I.J.S.N., VOL. 3(3) 2012: 592-598 ISSN 2229 – 6441

INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

BEHAVIOUR OF SOME INDIGENOUS MULBERRY GENOTYPES OF KASHMIR VALLEY UNDER POLYHOUSE

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ABSTRACT
The rooting of mulberry varieties for their survival and quick propagation has been of great concern and as such evolution of varieties which among other parameters are best rooters is the need of hour. The indigenous mulberry varieties in Kashmir valley although nutritionally better, yet they are shy rooters. Polyhouse has resulted in enhancing the rooting ability of these varieties under study. The rooting percentage increased significantly to 88.77 in T_6 (control) followed by 55.07 per cent in T_4 (Chatatul zaingir) in E-2 (polyhouse). Similar trend was observed in E-1 (open conditions) with T_6 (Chinese white) recording 83.32 per cent, being statistically significant over rest of the test varieties, followed again by T_4 (Chatatul Zaingir) recording 35.07 per cent rooting. The percentage increase in rooting under polyhouse in general was to the extent of 40.77%. Shoot biomass was also significantly higher in Brentul viz., 7.78 g/sapling under polyhouse. However under open conditions it was at par with Chinese white registering a value of 2.33 g/sapling. Significantly highest root number as well as root length/sapling was recorded in Chinese white with a value of 17.56 and 18.50 cm under polyhouse. Root biomass and root volume was also significantly higher in Chinese white under both environments. However Chatatul Zaingair indicated its parity with Chinese white in root biomass and root length under both the conditions.

KEY WORDS:- Mulberry, rooting, polyhouse, indigenous, Kashmir

INTRODUCTION

Sericulture Industry in India is well organised industry which provides succour to large number of families who are associated with it. It is estimated that the industry provides direct employment to about six hundred thousand people (Subramanian *et al.*, 1995). The industry comprises of two main sectors which include mulberry cultivation and silkworm *Bombyx mori* L. rearing. Mulberry which besides, constituting the only food for silkworms is best suited for afforestation programme and is generally grown as trees. The plant can practically be grown on any type of soil, however the major constraint under temperate conditions like Kashmir (India) which comes in the way of smooth and large scale multiplication of varieties of mulberry is their shy rooting behaviour and as result farmers often face shortage of leaf during silkworm rearing which in turn affects the quality, productivity and economics of the activity (Mir *et al.,* 2005). Although these varieties are nutritionally better, yet difficulty is encountered during the course of raising them. In Kashmir, 760 villages are engaged with this industry, constituting 1.46 % of the total sericulture villages in India. There are about twenty five thousand families associated with sericulture industry in the state contributing to the production of 521 MT of cocoons (Anonymous, 2005). This demands production and exploitation of indigenous varieties of mulberry in a big way for overall improvement and sustenance of industry.

Although grafting technique is followed for multiplication of these varieties, yet the low survival percentage of grafts in the field not exceeding 35-65 per cent (Ticku and Bindroo, 1989) does not appear to be promising. More so the plants also take 4-5 years to be ready for distribution among the beneficiaries in the field. Another technique of raising exotic mulberry varieties under polyhouse was generated and through this mulberry saplings have been raised on commercial scale (Baqual *et al.*, 2004) at 50% of the cost which is otherwise incurred through raising plant material through grafts. However, information on raising indigenous mulberry varieties like Botatul, Brentul, Chatatul, Chattatul zanigir, Robeshsernal etc. under polyhouse and evaluation of their rooting behaviour and other associated rooting parameters is lacking. Thus with this background the study was initiated.

