
TEAK BREEDING IN SRI LANKA: BUDDED TEAK PLANT DEVELOPMENT TO ESTABLISH CLONAL SEED ORCHARDS

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Summary

A series of nursery studies were conducted to investigate the suitable budding method, type of root stock and bud opening time after budding for teak. Three budding methods (H-budding, Patch budding and Forket budding), two root stock types (Two-year-old potted seedlings and one-year-old bare rooted stumps) and two different bud opening times (10 days and 15 days after budding - DAB) were tested in two nursery experiments in the Forest Department Central Nursery at Hadapanagalla, Wellawaya, Sri Lanka in 2010. Scion buds were collected from the upper one third of the canopy, subsequently budding was carried out at 10 cm above the base of the root stock and kept under 80% of shade. The data (success percentage) was analyzed using binary data analysis procedure. No significant differences of the success percentages were found among different budding methods or root stock types. Significant differences were observed in bud opening times for success rate for seedling plants. The average success rates between two root stocks (bare rooted stumps and potted seedling plants) were 76% and 82% respectively; success percentages for H, Patch and Forket methods were 83%, 80% and 75% respectively. Furthermore, the bud opening time for the maximum success for potted seedlings was 10 days after budding whereas for bare rooted stumps it was 15 days after budding.

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INTRODUCTION

Teak (*Tectona grandis*) is the main plantation tree species in Sri Lanka where approximately 26000ha of plantation have been established by the Forest Department and unaccounted large number of teak trees have been established by the small scale farmers (FAO, 2009). The seed requirement for the Forest Department plantation establishment is mainly derived from seed stands and two clonal seed orchards (CSO) which were established in 1970s. The extent of the Sri Lankan teak CSO is limited; only 32 hectares of CSOs are available for seed production. However, the seed production per tree is moderately high; the average seed production is 6 -10 kg per tree, which is higher than the production of other tropical countries (i.e Kaosaard *et al.*, 1998). Therefore, teak management plan of the Forest Department of Sri Lanka (Forest Department, 1997) has proposed to increase the extent of teak CSO to increase the high quality seed production of the country.

Clonal seed orchards in teak have been established in many tropical countries to accomplish genetically superior teak seeds. Clonal seed orchard development of teak in teak growing countries (India - Venkatesh *et al.*, (1986), Thailand - Kaosaard *et al.*, (1998), Indonesia - Suhaendi, (1995) Sri Lanka - Vivekanandan, (1975) were started in 1970s-1980s. The clones for CSOs are mainly propagated by budding/grafting to establish large scale orchard development. As CSO development is a continuous process in tree breeding programs, new information on teak clonal

propagation is vital for future CSO establishment.

Budding method, root stock type and management of budded plants in nursery are essential steps in successful budded plant development. Budded plant development process needs to be economical as well as the success rate of budding process has to be high. Therefore, the objective of this nursery study is to investigate the appropriate budding technique, to identify the suitable root stock and to find out the appropriate management practices in the nursery. This research work was conducted as a part of CSO development program of teak in 2010.

METHODS

Two nursery experiments were conducted to investigate suitable budding method, identify the economical root stock type and to find out the time of the bud opening for the highest budding success rate.

Experiment 01

Three types of budding methods (H. patch and Forket) and two types of root stocks (two-year-old seedlings and one-year-old bare rooted stumps) were tested in factorial design. The experiment was conducted at Forest Departmental nursery at Hadapanagalla, Wellawaya; the mean annual temperature and the mean annual rainfall of the site were 30°C and 1750 mm respectively.

Root Stocks

Teak seedlings were planted in 12" × 8" poly bags which were filled with suitable potting media (3: 2: 1 - Forest soil: compost: sand) and maintained in the nursery for 24 months to produce suitable seedling root stock. Continuous root pruning (once per month) of the seedling plants were practiced to prevent the root penetration to the ground. The bare rooted stumps were prepared from one-year-old teak plants which were raised in the mother beds. The shoots of one-year-old plants were removed 10 cm above the ground and uprooted. Then the tap root was pruned at 10 cm below the ground level and trimmed the lateral root to make the bare rooted stumps. This process was similar to the normal planting teak stumps production procedure. The collar diameter of both seedling plants and the bare rooted stumps were approximately 2 - 3 cm at the stage of budding.

Scions were collected from the branches of the selected teak trees which have been attained the reproductive maturity. Bud-wood cuttings were prepared in 20-30 cm in length and those were transported to the nursery after bundling and wrapping in wet papers.

