8.87	8.94	8.90	8.88
Vermiculite + Sand + FYM	9.25	9.28	9.44	9.35	9.33
Perlite + Sand + FYM	9.11	9.15	9.19	9.17	9.15
Mean	9.07	9.12	9.20	9.15	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.02		
Time of planting cuttings	0.01		0.02		
Media x Time	0.01		0.04		

**Table 13: Influence of soil media, time of planting cuttings and their interaction effect on length of primary root (cm) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	4.00	4.37	4.68	4.60	4.41
Perlite + Sand	3.46	3.63	4.08	3.74	3.73
Sand + FYM	3.23	3.31	3.81	3.60	3.48
Vermiculite + Sand + FYM	4.48	4.60	4.93	4.76	4.69
Perlite + Sand+ FYM	3.93	4.00	4.53	4.47	4.23
Mean	3.82	3.98	4.41	4.23	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.03		0.08		
Time of planting cuttings	0.02		0.07		
Media x Time	0.06		0.16		

**Table 14: Influence of soil media, time of planting cuttings and their interaction effect on average root fresh weight (g) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July 15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	1.05	1.07	1.16	1.12	1.10
Perlite + Sand	1.19	1.22	1.31	1.27	1.24
Sand + FYM	1.03	1.06	1.14	1.12	1.09
Vermiculite + Sand + FYM	1.06	1.09	1.17	1.13	1.11
Perlite + Sand+ FYM	1.23	1.27	1.31	1.29	1.27
Mean	1.11	1.14	1.21	1.18	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.01		
Media x Time	0.01		0.01		

**Table 15: Influence of soil media, time of planting cuttings and their interaction effect on average root dry weight (mg) of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June 15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	44.67	45.00	50.69	48.70	47.26
Perlite + Sand	48.01	52.68	58.34	55.35	53.84
Sand + FYM	37.34	36.69	45.02	40.68	39.93
Vermiculite + Sand + FYM	46.31	47.66	55.35	50.67	50.10
Perlite + Sand+ FYM	55.02	62.68	67.70	64.70	62.52
Mean	46.35	48.94	55.62	52.02	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.30		0.85		
Time of planting cuttings	0.27		0.76		
Media x Time	0.60		1.71		

**Table 16: Influence of soil media, time of planting cuttings and their interaction effect on chlorophyll percentage of guava cuttings cv. L-49 after 90 days**

Time of planting Cuttings Soil media	June15 <sup>th</sup> -21 <sup>st</sup>	July15 <sup>th</sup> -21 <sup>st</sup>	Aug15 <sup>th</sup> -21 <sup>st</sup>	Sep15 <sup>th</sup> -21 <sup>st</sup>	Mean
Vermiculite + Sand	2.34(0.17)	2.56(0.21)	2.78(0.24)	2.67(0.22)	2.59(0.21)
Perlite + Sand	1.95(0.13)	2.09(0.14)	2.64(0.22)	2.43(0.19)	2.27(0.17)
Sand + FYM	1.61(9.09)	2.02(0.13)	2.50(0.20)	2.41(0.19)	2.24(0.15)
Vermiculite + Sand + FYM	2.43(0.19)	2.61(0.21)	2.86(0.25)	2.74(0.23)	2.66(0.22)
Perlite + Sand+ FYM	2.12(0.14)	2.41(0.18)	2.74(0.23)	2.61(0.21)	2.47(0.19)
Mean	2.09(0.14)	2.34(0.17)	2.70(0.23)	2.57(0.21)	
Factors	S.E. m ( $\pm$ )		C.D (0.05)		
Soil media	0.01		0.01		
Time of planting cuttings	0.01		0.01		
Media x Time	0.01		0.02		

