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USE OF POLYHOUSE ECOSYSTEM FOR BETTER AND UNIFORM GROWTH OF BUDDED STUMPS OF RUBBER IN POLYBAGS

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ABSTRACT

Two polybag nursery experiments were conducted at the Central Experiment Station of the Rubber Research Institute of India, at Chethakkal with the objectives to compare sprouting and growth of green and brown budded stumps planted in polybags kept in polyhouse and outdoor. Budded stumps generated from both green and brown budding techniques recorded early emergence of buds and better and uniform growth of scion in polyhouse conditions. Plants raised in polyhouse were better in terms of height of scion, diameter of stem, number of whorls, number of lateral roots and total biomass content. The study has shown that growing plants inside polyhouse will improve the quality of plants.

The use of polyhouse made it possible to overcome intra clonal variability in growth expressed by individual bud grafted plant to a certain extent. The polyhouse gave protection to the grafts against diseases and pests and reduction in mortality due to adverse weather conditions and ensured production of healthy plants. The environmental conditions available to the plants in the polyhouse had no adverse effect on further growth and development in the field.

Key words: *Hevea*, polyhouse, budgrafted plants, polyvinyl sheets

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INTRODUCTION

Bud grafted plants in the rubber nursery need extreme care during the early stages of their development. During adverse climatic conditions like heavy rainfall and high/low temperature, nursery plants are affected by diseases and pests and as a result low and delayed bud break followed by uneven growth of scion occurs. This will also lead to shortage of planting materials in many rubber nurseries.

A polyhouse is a framed structure of UV-stabilized rigid polythene sheets of 200 micron thickness in which plants can be grown under sufficiently controlled environmental conditions as it protects plants from environmental impacts. The covering of nursery areas with polyvinyl sheets overhead protects young plants from insect and pest attacks to a great extent and provides protection from heavy rain, drought and cold weather, ensuring the production of healthy plants. Hence, polyhouse technique is widely adopted for the propagation of many cultivated crops like tomato, brinjal, cucumber etc. Kavitha *et al* (2003) reported 96% increase in shoot length and 27% increase in yield of tomato inside the polyhouse as compared to control. Farake *et al* (1990) in their study on the effects of plastic tunnel and mulches reported 48% increased yield of tomato over the control.

Very few attempts have so far been made to systematically study the benefits of polyhouse in relation to growth of rubber plants. A report from India on rubber gave indications of an increase of CO_2 concentrations, RH and temperature inside polyhouse which led to a significant increase in total leaf area and dry matter per plant (Devakumar, 1996). Datta *et al* (2010) reported that sprouting percentage of budded stumps inside polyhouse during winter months ranged from 50-70% whereas in the control plants kept outside the polyhouse it was only 6-20%. Therefore, the present study was undertaken as an effort to analyse the feasibility of polyhouse technology for production of quality planting materials in rubber by inducing early sprouting of budded stumps and uniform and better growth of scion.

MATERIALS AND METHODS

Two polybag nursery experiments were conducted at the Central Experimental Station of the Rubber Research Institute of India at Chethakkal in Central Kerala, India.

Experiment No. I: Green budding was carried out during January by bud grafting scale buds collected from 6-8 week old scion shoots on vigorously growing 5-6 months old stock plants. Budded stumps were prepared adopting the commonly followed techniques and planted in polybag nursery established inside the polyhouse during February.

Experiment No. II: Root stock of almost similar girth of about 7.5 cm at the root collar region was selected and was grafted with brown coloured leaf buds during June. Budded stumps were prepared and planted in polybag nursery established inside the polyhouse.

For both the nursery experiments, polybags with 25 x 55cm lay flat dimensions which could hold about 11 kg of soil were used. The budded stumps were planted in a completely randomized design in the nursery. Plants inside the polyhouse were maintained by irrigating alternate daily using a hose. Control plants for both the experiments were pulled out from the ground nursery, stumped and planted in the polybag nursery established in the outdoor conditions. Plants grown in the outdoor condition were protected by giving all agro management practices recommended for the same (Potty 1980; Marattukalam 1980). I additin to this, outdoor plants were protected, maintaining optimum soil moisture and providing 50% shade with plastic net that saved the plants from extreme summer temperatures. For effective control of this disease in outdoor plants, repeated spraying with the recommended dose of Bordeaux mixture 1%, mancozeb 0.2% (Dithane/ Indofil M 45 2.66 g/L) or carbendazim 0.02% (Bavistin 4 g/10 L) was given.