Budding

H budding was done by making two vertical cuts (2.5 to 3 cm) parallel to each other at the base of the root stock. The parallel lines were then connected with a horizontal cut (1-1.5 cm in length) to form H shape. The skin flaps were then lifted upward and downward to expose the cambium of the stock. Then, a rectangle bud

patch containing one bud taken from the bud wood was placed on the exposed cambium of the root stock. A rectangular patch of the root stock was removed and one bud containing bud patch was placed on the exposed cambium in patch budding. For the Forket budding, two vertical incisions of about 2-3 cm were made at the distance of 1.5 cm at the base of the root stock and they were arched over to meet at the top. The rind flaps were then lifted downward from the point where the two incisions met and exposed the cambium of the stock. Then, similar to the other two methods, a rectangular bud patch was placed on the exposed area and rind flap was pushed back. Once the bud patch was placed on the exposed cambium budding area was wrapped with budding tapes. The stem of the seedling plants were cut about 5cm above the budding point and covered the exposed surface with a poly tape. The bare rooted stumps which were budded were immediately transplanted in the poly bags which were filled with suitable potting media. Each treatment was allocated five plants, replicated for four times, which totaled 120 plants for the trial.

Budded plants were kept under high shade (80%) and watered daily. The budding tapes were unwrapped 15 days after budding. Then the budded area of the plants were rewrapped while the healed bud was kept open. One week after opening the buds, the shoots started to emerge. The success percentage for each treatment was assessed four weeks after budding. Binary data analysis procedure was applied for the percentage data analysis.

Experiment 02

In this experiment, two types of root stocks (seedling plants and bare rooted stumps) and two different bud opening times (10 and 15 days after budding) was tested. H budding method was used in this experiment. Maintenance of the budded plants were done similar to the experiment 01. Success of the budding was measured repeatedly at 15, 20, 25, 35 and 40 DAB. The success rate of the budding was graphically presented.

RESULTS

The effect of the budding method and root stock type on the success rate

There were no significant differences among budding methods or root stock types

for the success rate (Table 1). The overall success rate was high, 80%. The average success rates for different root stock (stumps and potted plants) were 76% and 82% respectively. The success rates for different budding methods (H, Patch and Forket) were 83%, 80% and 75% respectively (Table 1, Figure 1 and Figure 2).

The effect of bud opening time on the success rate of budding

There were statistically significant differences between two bud opening time for success rate for seedling plants. Figures 3 and figure 4 indicate that the success rate (%) of the budding is varying between root stocks. Further, it shows the potted seedlings need early opening of the buds than the stumps for the higher success rate. The highest success rate

Table 1: Effect of different budding methods and root stock types on the success rate (%) at 30 days after budding at Hadapanagalla

Budding method	Success Rate		
	Root stock		Average
	Stumps	Potted plants	
H	83	83	83
Patch	73	86	80
Forket	73	76	75
Average	76	82	

Note: No significant differences ($P>0.05$) between budding methods or root stock types were observed.