MATERIALS AND METHODS

The present investigation on the rooting ability and subsequent propagation of some indigenous cultivars of mulberry (*Morus* spp) through stem cuttings under temperate climatic conditions of valley was carried out using 6 mulberry cultivars along with control. These included Botatul (*Morus alba* var. Botatul), Brentul ((*Morus alba* var. Brentul), Chattatul (*Morus alba* var. Chattatul), Chattatul Zanigir (*Morus alba* var. Chattatul Zanigir), Robesh Sernal (*Morus alba* var. Robesh Sernal) and Chinese White (*Morus indica* var. Chinese White as control). The study was carried out during 2007 and was laid in completely randomised block design CRD with 4 replications. The study was conducted under two environments (E1 = open and E2 = Polyhouse). In each replicate 15 cuttings prepared from ten month old shoots bearing healthy intact buds, 15-20 cm length having 1.2-1.5 cm diameter with at least three to four viable buds were prepared from the middle portion of the shoot. Coarse sand, free from gravel, finely powdered soil and well decomposed FYM in the ratio of 4:2:1 respectively were mixed together properly and then filled in polythene bags of 4.5 inch diameter and 11 inch height perforated at the bottom to avoid water logging in the polythene bags.Prior to planting the cuttings were dipped in the fungicide solution of Dithene M-45 @ 0.1% as prophylactic measure against fungal inoculum if any present on the surface of cuttings for 30 minutes and then washed thoroughly with distilled water under shade. The treated cuttings were then planted in polythene bags keeping upper most bud exposed. The rooting media was well moistened through the application of water by cane. One set of cuttings in polythene bags were kept under natural conditions and the other set of such cuttings in similar polythene bags were kept in polyhouse. The cuttings were maintained by watering in the morning and evening hours with the help of water can in both the sets. Temperature in the range of 25-30^{o}C and relative humidity in the range of 80-90 per cent in the polyhouse was regulated by sprinkling water with spray pump on vacant spaces in the form of mist. However, during night, temperature ranged from 15-20 ^{o}C in the polyhouse. Manual weeding at regular intervals was done to mitigate nutrient depletion and competition for light, space and water by weeds with the planted cuttings. Lifting of polythene cover at regular intervals was done to maintain the air ventilation and for removal of other gases from the polyhouse so that the cuttings may not get damaged. The details on outside temperature and humidity were also recorded and are given in Fig. 1. Various observations recorded during the entire period of experiment are discussed.

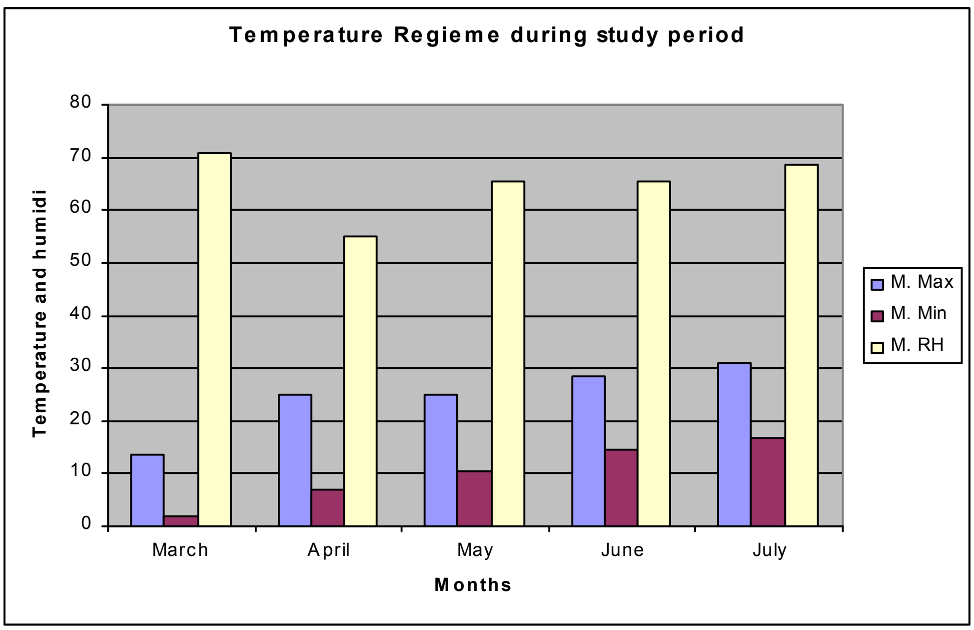

FIGURE 1: Temperature and relative humidity during study period (March 2007-July 2007)

