Experimental Studies on Suitability of Greenhouse for Nursery Raising

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ABSTRACT

In this communication growth response of *Albizia lebbeck* seedlings raised in greenhouse conditions was assessed and compared with open field conditions. To accelerate the germination of seeds, some soaking treatments were also given prior to sowing. Experimental results show that the height of the 3 months old seedlings of *Albizia lebbeck* was 135 per cent more inside the greenhouse as compared to open condition. The corresponding increase in collar diameter in greenhouse was 50 per cent and dry matter content was 215 per cent.

Keywords: Energy plantation, Albizia lebbeck, seedling, greenhouse, solar energy, India

1. INTRODUCTION

Energy plantation is the effective means to capture solar energy for accelerating fuel wood vegetative growth in barren and fallow land.. Energy plantation system generally involve the cultivation of fast growing, multi-use tree species which are tolerant to unfavourable soil and climatic conditions. For successful plantation programme trees seedling must be raised first in nursery (Rathore et.al. 2006). Production of healthy seedlings is important where the planting stock is raised from seeds or cuttings and maintained for about six months to one year before being transplanted in the field. However, raising to raise the nursery for 6-12 months is not only time consuming but labour intensive as well. As the planting is done mostly in rainy season, nursery raining in summer becomes complicated due to adverse weather conditions like high temperature, low humidity and water scarcity. To combat these adverse conditions, control on microclimate becomes important (Vimal and Tyagi, 1984). Microclimate can artificially be controlled in greenhouse. The plastic covered greenhouse is only mechanism, which transmits the useful wavelength of light spectrum for photosynthetic activities (Behera et.al. 1990, Rathore et. al. 2007). Greenhouses provide a suitable environment for the intensive production of various crops. They are designed to control solar radiation, temperature, humidity and carbon dioxide levels in the aerial environment. The availability of solar radiation and its daily and yearly distribution has a tremendous influence on vegetative productivity and quality of plant growth and also on comfort living (Kania and Giacomelli, 2001). The greenhouse air temperature mainly depends on the distribution of

solar radiation after transmission through the greenhouse cover which in turn depends on shape and size of greenhouse, motion of the sun and weather conditions (Tiwari and Goyal, 1998). From the heating point of view, uneven span greenhouse is found most suitable (N. Kumari et. al. 2006, 2007). Though the low tunnels and greenhouse are used for nursery raising of different crops and plants but their efficiency for seedlings of agroforest plants has not been so far studied. More time, higher labour and adverse weather conditions are the major hurdles in the healthy growth of nursery of agroforest plants during summer. Hence it was felt to study the growth response of seedlings of agro-forest plants in greenhouse, especially under partially controlled conditions. Since it is medium cost and easy to install. The controlled environment ensures desirable microclimate for plant growth, good and uniform establishment of plants and their vigorous growth. It was also felt necessary to evolve a suitable seed treatment method for agro-forest plants to boost the germination and growth (Chatterjee and Mukherjee, 1970, Gopi Kumar, Mohato, 1993, Panwar et. al, 2001). Therefore, this study on performance evaluation of greenhouse for nursery raising" was carried out under partially controlled environmental conditions for preparing nursery of the *Albizia lebbeck* species.

2. EXPERIMENTAL STUDIES

Field experiment was conducted in greenhouse and open field conditions to assess the growth response of *Albizia lebbeck* in terms of germination period, germination rate and survival per centage, plant height, collar diameter and dry matter content in the seedling as the time elapsed. To achieve the above objectives different component of the study i.e. thermal environment, seed treatment and growth related factors were studied and evaluated by adopting standard procedures.

2.1 Experimental Site

The experiment was conducted in the plastic greenhouse at instructional farm of the College of Technology and Engineering, Udaipur. The altitude of the experimental station is 582.17 m from mean sea level. The latitude and longitude are 24°35' N and 73°42' E respectively.

2.2 Greenhouse Details

A hemi circular shaped greenhouse as presented in Fig.1, covering a floor area of 4 m x 10 m (40 sq.m.) was used for study. The orientation of greenhouse is in east west direction to capture south sun for accelerating photosynthesis process. The greenhouse is covered with ultra violet stabilized low density polyethylene (LDPE) sheet of 200 μm thickness.