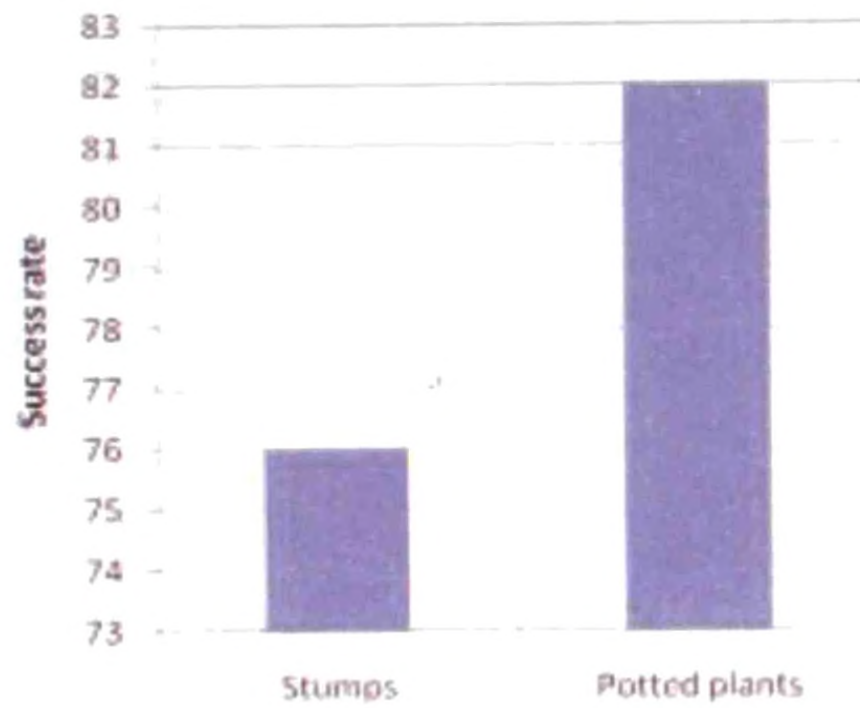


Figure 1: The success rate (%) of budding of different root stock types (stumps and potted seedlings) at Hadapanagalla Nursery

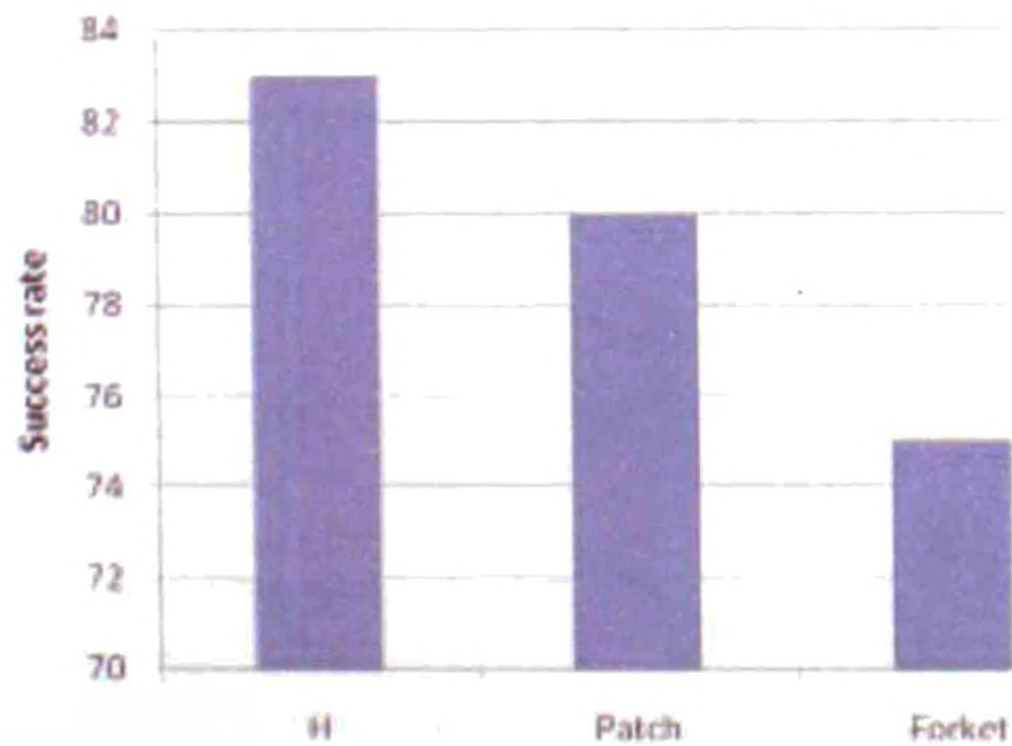


Figure 2: The success rate (%) of budding of different budding methods (H, Patch and Forket) at Handapanagalla Nursery