RESULTS AND DISCUSSION

Rooting percentage

The rooting percentage increased significantly to 88.77 in T6 (control) followed by 55.07 per cent in T4 (Chatatul Zaingir) in E-2 (Table-1, Fig. 2). Similar trend was observed in E-1 with T6 (Chinese White) recording 83.32 per cent, being statistically significant over rest of the test varieties, followed again by T4 (Chatatul Zaingir) recording 35.07 per cent. There might be better availability of carbohydrate and nitrogen compounds in cuttings of Chinese White and Chatatul Zaingir. These findings are in conformity with the findings of Susheelamma *et al*. (1992) who reported variable rooting percentage among the mulberry genotypes. The rooting ability of Chinese White is well documented (Fotadar *et al.,* 1990, Baksh *et al.,* 2000 and Anonymous, 2000) and the studies confirmed the rooting potential of this variety beyond doubt during present study. The results are also in conformity with the earlier studies conducted (Anonymous, 2000, Peer 2002, Munshi *et al*., 2003 and Baqual *et al*., 2004).

TABLE 1. Rooting percentage and shoot biomass in six mulberry varieties

Treatment/ variety	Rooting percentage			Shoot biomass (g)		
	E-1	E-2	Per cent increase over E-1	E-1	E-2	Percent increase over E-1
T_1 – Botatul	16.65[c] (23.99)	31.65[c] (34.08)	15.00	1.68[b]	6.75[b]	301.78
T_2 – Brentul	14.99[c] (22.70)	35.00[c] (36.35)	20.01	2.30[a]	7.78[a]	238.26
T_3 – Chatatul	3.30[d] (7.77)	9.95[e] (18.19)	6.65	0.42[c]	5.55[c]	1221.43
T_4 – Chatatul Zaingir	35.07[b] 36.08)	55.07[b] (47.93)	20.00	1.78[b]	6.84[b]	284.27
T_5 – Robesh Sernal	18.32[c] (25.28)	21.62[d] (27.54)	3.30	1.66[b]	5.55[c]	234.34
T_6 – Chinese White*	83.32[a] (66.49)	88.35[a] (70.57)	5.03	2.33[a]	6.57[b]	181.98
Mean	28.60 (30.38)	40. 27 (39.11)	11.67	1.69	6.51	285.20
C.D at 5%	10.11	8.54	-	0.53	0.60	-
SE±	4.81	4.06	-	0.25	0.28	-

*Check E-1 = Open conditions, E-2 = Polyhouse conditions
Values superscripted by same letter(s) are statistically identical