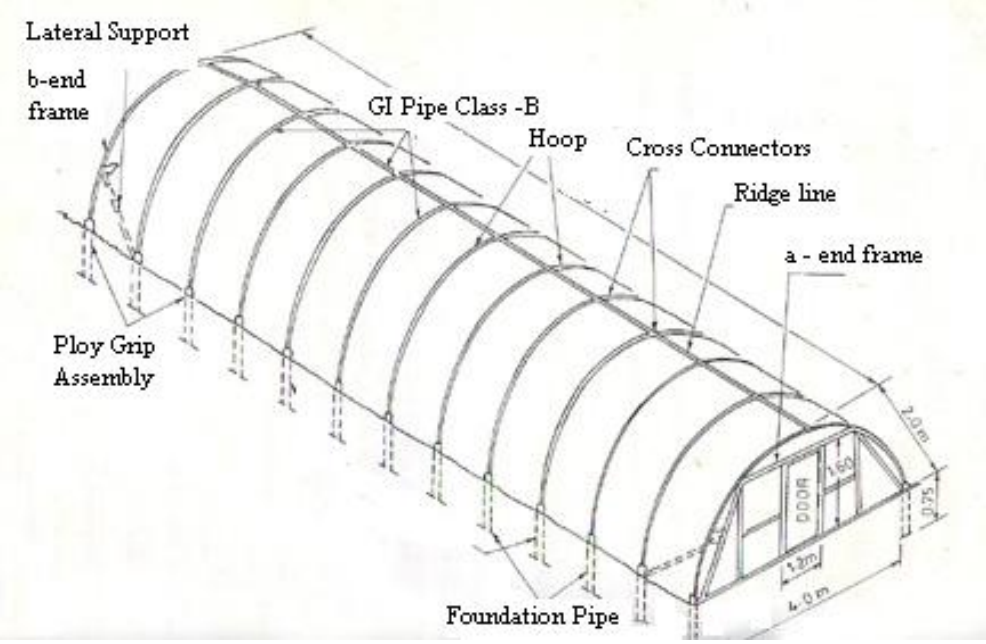

Fig.1. Line Diagram of Greenhouse used for Study

2.3 Treatment Details

In order to enhance seed emergence, germination as well as survival percentage the appropriate seed treatment needs to be evolved. Accordingly treatments of seed soaking were included in the study. The details of the treatments is given in Table 1

Table 1. Seed Soaking Treatments before Sowing

S.No.	Treatment	Seed soaking treatments
1	T_1	In 2% H_2SO_4 for 30 min.
2	T_2	In biogas slurry for 24 hours.
3	T_3	In boiling water for 3 min.
4	T_4	In cold water or tap water for 24 hours
5	T_5	Control (No soaking)

2.3 Biometric and Other Observations

The various biometric observations were recorded on five randomly selected plants of the selected species from each treatment during the entire growth period. These plants were properly tagged for their identification.

The height of seedling was recorded by measuring the length of shoot from the soil surface level of the polythene bag, upto the top of the completely open leaf at an interval of 7 days. The collar diameter of seedlings were recorded simultaneously

Shoot and root weight are the most commonly used parameters for studies of plant growth in response to environment. To determine the dry weight, the washed and clean root and shoot part

of seedlings were put in solar dryer. The observations of weighings of samples were taken after every 24 hours till they attained the constant weight.

2.4 Shoot Root Relations

The common parameters for evaluating the relation between above and below ground growth of plants is the shoot root ratio. The coefficient (C) is obtained by the equations.

$$C = \frac{Shoot\ weight}{Root\ weight}$$

3. RESULTS AND DISCUSSION

To evaluate the response of greenhouse over open conditions for nursery raising, *Albizia lebbeck* species with five treatments were used. The observations regarding seedling height, seedling collar diameter and dry matter content was collected.

3.1 Plant Height

The data pertaining to the mean plant height of *Albizia lebbeck* under open and greenhouse conditions is graphically presented in Fig.2.

The mean plant height increased progressively with increase in the age of seedlings in the three months study period. The plant growth rate, measured in terms of plant height was almost same in both open and greenhouse conditions upto the 36 days after sowing. After that there was steep rise in the height of seedlings grown inside the greenhouse.

It may easily be seen from the Fig-1 that there was little difference in the seedling heights among different treatments grown in open as well as greenhouse conditions whereas there was obvious difference between the heights of seedlings grown inside and outside the greenhouse. However the plant growth rate was higher in treatment T_3 as compared to other four treatments, in both the conditions.