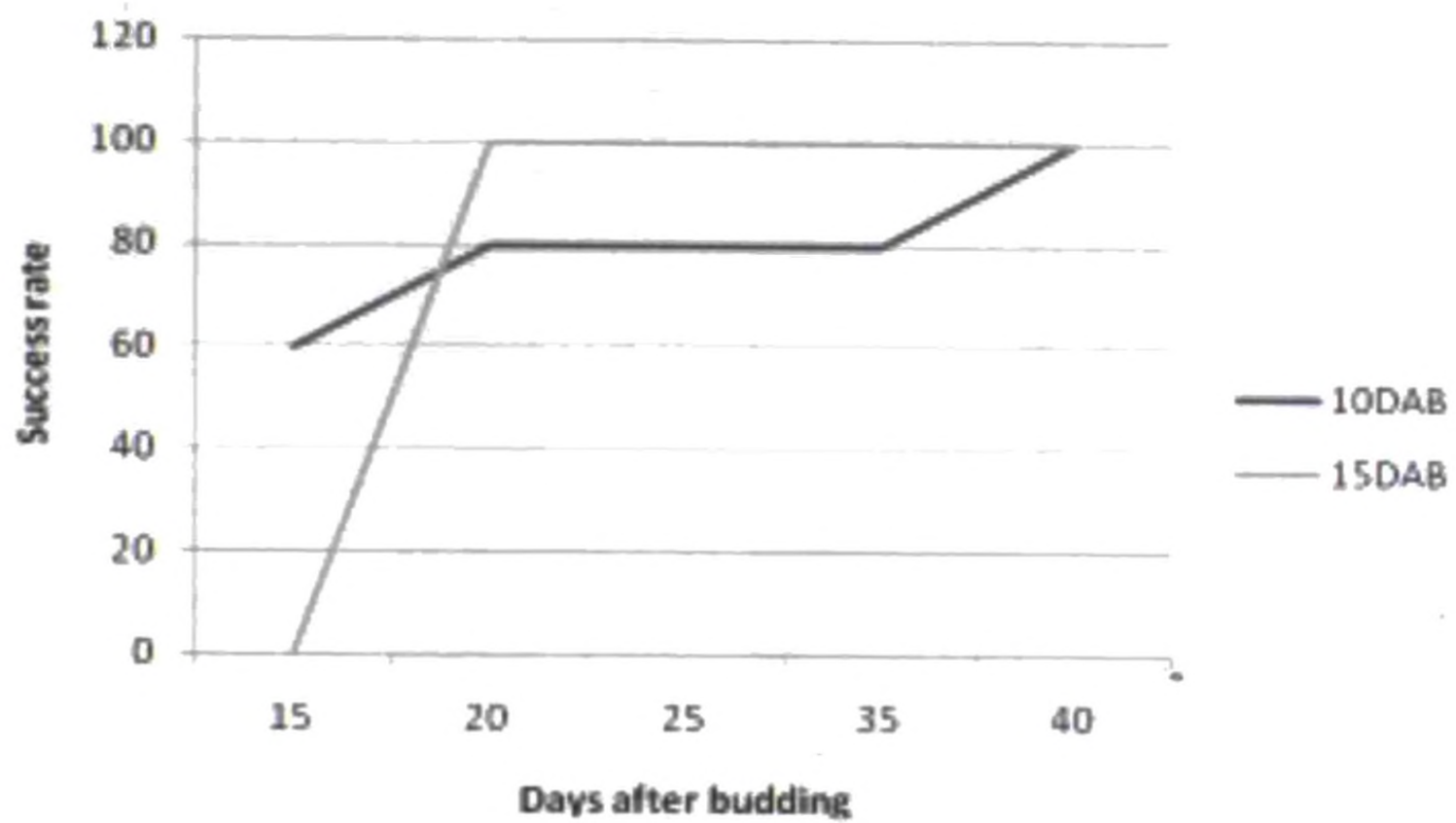


Figure 3: Budding success rate of stump plants with the days after budding at Hadapanagalla Nursery