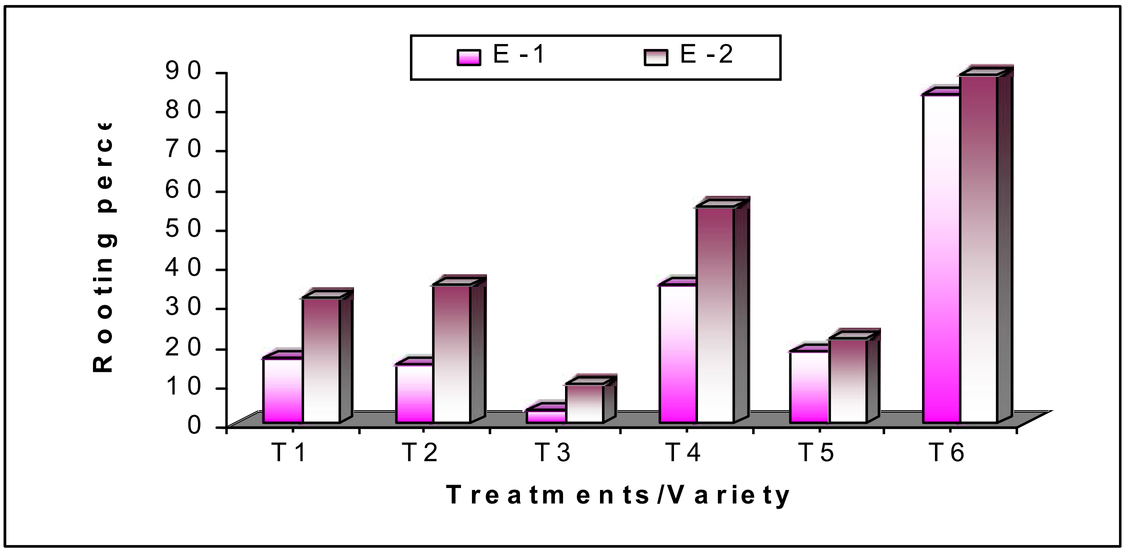

FIGURE 2. Influence of polyhouse on rooting percentage of mulberry cuttings

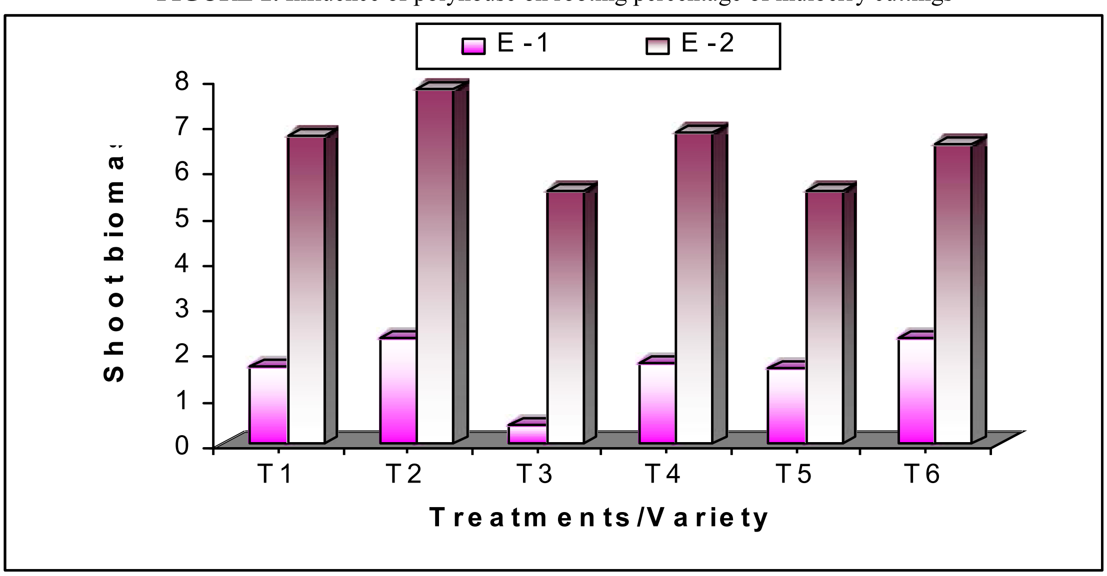

FIGURE 3. Influence of polyhouse on shoot biomass of mulberry saplings

Shoot biomass per sapling

In E-2, significantly higher shoot biomass per sapling viz. 7.78 g was recorded in T_2 (Brentul). This was, however, followed by T_4 (Chatatul Zaingir) recording 6.84 g of shoot biomass per sapling. The lowest value in this regard was registered in T_3 (Chatatul) and T_5 (Robesh Sernal) viz. 5.55 g per sapling in both the varieties as shown in Table-1, Fig. 3) However, in E-1, highest shoot biomass per sapling viz. 2.33 g was recorded in T_6 (Chinese White) which was at par with T_2 (Brentul) recording 2.30 g shoot biomass per sapling. These two treatments, however, were significant over the rest. T_3 (Chatatul) has again registered the lowest value of 0.42 g of shoot biomass per sapling. Shoot biomass which is again dependent upon the rooting ability and root volume as well, was highest in T_2 (Brentul) in both the environments and this can be