Observations on bud break were made over a period of two months. Growth parameters such as height of scion, diameter of the scion at a height of 5 cm above the bud union and number of whorls were recorded at monthly intervals for seven months. Number of lateral roots and biomass content was recorded from randomly selected ten plants per treatment. Evaluation of polyhouse grown plants for the incidence of nursery diseases namely Colletotrichum leaf disease, Oidium leaf disease and Bird's eye spot disease was carried out and compared with the plants grown outdoor.

To observe the effects of environmental conditions in polyhouse on further growth and development in the field, uniformly growing polybag plants of 2-3 whorls from each set were selected and planted in a clonal nursery in the main field at the Central Experiment Station. A spacing of 1 x 1m was maintained with 12 plants in each block during the period of northeast monsoon of 2010. Conventional cultural operations were followed. Height of plants, diameter of scion and number of whorls were recorded six months after planting in the field and were subjected to statistical analysis. Pooled analysis using't' test was carried out to compare the plants grown inside polyhouse and outdoor.

Incidences of nursery diseases namely Colletotrichum leaf disease, Odium leaf disease and Birds eye spot diseases were evaluated between the polyhouse grown plants for the incidence of nursery diseases namely Colletotrichum leaf disease, Odium leaf disease and Birds eye spot disease were observed compared to outdoor grown plants.

Meteorology data such as daily maximum and minimum temperature, sunshine hours and twice daily relative humidity were collected inside the polyhouse. These data were compared with the agrometeorological observatory situated at about 300m away form the experimental site.

RESULTS AND DISCUSSIONS

The time taken for the emergence of two types of buds grown inside the polyhouse was significantly better in both the experiments. Buds from stumps grown inside the polyhouse emerged faster than that of the outdoor (Fig 1). Weekly observation on bud emergence showed that maximum increase in bud break compared to control was 40 % for green budded stumps and 34 % for brown budded stumps during the third week and fourth week respectively after planting in the polybags. After a period of two months total bud emergence was 96 and 92 % inside the polyhouse as against 76 and 83 % in the outdoor in green and brown budded plants respectively. This showed that the controlled environmental conditions inside the polyhouse saved the plants leading to a decline in the relative sprouting rate.

Regarding growth, plants grown inside polyhouse, in general, performed better than the outdoor and retained supremacy over the outdoor plants throughout the period. The scion height (a measure of growth), showed faster growth under the polyhouse condition than that of outdoor conditions. Scion height of green budded plants inside the polyhouse was two times more than the control plants. Similarly brown budded plants recorded an increase in scion height of 68 % over the control (Fig. 2). An increase of 32% and 20% in stem diameter was recorded by green and brown budded plants respectively compared to the control plants (Fig. 3). Similarly the percentage increase in the number of whorls also was about 41 and 19% respectively (Fig. 4).

Other growth parameters such as, number of lateral roots and total biomass content of the plants was found to be significantly superior inside that of the polyhouse. Number of lateral roots, an indicator of healthy plants, inside the polyhouse showed 37% and 21% improvement over outdoor plants in green and brown budded plants respectively (Fig.5). A magnitude of 92% increase in biomass was obtained in green budded plants inside the polyhouse than the control, whereas in case of brown budded plants, 28% of increase in biomass was noted inside the polyhouse (Fig.6). High efficiency of polyhouse conditions as compared to out door might be attributed to better sprouting, plant height, number of leaves and roots as also noted in crops like tomato and brinjal (Firake *etal* 2003; Kavitha etal 2003).

It is used for enhancing the production of quality vegetables, flowers and ornamental plants etc. as it provides protection to crops from severe effect of frost and cold and diseases.

Statistical tests revealed that performance of plants grown in polyhouse in terms of height of plants, diameter of scion and number of whorls was in no way inferior to conventional types in the field conditions (Table 2).

In general, polyhouse is more advantageous in increasing growth of plants compared to growing them outdoors. Polythene sheet prevents the entry of UV rays and conserve greenhouse gases which enhances the efficiency of plant growth and development (Maikhuri *et al.*, 2007, 2010). Generally, the temperature and moisture inside the polyhouse is greater as compared to outside environment which enhances the rate of photosynthesis and helps in better and uniform growth of plants (Palni, 1996; Palni and Rawat, 2000). A polyhouse system protects plants from sudden change in weather and regulates the environment inside the polyhouse. This helps the plants to grow without any external obstruction.

