Techniques for Raising Seedlings from Detached Germtubes of *Borassus flabellifer* Linn.

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Abstract

It is generally believed that the seedling of palmyra palm (*Borassus flabellifer* Linn.) is difficult to transplant and hence requires direct sowing. This hinders mass propagation and plantation of this species. Its propagation is mostly through natural means, and hence palm trees are found to grow scatteredly. At present, palmyra palm has been recognized as a priority species for raising plantations in the coastal embankment. This study has been undertaken to develop technique for raising palm seedlings. Investigations suggest that the bed mixture comprising 50% soil, 25% sawdust, 20% cowdung and 5% ash was the best, where the average elongation of germtubes and coleorhiza/root-sheath was 37.3 cm by 7 weeks, the mixture depth of 38.1 cm was sufficient to accommodate their cumulative growth. These elongated germtubes could be removed from the temporary bed after 7 weeks of sowing seeds, when the tip of emergent coleoptile is visible on the surface of the bed. Rootlets were also found to occur in the root-sheath of all the germtubes by that time. These germtubes were then detached from their seeds and transplanted immediately into suitable polybags of 22.9 cm x 30.5 cm size. All the transplantated seedlings survived and the emerging leaflets of these seedlings turned to green within a week after transplantion. The mortality of early and late trasplanted seedlings was 11% and 25% respectively. Germtubes were found to elongate up to 82.6% within 4 weeks after sowing seeds. On the other hand, more than 50% elongation of the coleoptile was observed during the 5-7th weeks after sowing.

সারসংক্ষেপ

সাধারণ ধারণা এই যে, তালের চারা স্থানান্তরিত করা সম্ভব নয়, ফলে তালের বীজ সরাসরি রোপণ করতে হয়। প্রজাতিটির বংশ বিস্তার ও বনায়ন কার্যক্রম এ কারণে বাধাগ্রস্ত হয়। শুধুমাত্র প্রাকৃতিক নিয়মে বংশ বিস্তারের ফলে তাল গাছ বিক্ষিপ্তভাবে জন্মাতে দেখা যায়। বর্তমানে উপকূলীয় অঞ্চলের বেড়ী বাঁধে লাগানোর জন্য তাল একটি অগ্রাধিকারপ্রাপ্ত প্রজাতি হিসেবে স্বীকৃত। তাল প্রজাতির চারা উত্তোলনের জন্য বিজ্ঞানসম্মত পদ্ধতি উদ্ভাবনের লক্ষ্যে এ গবেষণা কার্যক্রম হাতে নেয়া হয়। গবেষণায় দেখা যায় যে, পরিপক্ষ তাল বীজ প্রথমে ৩৮.১ সে. সি. গভীর সাময়িক বেডে লাগাতে হয়। সাময়িক বেড ৫০% মাটি, ২৫% কাঠের গুঁড়া, ২০% গোবর ও ৫% ছাই-এর মিশ্রণ দিয়ে তৈরী।

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এ মিশ্রণে জার্মটিউব সহজে প্রবেশ করতে পারে এবং স্বল্প সময়ে ভাল বর্ধন হয়। সাত সপ্তাহে জার্মটিউব ও রুটশীথের গড় বর্ধন ৩৭.৩ সে. মি. হয়। বর্ণিত মিশ্রণের গভীরতা এ বর্ধনের জন্য যথেষ্ট। সাময়িক বেডসমূহে রোপিত বীজ ৭ সপ্তাহ পর যখন কোলিওপ্টাইলের মাথা মিশ্রণের উপর দৃশ্যমান হয় তখন সাময়িক বেড থেকে উঠিয়ে ২২.৯ সে. মি. × ৩০.৫ সে. মি. পলিব্যাগে স্থানান্তর করতে হয়। স্থানান্তরের পূর্বে লাগানো বীজ থেকে জার্মটিউবসমূহ পৃথক করে নিতে হয়। এ সময়ে ১০০ ভাগ জার্মটিউবের রুটশীথে পর্যাপ্ত শিকড়মূলিকার উপস্থিতি পরিলক্ষিত হয়। যার ফলে এ সময়ে পলিব্যাগে স্থানান্তরিত সমস্ত চারা বেঁচে যায় এবং চারার নতুন গজানো পাতা পলিব্যাগে লাগানোর এক সপ্তাহের মধ্যে হালকা সবুজ রং ধারণ করে। নির্ধারিত এ সময়ের আগে ও পরে পলিব্যাগে স্থানান্তরিত চারার যথাক্রমে ১১% ও ২৫% মৃত্যু ঘটে থাকে। তালবীজ লাগানোর প্রথম ৪ সপ্তাহের মধ্যে জার্মটিউবের ৮২.৬% বর্ধন সাধিত হয়। অন্যদিকে ৫-৭ সপ্তাহে কোলিওপ্টাইলের ৫০% বর্ধন সাধিত হয়।