attributed to more number of roots per sapling in this variety and also greater leaf area which has increased the nutrient uptake and photosynthetic efficiency in this variety. The least value of shoot biomass in T_3 (Chatatul) under both the conditions too is attributed to less number of roots per sapling and lesser leaf area. The results are in conformity with the findings of Peer (2002) and Najar (2005).

TABLE 2. Root number per sapling and longest root length in six mulberry varieties

Treatment/variety	Root number			Longest root length (cm)		
	E-1	E-2	Per cent increase over E-1	E-1	E-2	Per cent increase over E-1
T_1 – Botatul	4.96[b]	11.77[c]	137.30	6.42[b]	15.63[b]	143.46
T_2 – Brentul	6.62[b]	13.39[b]	102.27	8.71[a]	15.92[b]	82.78
T_3 – Chatatul	1.75[c]	10.66[c]	509.14	2.50[c]	11.87[c]	374.80
T_4 – Chatatul Zaingir	6.84[b]	13.67[b]	99.85	8.89[a]	17.61[a]	98.09
T_5 – Robesh Sernal	5.50[b]	11.20[c]	103.64	7.29[b]	12.52[c]	71.74
T_6 – Chinese White*	11.50[a]	17.56[a]	52.69	10.68[a]	18.50[a]	73.22
Mean	6.20	13.04	110.32	7.41	15.34	107.01
C.D at 5%	1.93	2.04	-	2.09	2.30	-
SE±	0.92	0.97	-	0.99	1.09	-