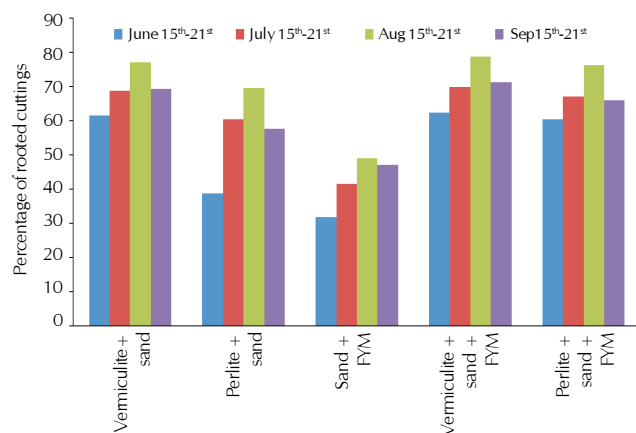
cuttings than those rooted in other substrates.

The time of planting cuttings, soil media and their interaction significantly influenced the number of days taken for sprout as presented in Table 2. Minimum (8.95) number of days taken to sprout was observed in cuttings planted during 15<sup>th</sup>-21<sup>st</sup> of August in treatment combination of perlite + sand + FYM (1:1:1) during. These findings are in conformity with that of Conover and Joiner, 1963 where they reported that perlite having pH 6.7 and vermiculite with pH 7.5 may be high enough to suppress initiation and growth of roots. Vermiculite stuck together and held a thin layer of moisture on the surface, resulting in poor aeration of the media.

As presented in Table 3 response of vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of August was also found to be best in terms of number of shoots per plant. At 60, 90, 120, 150 and 180 days of planting, number of shoots in cuttings (4.88, 5.34, 7.80, 8.97 and 10.42 respectively) were observed maximum in cuttings planted in media of vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup> to 21<sup>st</sup> of August. These findings are in line with the results of Behrke, 2007 where he reported that vermiculite is having high nutrient holding capacity than perlite and contributes potassium and magnesium to the media which resulted in more shoots.

Vermiculite + sand + FYM (1:1:1) combinations of soil media used for planting guava cuttings showed maximum increase





**Figure 1: Influence of soil media and time of planting cuttings on percentage of rooted cuttings of guava cv. L-49 after 90 days**

in plant height as presented in Table 4. At 60, 90, 120, 150 and 180 days of planting, plant height (17.57 cm, 21.17 cm, 23.39 cm, 25.38 cm and 26.49 cm respectively) was found highest in cutting planted in soil media of vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup> to 21<sup>st</sup> of August. These results are in accordance with the findings of Cros *et al.*, 2007 where they reported that substrate containing vermiculite exhibited more plant height as compared to plant height in perlite.

The time of planting cuttings, soil media and their interaction significantly influenced the number of leaves as presented in Table 5. At 60, 90, 120, 150 and 180 day of planting, number of leaves (10.40, 15.88, 18.62, 21.82 and 24.29 respectively) were obtained maximum in cuttings planted in soil media of vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup> to 21<sup>st</sup> of August and at 30 days results were non-significant. Similar results have been obtained in Dahlia plants by Ali (2011) where he reported that number of leaves per plant was maximum in substrate containing vermiculite and less number of leaves per plant was recorded in substrate containing perlite in dahlia plants.

Treatment combination of vermiculite + sand + FYM (1:1:1) resulted in higher subsequent growth with respect to leaf fresh weight (0.43 g) and leaf dry weight (27.00 mg) as presented in Table 6 and 7 respectively during 15<sup>th</sup>-21<sup>st</sup> of August after 90 days which was followed by leaf fresh weight (0.42 g) and leaf dry weight (26.90 mg) in vermiculite + sand (1:1) during 15<sup>th</sup>-21<sup>st</sup> of August. These findings are in consonance with Croset *al.* (2007) where they reported that substrate containing vermiculite resulted in more fresh weight of plants as compared to substrate containing perlite in common purslane which resulted in more leaf dry weight of plants grown in media containing vermiculite.

In the Table 8 response of cuttings planted in vermiculite + sand + FYM (1:1:1) among other media during 15<sup>th</sup>-21<sup>st</sup> of August, was found to be excellent after 90 days of planting with respect to average leaf area (22.17 cm<sup>2</sup>) which was followed by (20.18 cm<sup>2</sup>) in vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of September. The findings are in agreement with the results of Ali (2011) where he observed maximum leaf area index in plants grown in substrate containing vermiculite and less leaf area index of leaves in plants grown

in substrate containing perlite.