Key words : Coleoptile, coleorhiza, germtube, growth, seed separation, transplanting period

Introduction

Palmyra palm (*Borassus flabellifer* Linn.) is found to grow scatteredly throughout Bangladesh. It is an erect tall tree attaining 12-25 m height and bearing fan-like leaves in the crown. It is also called fan palms due to extensive use of its leaves in making hand fan. Its fruit juice is popularly used in the country for making indigenous cakes, molasses and other edibles. Its seeds with emerging seedlings are eaten by the rural people. In many countries palmyra palm is tapped for toddy, the yeast of which is well recognized as a good source of Vitamin B complex (Anon. 1984). Large quantities of vinegar are also made from toddy of palmyra (Blatter 1926). Despite its numerous uses such as pillars, posts, boats, baskets, mats, roofs, beams, etc., this species has not received due attention for its propagation and improvement.

After the devastating cyclone of 1991, which caused a death of 140,000 people in the coastal areas,the policy-makers thought that the impact of cyclonic damage on exposed coastal belt could be reduced by raising vegetative shelter belt along the regions. Accordingly, palmyra palm has got priority and came into consideration as a plantation species in both the Coastal Greenbelt Project and the Coastal Embankment Rehabilitaion Project (Anon. 1995). However, it was thought that the palmyra palm can only be propagated by direct sowing, owing to the difficulty of transplanting its seedlings (Troup 1921). Another reason of reluctance to raise plantation of this species is its prolonged growth after sowing seeds coupled with the problem of taking away emerging seeds from the spot. Direct sowing is still more difficult in the coastal areas where periodic inundation occurs causing damage to germinating seeds. The main reason for non-availability of seedlings in commercial nurseries is the lack of easy technique for raising its seedlings. This paper reports an easy technique for raising palm seedlings in the nurseries.

Materials and methods

The experiments were conducted at Rangabali, Char Osman and Kukri-Mukri Research Stations of Bangladesh Forest Research Institute during 1997-99.

To find out a suitable medium for easy penetration and elongation of germtubes palm seeds were sown in three mixtures : a) equal proportion of soil, cowdung and rice husk , b) soil and cowdung (3:1) , and c) 50% soil, 25% sawdust, 20% cowdung and 5% ash mixture. The experiment was replicated thrice.

To find out the required depth for elongation of germtubes in the nursery bed, experiments were also set up with varying nursery depths such as 12.7 cm, 25.4 cm, 38.1 cm, 50.8 cm with the soil : cowdung mixture and the flat land bed having no mixture. The experiment was also replicated thrice.

Depending on the results of these experiments, temporary nursery beds with 38.1 cm mixture (soil : sawdust : cowdung : ash = 50 : 25 : 20 : 5) depth were prepared in 1998-99. Fresh seeds were sown in three separate beds.

Watering was done in each alternate day in order to keep the seeds and seed beds moist. To avoid excessive evaporation partial shading was provided to the bed.

Equal number of germtubes were removed from each temporary bed regularly 4-7 weeks after seed sowing. Measurements on the growth of cotyledon sheath, germtubes, coleorhiza / root-sheath region as well as the development of coleoptile within the germtubes were taken.