It has been noted that performance of green budded plants was better in terms of sprouting and growth attributes compared to brown budded plants inside the polyhouse. Tender and young green budded stumps when planted in polybags for raising bag plants often showed higher percentage of casualty due to poor sprouting, die back of scion and incidence of diseases compared to hardy brown budded stumps (Marattukalam, 2000; Mercykutty and Gireesh, 2010). Stable and controlled environmental conditions inside polyhouse enhances the rate of photosynthesis which helps in better sprouting and growth of green budded plants. In addition to this, leaf diseases caused by *Colletotrichum* spp., *Drechslera heveae* and *Oidium heveae* can be prevented due to better environmental conditions within the polyhouse ensuring uniformity in scion growth production in polyhouse grown plants as compared to those grown outdoor.

Low magnitude of variability in various growth characters as judged from relatively lower coefficient of variation of plants grown inside in the polyhouse compared to outdoor plants (Table 1) indicated better uniformity in growth of plants under polyhouse conditions compared to out door conditions. When sprouting started earlier, growth of scion shoot is uniform and better. Both higher percentage of sprouting and uniformity in growth are equally important factors to the planter. Out door plants showed pronounced weaker growth followed by heavy mortality as the plants are grown in uncontrolled environmental condition. The plants were affected by heavy rain, excess solar radiation and high temperature etc even though recommended agromanagement practices were adapted. Lower incidence of disease under polyhouse condition had high chance to get themselves to establish quickly. To protect adverse micro climatic condition a protected environment is essential. There is a great scope to improve the present situation and to make the budded plants more profitable by growing it in the protected environment inside the polyhouse.

The improved nursery practices under polyhouse condition is also important under present situation of climate change, rising man power costs and labour shortage. Thus, it can be summarised from the present study that polyhouse grown polybag plants show no disease as compared to those grown in outdoor conditions during the period under study. Consequently, growing plants in polyhouse is ecofriendly as fungicides need not be used, is cost effective due to lesser investment towards disease management and is thus farmer friendly. Normally incidence of diseases in polyhouse is less as compared to outdoor conditions.

It appears that budded stumps of rubber needs special requirement for light, temperature and humidity for sprouting and uniform and better growth (Table 3).0 It was observed that inside the polyhouse the temperatures were comparatively having a longer duration of days with higher temperature compared to ambient temperature in the outdoor conditions. Differences in humidity levels were not observed. The outdoor polybags were exposed to a total of 229 hours of sunshine with 26 % days below 1.0 hour of sunshine (mean = 3.8 hours/day). Inside the polyhouse, plants were safer than outside as it cuts 75% of UV – B and 50% of visible light (Personal communication).

In the case of brazillwood it was already seen that in greenhouse conditions when other limiting growth conditions are absent, temperature increases in a tropical environment can contribute to higher plant productivity. This effect is enhanced when latitudinal temperature of the species is approached (Hendrickson *et al.* 2004).

A polyhouse protects the crop from ill effects of environments and increase availability of quality planting materials. Hence, for successful propagation of rubber, a propagation structure like polyhouse is very important. Due to higher cost involved in construction of iron supported shade in the first year, the net return may be in negative. However, during 2nd and 3rd year onwards the net monetary return goes higher. Recently low cost polytunnels and polytents made of wood and bamboo also have a scope for clonal propagation of tree species like rubber.