*Check E-1 = Open conditions, E-2 = Polyhouse conditions

Values superscripted by same letter(s) are statistically identical

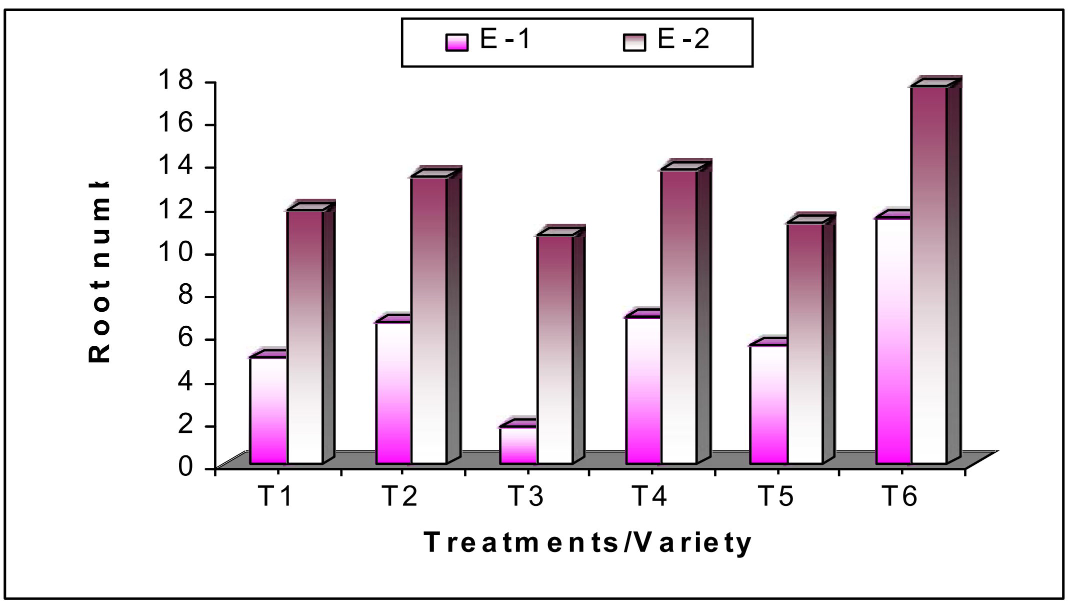

FIGURE 4. Influence of polyhouse on root number of mulberry saplings

Number of roots per sapling

T_6 (Chinese white) continued to excel in so far as root number per sapling is concerned registering 19.56 roots per sapling in E-2 and 11.50 in E-1 (Table-2, Fig. 4)). It was significantly higher than the rest of the varieties under both the conditions. T_6 (Chinese White) under both the environmental conditions was followed by T_4 (Chatatul Zaingir) and T_2 (Brentul). However, T_3 (Chatatul) registered the least value viz. 10.66 and 1.75 in E-2 and E-1 respectively. Although number of roots per sapling can be regarded as a varietal factor (Bhat and Hittalmani, 1992 and Chauhan and Reddy, 1994), yet E-2 in general has resulted in enhancement of average root number per sapling by providing ambient temperature and humidity. Tarasenko and Ermakov (1966) while studying the effect of mist on rooting in stem cuttings of a number of plants including plum reported that mist proved superior in terms of percentage and speed of rooting and number of roots per cutting.

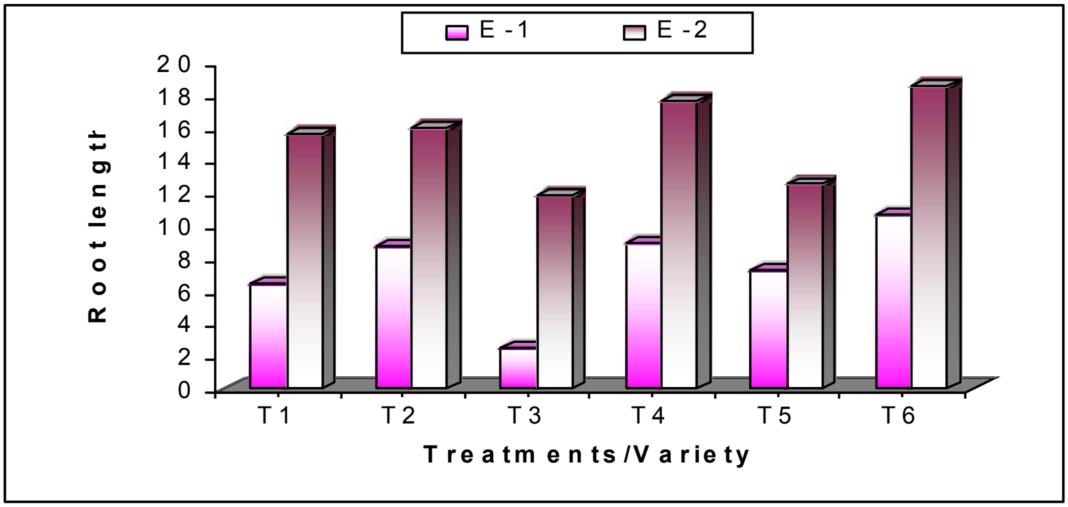

FIGURE 5. Influence of polyhouse on root length of mulberry saplings

Longest root length

Results revealed that T_6 (Chinese White) recorded the highest root length of 18.50 cm which was statistically significant over rest of the treatments except T_4 (Chatatul Zaingir) recording 17.61 cm root length. The lowest root length in E-2 was recorded in T_3 (Chatatul) with 11.87 cm only (Table-2, Fig. 5).

Similar trend was observed in E-1 with T_6 (Chinese White) recording 10.68 cm of root length which was at par with T_4 (Chatatul Zaingir) recording 8.89 cm and T_2 (Brentul) recording 8.71 cm and significant over the rest. T_3 (Chatatul) recorded the lowest root length viz. 2.50 cm in E-1.