To determine the suitable time for germtube detachment and transplanting into polybags, the germtubes were exposed from the beds 4-12 weeks after sowing and transplanted into polybags by separating seeds from cotyledon sheath. Data on the occurrence of rootlets in the coleorhiza region and survival of transplanted germtubes were recorded.

Results and discussion

Germination percentage of palmyra palm varied from 65 - 86% in different Research Stations. At Rangabali Research Station, a total of 1000 seeds were sown, of which 862 were germinated. At Kukri-Mukri Research Station, 260 seeds were germinated out of 400 seeds sown. At Char Osman Research Station, 210 seeds were germinated out of 254 seeds sown. Seeds collected and sown in September showed better germination than those sown earlier. It indicates that the seeds should be mature enough for getting higher germination. Seeds sown in mid-September showed 82.7% germination in Char Osman Research Station.

The bed mixture having 50% soil, 25% sawdust, 20% cowdung and 5% ash was better than other mixtures used. The inclusion of sawdust enhanced the growth rate due to easy penetration of germtubes into the mixture. The purpose of using a small portion of ash is to serve as a deterrant for insects. Initially, the rice husk medium was found better but it has been rejected due to its susceptibility to insect and/or fungal attack.

Palm seeds sown in flat land beds were found difficult to remove due to its firm anchorage of germtubes and lateral roots to the soil. Moreover, it took long time for gemtube elongtion due to its difficulty in penetrating the soil. The temporary beds having 12.7 cm and 25.4 cm mixture depths were found insufficient to accomodate the growing germtubes into the mixture. On the other hand, sporadic emergence of coleoptile tips was observed at the begining of 7th week in temporary beds with 38.1 cm mixture depth.

As shown in Table 1, the elongation of germtubes with coleorhiza was less than 40 cm in the case of 82 to 92% germtubes, whereas, only 8 to 18% germtubes were found to elongate more than 41 cm length. It indicates that the depth of mixture in temporary bed less than 40 cm is sufficient to accommodate the elongated germtubes of seven weeks.

Spongy cotyledon of palm seed initially exhibited a cotyledon sheath which elongated differently depending on the positional arrangements of seeds sown in the mixture. The average length of cotyledon sheath was 13.0 cm ranging from 3.3 cm to 17.8 cm. However, this portion was subjected to cutting during the removal of seeds

Table 1. Germtube elongation and their height distribution (based on measurements of 100 germtubes 7 weeks after sowing seeds).

Observations	Elongation (cm) of germtubes with coleorhiza							
	<20	21-24	25-30	31-35	36-40	>41	<40	>41
	nos						%	
1	4	10	22	20	26	18	82	18
2	6	8	30	28	20	8	92	8
3	4	8	24	24	24	16	84	16

Table 2. Average growth of germtube and coleorhiza region.

Observations	Growth (cm) after 7 weeks				
	Germtube		Coleorhiza/root-sheath		Total length (Germtube + coleorhiza)
	Length	Range	Length	Range	
1	21.5	16.5-24.1	18.9	10.0-21.0	40.4
2	20.4	16.5-25.4	16.7	7.0-19.0	37.1
3	19.5	15.2-24.4	15.0	7.0-20.0	34.5
Mean ± SE	20.5 ± 0.58	-	16.9 ± 1.13	-	37.3 ± 1.71

from germtubes before transplanting into polybags and hence it is less important for raising palm seedlings. Further development of cotyledon sheath in the germtube and coleorhiza region is highly responsible for nursery raising of palm seedlings. The average growth of germtubes and coleorhiza region after 7 weeks of sowing was shown in Table 2.

The length of germtubes ranged from 15.2 cm to 25.4 cm with an average of 20.5 cm. The average length of 16.9 cm was recorded for coleorhiza region, ranging from 7 cm to 21 cm in different replications. The total length of germtubes and coleorhiza ranged from 34.5 cm to 40.4 cm with an average of 37.3 cm. Based on the total length of germtubes and coleorhiza, the widely used polybag size 22.9 cm x 30.5 cm was considered suitable for raising palm seedlings. However, it is also necessary to investigate whether the length of only coleorhiza is sufficient to grow palm seedlings. In that case the size of polybags could be reduced.