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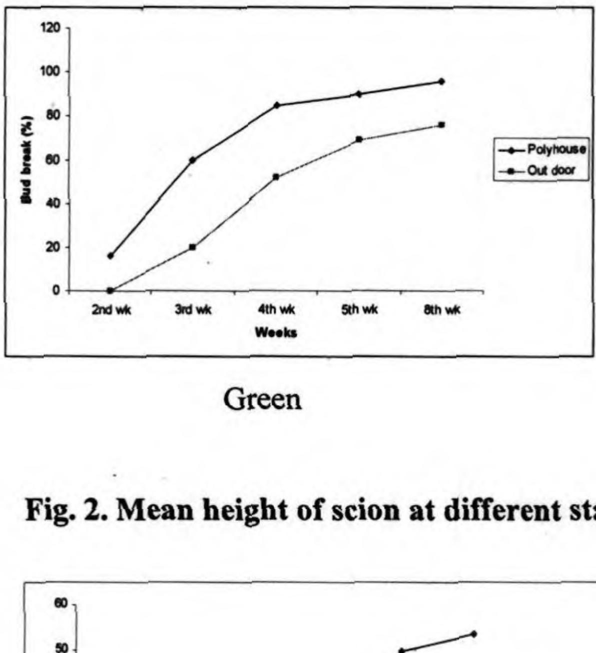
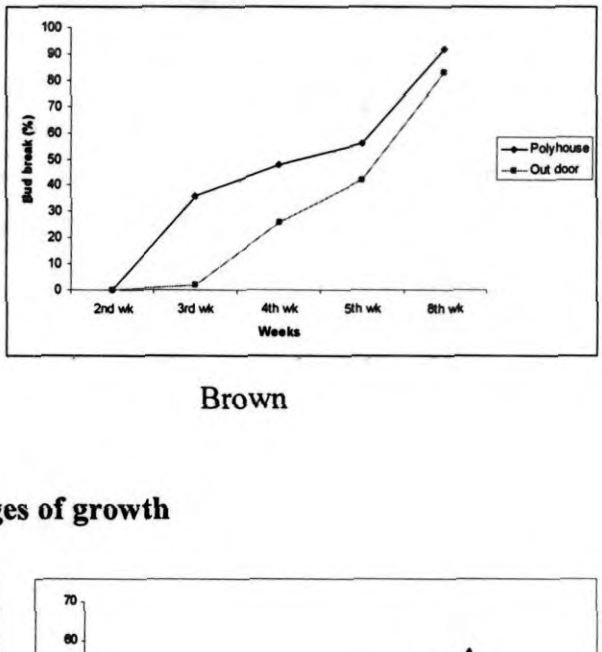
Fig 1: Emergence of buds (%)

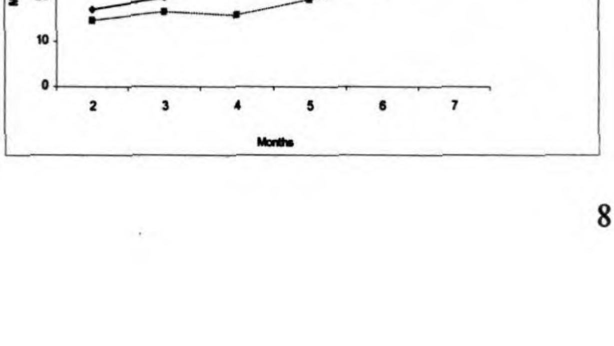


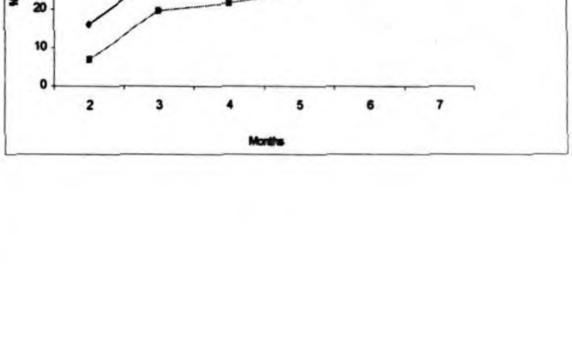
Green



Brown

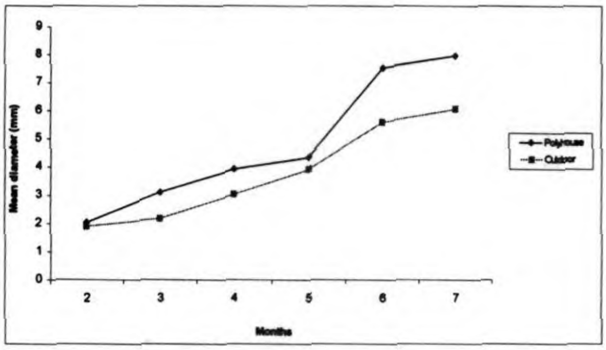
Fig. 2. Mean height of scion at different stages of growth