Satpathy *et al.* (1995) also observed varietal differences in root length in S_1 and S_{1635}. However, E-2 in general has resulted in almost doubling the root length. The studies are also supported by the findings of Chauhan and Reddy (1974) who reported the longest primary root length in stem cuttings of plum grown under plastic mist chamber.

TABLE 3. Root biomass and root volume per sapling in six mulberry varieties

Treatment/variety	Root biomass (g)			Root volume (cm^3)		
	E-1	E-2	Per cent increase over E-1	E-1	E-2	Per cent increase over E-1
T_1 – Botatul	1.22^b	2.03^c	66.40	0.53^c	1.14^c	115.09
T_2 – Brentul	1.26^b	2.63^b	108.73	0.61^b	1.48^b	142.62
T_3 – Chatatul	0.27^d	1.40^d	418.52	0.37^c	0.87^d	135.13
T_4 – Chatatul Zaingir	1.40^a	3.24^a	131.43	0.78^b	1.58^b	102.56
T_5 – Robesh Sernal	0.71^c	1.77^c	149.30	0.53^c	1.21^c	128.30
T_6 – Chinese White*	1.50^a	3.72^a	148.00	1.01^a	1.95^a	93.07
Mean	1.06	2.46	132.07	0.64	1.37	114.06
C.D at 5%	0.19	0.57	-	0.20	0.33	-
SE±	0.09	0.27	-	0.09	0.16	-

*Check E-1 = Open conditions, E-2 = Polyhouse conditions

Values superscripted by same letter(s) are statistically identical

Root biomass per sapling

The root biomass is the indicator of robustness of the plant and since mulberry plant is primarily grown for its foliage, the increased root biomass is appreciated trait. The maximum root biomass was recorded by T_6 (control) followed by T_4 (Chatatul Zaingir) under both the environments. In general, the E-2 resulted in more root biomass production of test varieties which might be due to induction of more rooting sites under the influence of controlled temperature and humidity. The studies of Mukherjee and Sikdar (1974**)** in S_{146} mulberry variety are also in agreement to present findings.

Perusal of data presented in (Table 3, Fig. 6) showed that in E-2, T_6 (Chinese White) recorded root biomass of 3.72 g per sapling which was significantly higher over rest of the treatments except T_4 (Chatatul Zaingir) recording 3.24 g root biomass per sapling. The least root biomass per sapling viz. 1.40 g was recorded in T_3 (Chatatul).

Root biomass per sapling in E-1 also indicated similar trend with T_6 (Chinese White) recording 1.50 g root biomass per sapling which was significant over rest of the treatments except T_4 (Chatatul Zaingir) with 1.40 g per sapling. In this case also the least root biomass per sapling was recorded in T_3 (Chatatul) viz. 0.27 g.