The internal development of coleoptile was also recorded. For this equal number of germtubes were removed from each replication after 4 to 7 weeks of sowing. After measurements of the germtubes, the elongated coleoptiles were exposed by opening the sheath of germtubes with a sharp knife and measured. The growth rate of coleoptile was higher than the growth rate of germtubes after 4 weeks of seed sowing (Fig. 1).

On the other hand maximum growth rate of germtube was observed in the initial four weeks. By that time most of the germtubes attained up to 18.0 cm length with the initiation of coleoptile elongation within the germtubes. The average elongation of coleoptile was 10.4 cm, 11.8 cm, and 15.5 cm after 4, 5 and 6 weeks of seed

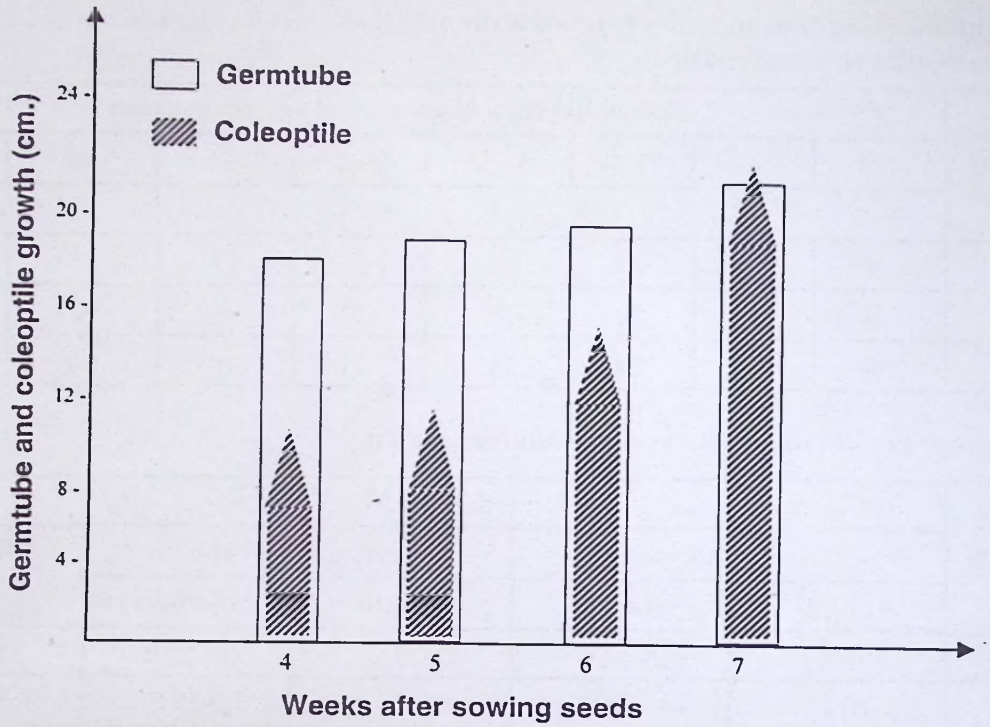

Figure 1. Growth rate and development of coleoptile within the germtubes.

sowing respectively. The intensive period of coleoptile development was 5 to 7 weeks after seed sowing within which more that 50% growth occurred. The elongation of coleoptile reached up to 22.1 cm by the end of 7th weeks and was visible from the top of the mixture. Thus, two phases for each of germtube and coleoptile elongation were recorded. Out of 7 weeks, 82.6% elongation of germtube was completed in the initial 4 weeks and less than 20% elongation occurred during 5-7 weeks. On the other hand, the maximum growth rate and development of coleoptile was observed during 5-7 weeks.

Another objective of the study was to identify the appropriate time for separating the germtubes from seeds before transplanting into polybags. In this regard, emphasis was given to the initiation of rootlets in the colerhiza region / root-sheath. Seeds were sown on September 24, 1998 and the elongated germtubes were removed from the temporary beds after 4 - 12 weeks of seed sowing and recorded the rootlets existing in the coleorhiza regions. At the 4th and 5th weeks there were 20% germtubes containing on an average 2 rootlets.