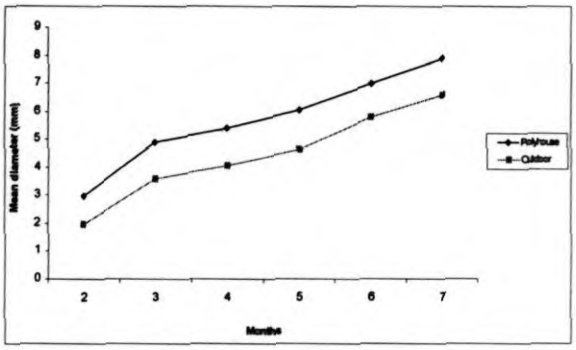




Green Brown

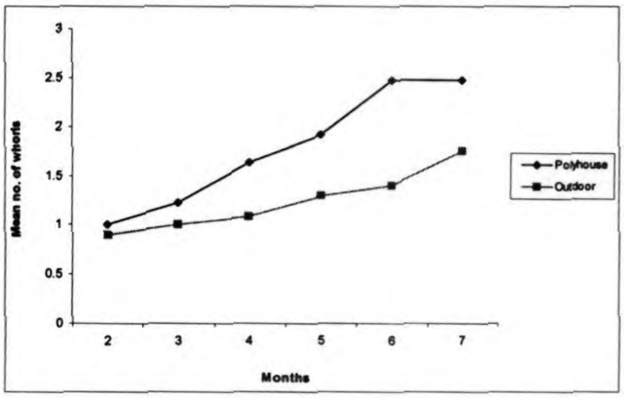
Fig.3. Mean stem diameter at different stages of growth

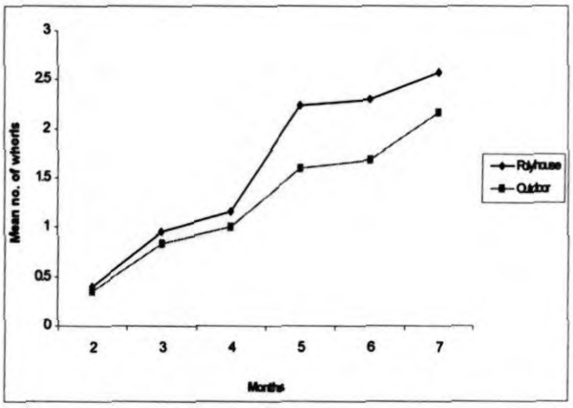




Green Brown

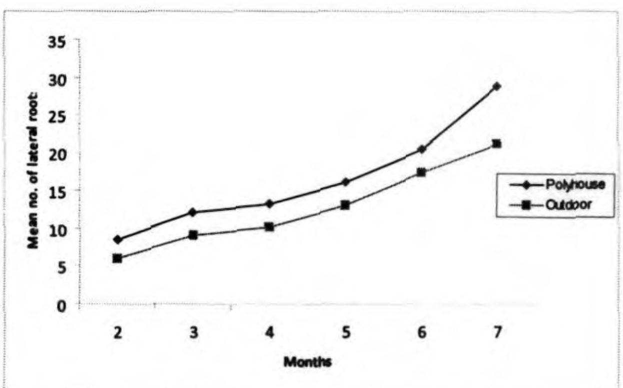
Fig.4. Mean number of whorls at different stages of growth

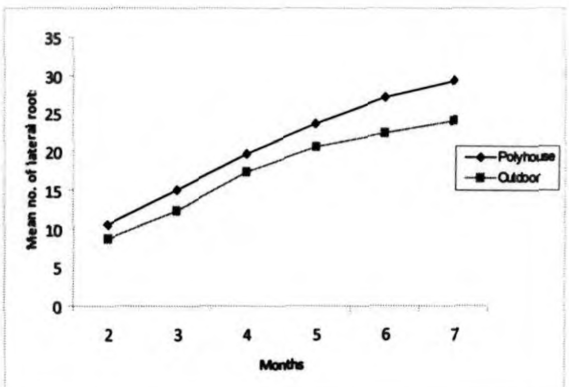




Green Brown

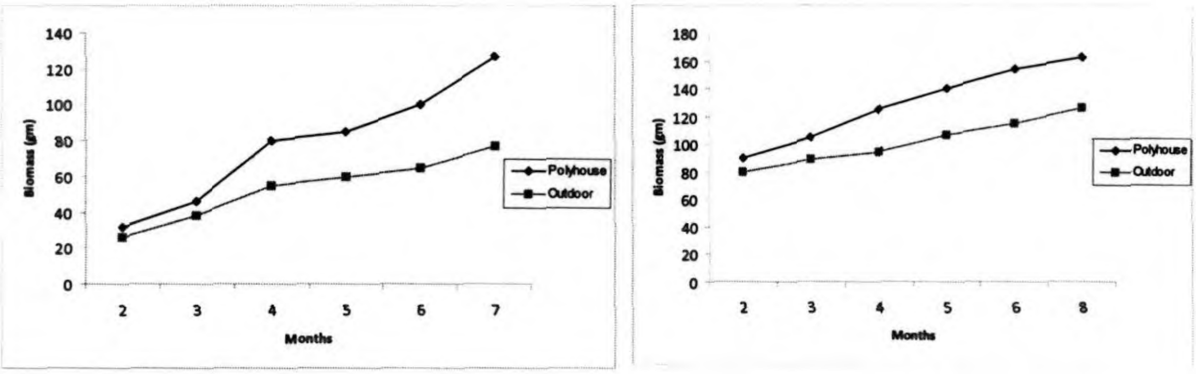
Fig.5. No. of lateral roots at different stages of growth