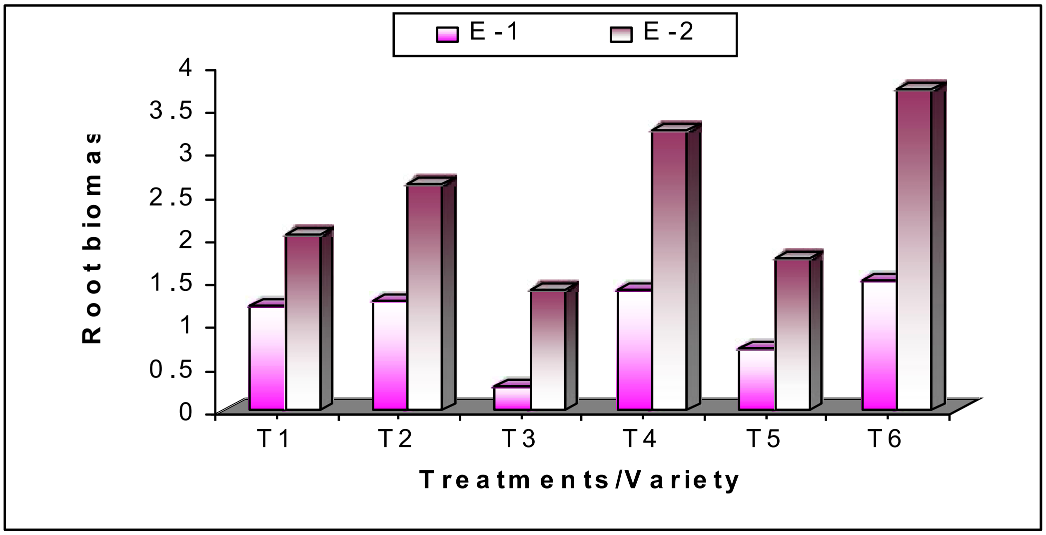

FIGURE 6. Influence of polyhouse on root biomass of mulberry saplings

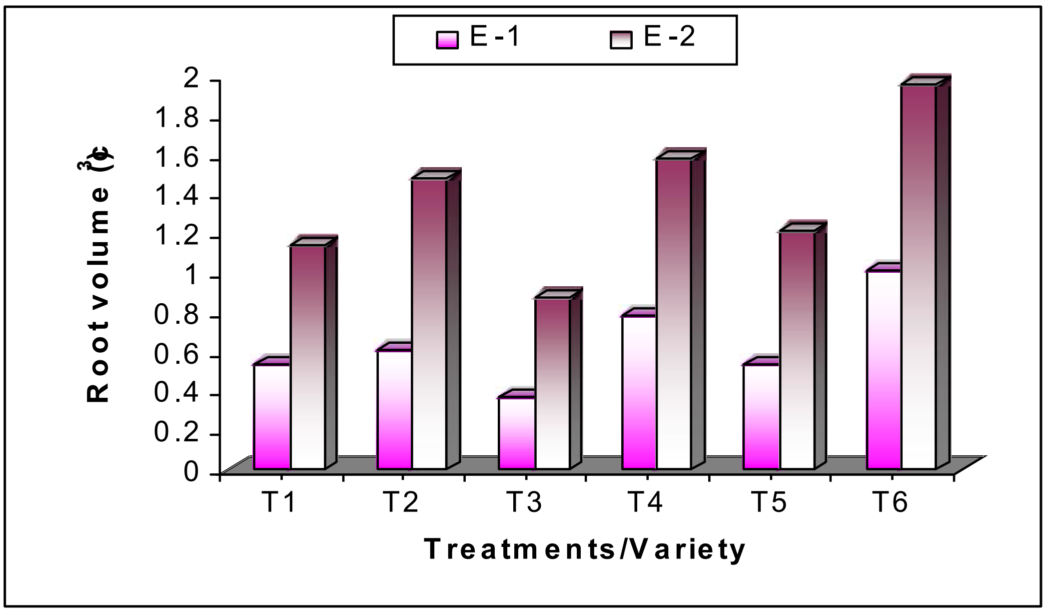

FIGURE 7. Influence of polyhouse on root volume of mulberry saplings

Root volume per sapling

In E-2, highest root volume per sapling viz. 1.95 cm^3 was recorded in T_6 (Chinese White), being significant over rest of the varieties. However, the least value of root volume was recorded in T_3 (Chatatul), being 0.87 cm^3 as presented in Table-3, Fig. 7).

In E-1, T_6 (Chinese White) recorded root volume of 1.01 cm^3 per sapling which was significant over rest of the treatments. The lowest value in the varieties under study was recorded in T_3 (Chatatul) viz. 0.37 cm^3 per sapling.

The increased root volume in general in E-2 might have been due to controlled conditions of humidity and temperature. The difference in root parameters along with root volume differs significantly among the varieties (Bhat and Hittalmani, 1992).

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