The occurrence of rootlets dramatically increased during 5-6th week when 70% of the germtubes initiated 2-4 rootlets (Fig. 2). By the end of 7th week 100% germtubes were found to develop rootlets, out of the which 74% developed lateral roots. Similar findings were recorded in the subsequent weeks. However, almost 20% of the previously developed rootlets were found decaying by the end of 12th weeks.

Germtubes containing rootlets were transplanted into polybags by separating seeds after 4th week of sowing. Among the transplanted seedlings, 89% were found to survive. It might be associated with the disturbance of coleoptile development during seed separation and early

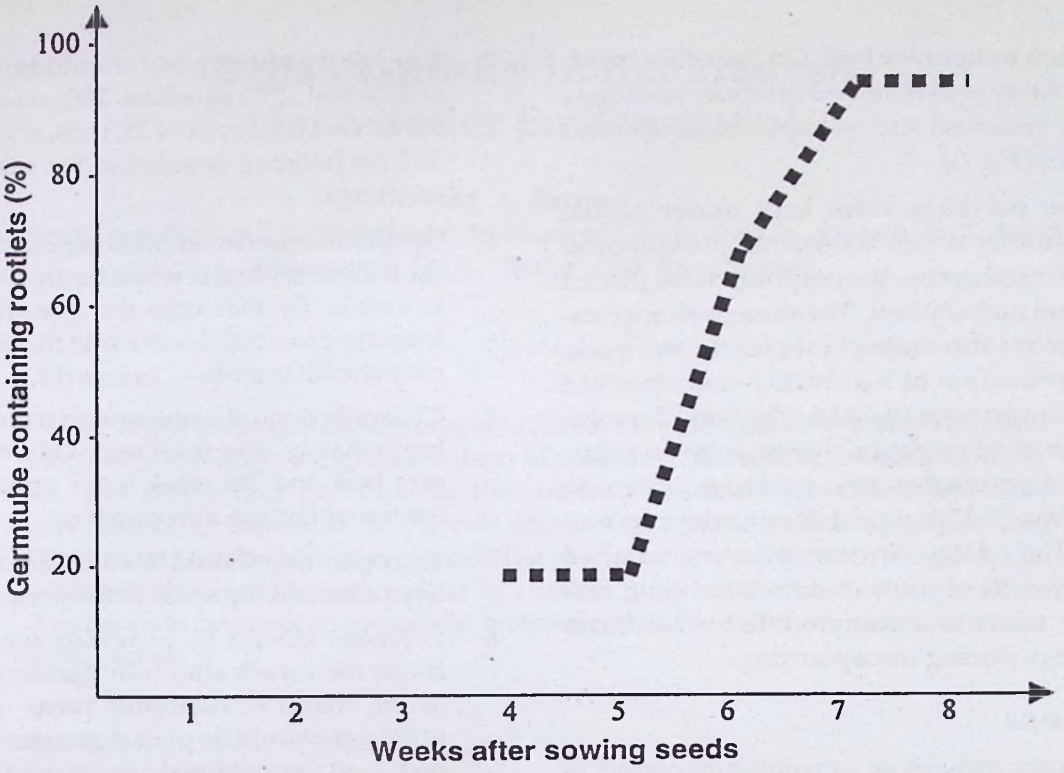

Figure 2. Occurrence of rootlets in the coleorhiza region/root-sheath.