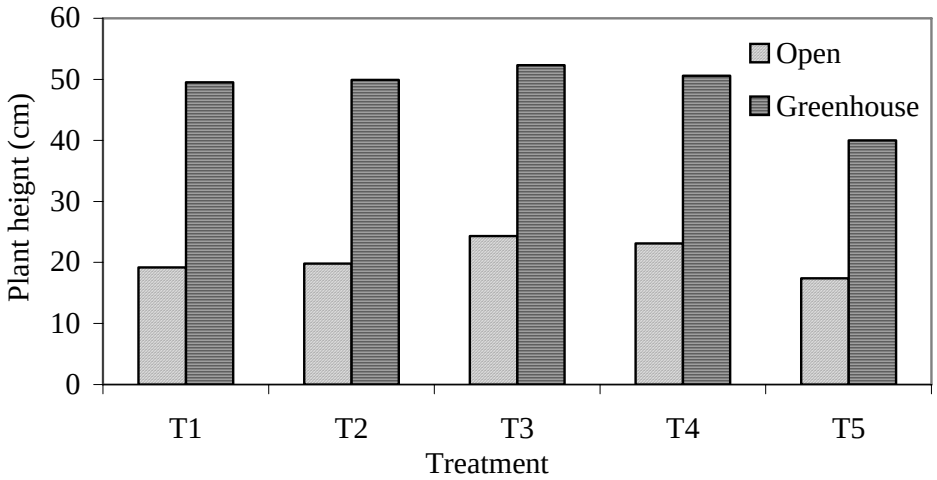

Fig.2 Plant Height of 3 months Old Seedlings of *Albizia lebbek* Under Open and Greenhouse Conditions

The seedling height growth rate in T_1 and T_2 was almost the same. The seedling height after 3 months was found 19.2 cm and 19.8 cm in T_1 and T_2 respectively in open conditions, whereas it was 49.5 and 49.9 cm in greenhouse conditions respectively. The treatment T_3 recorded 24.3 cm seedling height in open conditions and 52.3 cm in greenhouse conditions. Treatment T_4 resulted 23.1 cm seedling height in open conditions and 50.6 cm in greenhouse conditions. In T_5 the corresponding values were 17.4 cm and 40.0 cm respectively.

The mean seedling height among all the treatments in open conditions was found as 20.8 cm while it was 48.5 cm in greenhouse conditions. Thus there was about 27.7 cm (134.79 per cent) increase of seedling height inside the greenhouse over the outside. This increase in height may be attributed to the partially controlled environment i.e. relative humidity was almost in the range of 55 to 65 per cent and soil and air temperatures in the range of 10 to 30 ^{o}C during the day time except at noon hours. This might have contributed to the higher photosynthetic efficiency inside the greenhouse than open conditions.

3.2 Plant Collar Diameter

The growth rate of seedlings collar diameter (diameter) of *Albizia lebbeck* under open and greenhouse conditions is shown in Fig.3.

The growth rate in seedling collar diameter was faster inside the greenhouse after the 43 days of sowing. But as the number of days after sowing proceeded, the seedlings inside the greenhouse were influenced by the microclimate inside the greenhouse and hence the substantial faster growth rate is observed inside the greenhouse as compared to the seedlings grown in open conditions.

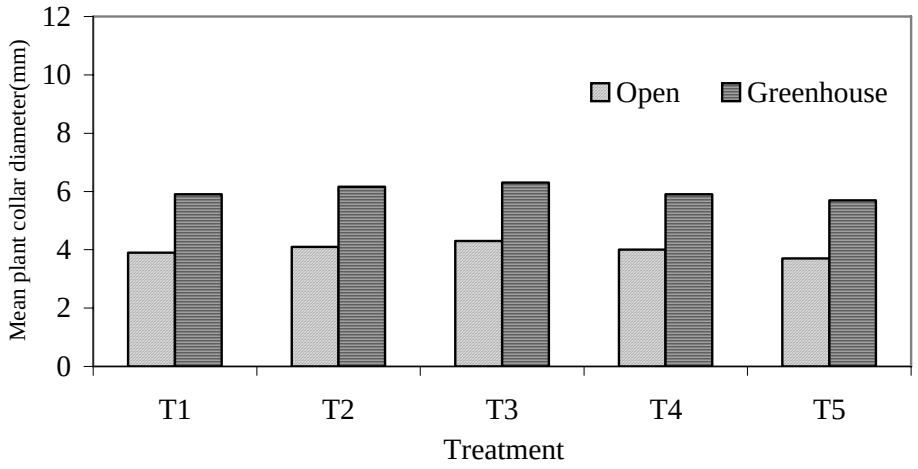

Fig.3 Mean Collar Diameter of 3 months Old Seedlings of Albizia.lebbeck Under Open and Greenhouse Conditions

The collar diameter of 3 months old seedlings was found to vary from 3.7 to 4.3 mm in open conditions and 5.7 to 6.3 mm inside the greenhouse. Maximum collar diameter is 4.3 mm was observed in T_3 in open and 6.3 mm in greenhouse conditions, while T_2 resulted in 4.1 mm and 6.1 mm in open and greenhouse conditions respectively. In T_1 and T_4 the collar diameters were 3.9 mm and 4.0 mm respectively in open conditions and 5.9 mm in both the treatments in greenhouse conditions. Least growth rate in collar diameter was observed in Treatment T_5

(unsoaked seeds before sowing). Therefore, it shows that at least some treatment of seed soaking before sowing is necessary for the healthy growth of seedlings.