Green Brown

Fig.6. Total biomass at different stages of growth



Green Brown

Table 1: Mean of different characters and their variation

Particulars	Types	Experiment No. 1			Experiment No. II		
		Mean	**CV**	**SE**	**Mean**	**CV**	**SE**
Height of scion (cm)	Poly house	53.53**	40.91	2.62	57.20**	17.48	3.16
	Out door	26.75	42.58	1.36	34.10	36.10	3.89
Diameter of scion(mm)	Poly house	7.97**	33.06	0.28	7.95	28.95	0.46
	Out door	6.06	42.91	0.8	6.61	49.64	0.66
No.of whorls	Poly house	2.47**	24.56	0.06	2.58	19.93	0.15
	Out door	1.75	32.37	0.06	2.17	33.13	0.22
No.of lateral roots	Poly house	28.91**	40.39	1.24	29.70**	8.41	0.79
	Out door	21.17	58.84	1.41	23.41	13.44	0.98
Total biomass (gm)	Poly house	127.92*	40.53	14.97	162.08*	22.80	10.67
	Out door	77.08	44.12	9.82	126.67	28.48	10.41

Table 2 : Mean of growth parameters in the field

Type of plants	Height (cm)	Diameter (mm)	No. of whorls
Polyhouse	115.23	19.42	2.44
Outdoor	112.45	18.61	2.30
t values	0.44	1.33	1.07

Table 3 : Ecosystem in polyhouse and outdoor conditions

Poly house					Outdoor				
	Tmax	Tmin	Rh1	Rh2	Tmax	Tmin	Rh1	Rh2	AvRH
Mean	36.6	22.9	90.0	68.0	31.1	22.0	90.6	67.3	78.9
S D	2.5	0.8	4.7	10.1	1.6	0.3	2.0	3.2	2.4

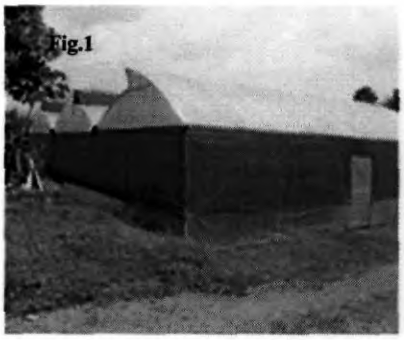


Fig.1

Fig.2

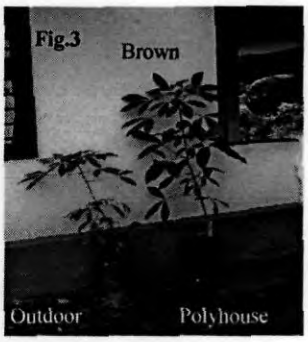


Fig.3


Fig.4
Green
Polyhouse
Outdoor

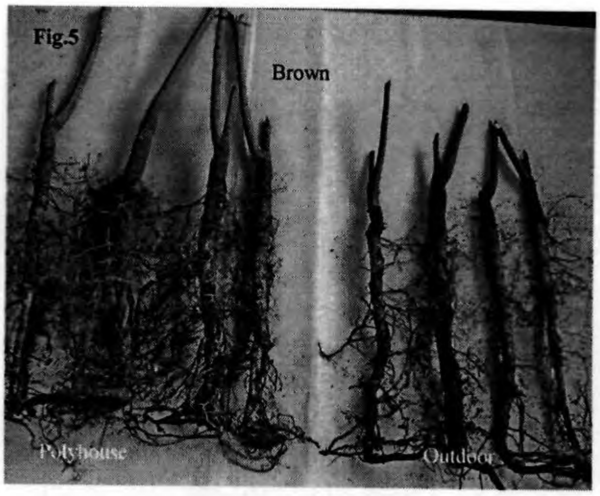


Fig.5
Brown
Polyhouse
Outdoor