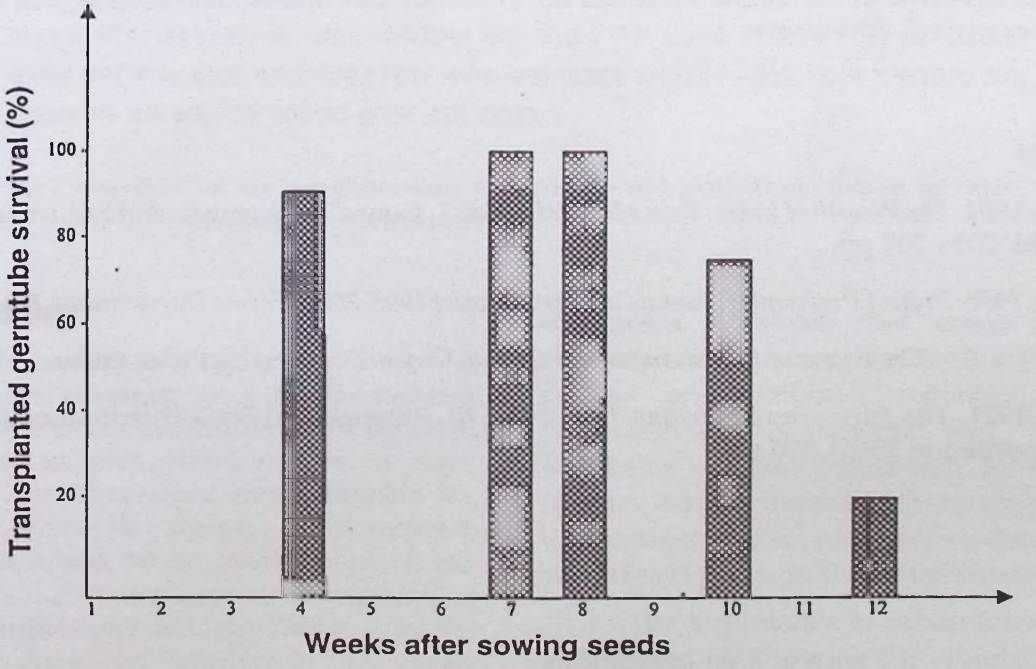

Figure 3. Survival of germtube transplanted in polybags at different weeks.

removal from temporary bed. On the other hand, 100% survivality was obtained for those seedlings which were removed and transplanted at the end of 7th weeks (Fig. 3).

These polybags were kept under partial shade for another week. As soon as the colour of coleoptile turned green, the polybags were placed in the normal nursery bed. The same was applicable for the germtubes transplanted in the 8th week. A gradual reduction of survivality was observed for the seedlings, transplanted after 8 to 12 weeks. This low survival might be due to delay in transplanting the germtubes into polybags, because this is the time (9-12th week) for developing root systems. The delay in transplanting resulted vigorous growth of roots and their pruning was required in order to accommodate the seedlings into polybags during transplanting.

Conclusions

1. Maximum growth of germtube occurred in the initial 4th week of sowing seeds, whereas maximum growth of coleoptile occurred in the subsequent (5-7th) weeks.
2. Temporary nursery bed should be composed of 50% soil, 25% sawdust, 20% cowdung and 5% ash with a depth of 38.1 cm, and 22.9 cm x 30.5 cm polybag is suitable for raising palm seedlings.
3. Optimum time for removal of germtubes from the temporary bed is when the tip of coleoptile is visible. By that time the germtubes were found to grow 100% rootlets in the coleorhiza/ root-sheath region.
4. Germtubes could be separated from the seeds immediately after their removal from temporary bed, and 7th week is the optimum time for transplanting into polybags.
5. Transplanting should be completed within 60 days after sowing seeds in the temporary bed.
6. Polybags should be provided with partial shade for a week after transplanting. As soon as the colour of coleoptile turns green, the polybags should be placed in normal nursery bed and maintained as normal nursery raising of seedlings. Generally it requires 7-8 months to maintain seedlings in the nursery bed.

References

Anonymous 1984. *The Wealth of India : Raw Materials - Vol. 1.* Council of Scientific and Industrial Research, Delhi. 203 - 207 pp.

Anonymous 1995. *Project Proforma : Coastal Greenbelt Project 1995-2000.* Forest Department, Dhaka.147 pp.

Blatter, E. S. J. 1926. *The Palms of British India and Ceylon.* Oxford University Press, Oxford. 173 - 190 pp.

Troup, R. S. 1921. *The Silviculture of Indian Trees : Vol. III.* International Book Distributors, Dehra Dun, (Reprinted in 1986). 975 pp.