The mean plant collar diameter for all the treatments in 3 months old seedlings was observed 4.0 mm in open and 6.0 mm in greenhouse conditions. The increase in plant collar diameter of seedlings in greenhouse over open conditions as 1.9 mm for T_4 and 2.0 mm for all other treatments. The per cent increase in collar diameter was 49.62 per cent. Thus, all the treatments resulted into higher collar diameter over control.

3.3 Biomass Yield

The dry matter content of shoot and root part of the seedlings is shown in Fig. 4. The maximum shoot and root weight of seedlings was found as 2.8 g and 1.7 g per plant in open conditions, while it was 8.7 g and 4.7 g per plant in greenhouse conditions for T_3 treatment. The seedling shoot and root weight in T_4 was observed as 2.6 g and 1.8 g per plant in open conditions and 8.4 g and 4.4 g per plant in greenhouse conditions. The dry weight of shoot and root part in T_2 had responded to 2.4 g and 1.3 g per plant in open conditions and 8.2 g and 4.2 g per plant in greenhouse conditions. In T_1 the shoot and root dry matter content was 2.4 g and 1.1 g per plant in open conditions while the respective values were 7.9 g and 3.9 per plant in greenhouse conditions. The dry matter content in shoot and root part of the seedlings in treatment T_5 was found 2.1 g and 0.9 g per plant in open conditions and 7.2 g and 4.0 g respectively in greenhouse conditions. The mean shoot root weight ratio was 1.89 in open and 1.91 in greenhouse conditions.

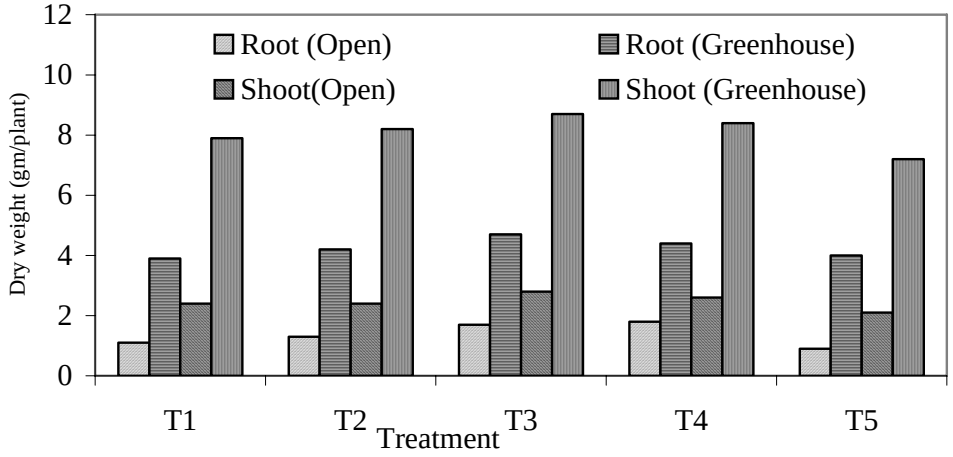

Fig 4. Dry Matter Content of 3 months old Seedling of Albizia lebbeck under open field and greenhouse onditions

Substantial difference was observed between the seedling dry matter in open and greenhouse conditions. In three months old seedling the dry matter of shoot part of the seedlings in greenhouse over open conditions was increased by 5.1 g to 5.9 g per plant while the dry matter of the root part was increased by 2.6 g to 3.1 g per plant.

Thus it may be concluded that the dry matter of shoot and root part of the seedlings of *Albizia. lebbeck* was increased more than twice in greenhouse conditions when grown during 9th to 22nd

standard weeks. Total dry matter (shoot and root) in 3 months old seedlings was 3.9 gm and 12.3 gm in open and greenhouse conditions.

4. CONCLUSIONS

1. The height of 3 months old seedlings of *Albizia lebbeck* was 20.8 cm in open conditions while corresponding values was 48.5 cm in greenhouse conditions. Thus corresponding increase in height was 135 per cent
2. In 3 months old seedlings the collar diameter in *Albizia lebbeck* was 4.0 mm in open conditions while the corresponding values was 6.0 mm in greenhouse conditions. Thus corresponding increase in collar diameter was 50 per cent.
3. The total dry matter content in 3 months old seedlings of *Albizia lebbeck* was 3.9 g in open conditions and the corresponding values was 12.3 g per plant in greenhouse conditions. The respective increase in dry matter content were 215 per cent. The mean shoot-root weight in *Albizia lebbeck* was 1.89in open conditions and 1.91in greenhouse conditions respectively.
4. Germination is the most dominant character in the growth of seedlings. It is found that earlier the germination and higher the germination per cent healthier and faster is the growth of seedlings in both open and greenhouse conditions, however faster growth rate was observed inside the greenhouse.
5. In 3 months old seedlings there was appreciable increase in plant growth parameters inside the partially controlled L.D.P.E. greenhouse over the open conditions. Thus enough labour and time can be saved in summer for nursery raising of agro-forest plants.

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