Treatment combination vermiculite + sand + FYM (1:1:1) after 90 days resulted in maximum plant fresh weight (4.78 g) and plant dry weight (0.23 g) during 15<sup>th</sup>-21<sup>st</sup> of August which was followed by (4.72 g) plant fresh weight and (0.19 g) plant dry weight in vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of September as presented in Table 9 and 10 respectively. Above findings are in accordance with the results of Martinez-Medina *et al.*, 2009 where they reported that plants treated with the bentonite-vermiculite formulation of *Trichoderma harzianum* showed significant increase in fresh and dry weights compared to non formulated plants.

As shown in Table 11, 12 and 13 the time of planting cuttings, soil media and their interaction significantly influenced the number of primary, secondary and length of primary roots respectively. Vermiculite + sand + FYM (1:1:1) among other media during 15<sup>th</sup>-21<sup>st</sup> of August, was found to be excellent after 90 days of planting with respect to number of primary roots (5.26), secondary roots (9.44) and length of primary roots (4.93 cm) which was followed by (5.20) primary roots, (9.35) secondary roots and (4.76 cm) length of primary root in Vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of September. These findings are in line with the results of Copes (1977) where they observed that use of vermiculite promoted lateral branches but appeared to have little effect on root thickness, while high proportions of perlite usually resulted in short and not well branched roots. He also reported that media containing only perlite or perlite + sand dried out rapidly and needed more frequent and heavy watering than others. It was almost impossible to overwater the perlite-sand media. Vermiculite was somewhat intermediate in water retention characteristics.

Response of cuttings planted in treatment combination perlite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of August, was found to be excellent after 90 days of planting with respect to root fresh weight (1.31 g) and root dry weight (67.7 mg) as shown in Table 14 and 15 respectively. These findings are in conformity with the results of Majdi *et al.* (2012) where they reported that substrate containing perlite showed maximum root weight then substrate containing vermiculite. Results of Copes (1977) also showed that perlite based media have thicker roots whereas vermiculite has no effect on root thickness.

As presented in Table 16 Vermiculite + sand + FYM (1:1:1) treatment combinations of soil media used for planting guava cuttings was found to be best among all treatments tried. Where, after 90 days of planting maximum (0.25 per cent) chlorophyll percentage was recorded in vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of August which was at par with (0.23 per cent) in vermiculite + sand + FYM (1:1:1) during 15<sup>th</sup>-21<sup>st</sup> of September. These findings are in agreement with the results of Martinez-Medina *et al.*, 2009 where he reported that plants treated with the bentonite-vermiculite showed significant increase in chlorophyll content.

Findings showing poor performance of substrate containing perlite as compared to vermiculite are in agreement with Bruckner (1997) where he reported that relative balance of air and water within a soil's pore space is critical to plant growth. Perlite is generally unsatisfactory for the production of plants



**Figure 2: View of guava (*Psidium guajava* L.) softwood cuttings treated with IBA and planted in polybags containing soil media**

in containers. This is primarily because perlite does not provide the aeration, drainage and moisture in good balance at low tensions required. Ors and Anapali (2010) also reported that perlite is generally unsatisfactory for the production of plants in containers.

Response of cuttings was found to be best during 15<sup>th</sup>-21<sup>st</sup> of August is in consonance with the findings of Gautam *et al.* (2010) who reported that maximum rooting in cuttings of guava took place in rainy season. However, relatively poor root formation recorded during extremely hot and cold conditions was due to low activity of cambium to proliferate in unfavourable and adverse environmental conditions (Goel and Behl, 1994). Hafeez ur Rehman *et al.* (1990) also reported maximum success in cuttings from June 15 to August 15. Maximum success during 15<sup>th</sup>-21<sup>st</sup> of August might be due to favourable temperature, high relative humidity, long sun-shine hours and low evaporation rate like climatic conditions which are congenial for growth and development of plant in month of August.

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