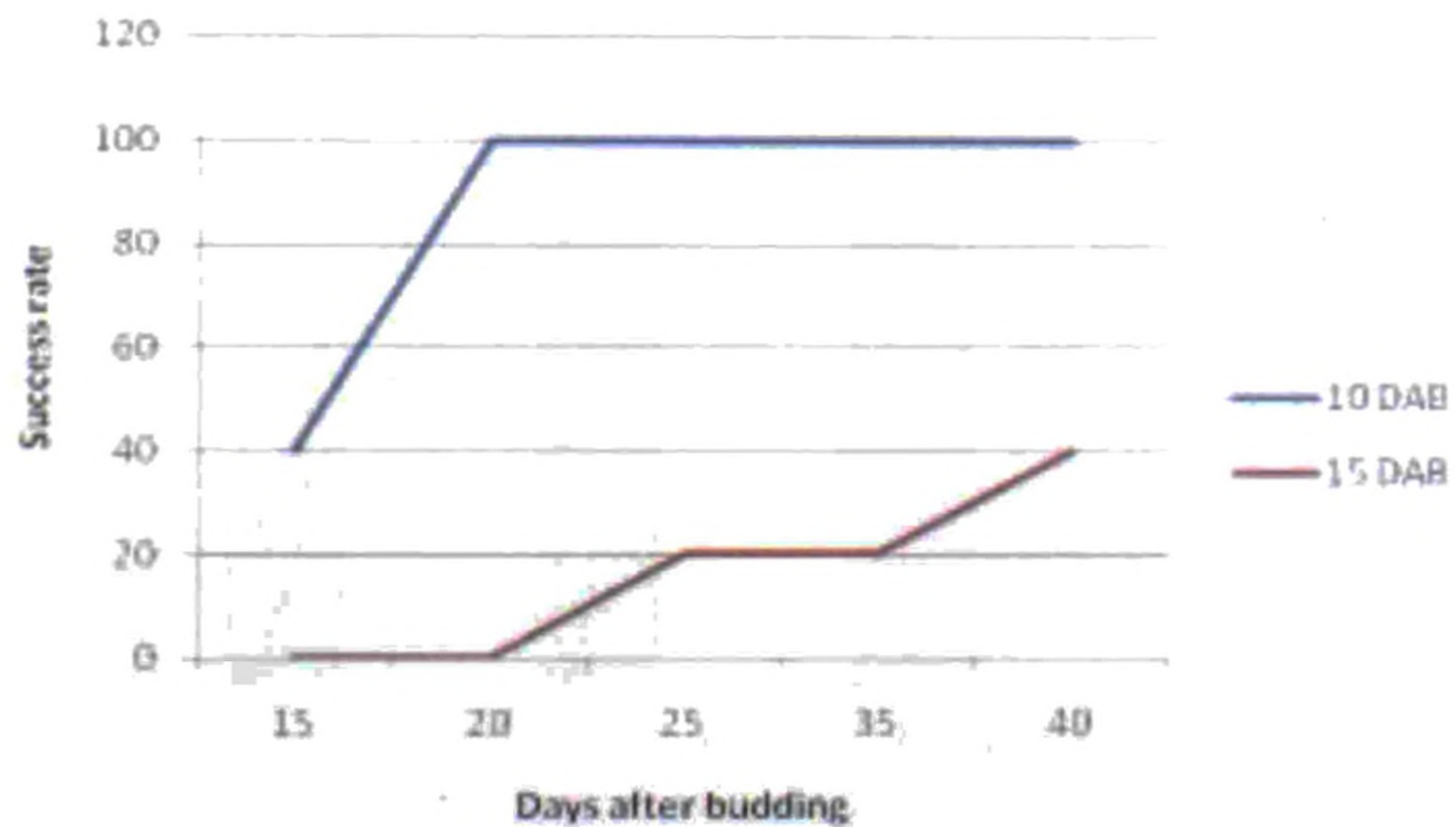


Figure 4: Budding success rate of potted seedlings with the days after budding at Hadapanagalla Nursery

(100%) for stumps was achieved when the bud opening was done at 15 DAB. In contrast, lower success for seedling plants (40%) was reported when the bud opening was done at 15 DAB (Figures 3 and 4). Seedling plants showed higher success rate (100%) with the bud opening at 10 DAB (early opening) however, in stumps, early opening (10 DAB) revealed a slow development of scion buds on the stock.

DISCUSSION

Series of teak budding experiments conducted at Handapanagalla Sri Lanka reveal that either of H, Patch or Forket budding methods can successfully be used for budded plant development in teak clonal seed orchard development. This result is comparable with the results of Perera (1961) from Sri Lanka and Venkatesh *et al* (1986) from Kerala, India.

The results further indicate that either potted seedlings or stumps can be used as the root stock. Preparation of seedling plant in a container is a very expensive process. To achieve suitable plant, the potted seedling should be managed in the nursery for two years. As the teak plants are kept in the mother-bed until the stump production, teak stump production is relatively an inexpensive process. Further, the handling of stumps for budding is easier than the seedling plants. However, more attention (aftercare in the nursery) will be required for stump plants for higher success rate.

Results of experiment on bud opening time indicate that the callus formation of seedling plants is rapid compared to the stumps. Therefore, in the budding process, bud opening of seedling plant should be done early. As the bare rooted stumps need to develop their own root system to feed the stump, stumps take more time to heal the budded area. Further, bud opening time for maximum success rate for seedling plants and stumps were at 10 DAB and 15 DAB respectively.

CONCLUSIONS

The results of two nursery experiments of teak reveal no significant difference among budding methods (H, Patch and Forket) for the success rate, indicating either of budding methods can be used for teak budding programs. Since there is no significant difference between root-stocks (Seedling plants and stumps) for the success rate, stumps can be used as the root stock in the economic point of view. For the highest success rate, bud opening time of seedling plants was 10 DAB and for stump plants it was 15 DAB.

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