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PROPAGATION OF BAEL FRUITS (BELI) [*Aegle marmelos* (L.) corr.] BY GRAFTING

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ABSTRACT

Beli (*Aegle marmelos* (L.) corr.) is a naturally propagated plant through seeds and roots. The characteristics of seedlings show morphological variations and use of root cutting is destructive and not suitable for large scale propagation. These have restricted the commercial cultivation and popularization of beli in Sri Lanka. Present study was conducted to identify a suitable grafting method in large scale propagation of beli plants. Seedlings with 5 mm stem girth were selected as root stocks and scion woods with 4 nodes were taken from a promising beli cultivar. The wedge, splice and side vineer grafting methods were tested. Percentage success, days taken to initial bud take on, days to emergence of first leaf, shoot length and number of leaves emerged were recorded. Percentage success of wedge grafting showed the highest results (86.7%) and for side vineer and splice the success rates were 80% and 66.7%, respectively. Mean shoot length of successful grafts in wedge grafts was 22.4 cm after 12 weeks and it was 18.6 cm for splice and 7.8 cm for side vineer. Average number of leaves in the successful grafts was 15.5 in the wedge grafted plants while it was 8.3 and 4.0 respectively, for splice and side vineer grafts. Thus, wedge grafting is a promising propagation technique for rapid multiplication of beli.

KEYWORDS: Beli fruit, Grafting, Propagation.

INTRODUCTION

Bale fruit (Beli in Sinhala) is a multi-purpose tree. The roots, bark, wood, unripe fruits, ripe fruit pulp, fruit shell, flowers and leaves etc., are extensively used for various needs such as food and medicine. Ripened beli fruit is highly nutritious with high levels of carbohydrate, protein, fat, carotene, vitamins and minerals.

The origin of beli is in India (Srivastava and Singh, 1999) and has been introduced to Sri Lanka in ancient times. It is widely distributed in the dry, wet and intermediate zones of Sri Lanka and a naturalized tree to the local conditions resembling an indigenous plant. Beli is more prized for its medicinal virtues than its edible qualities. In Sri Lanka beli is widely used in traditional medicines. Fresh fruits are used for making herbal drinks and many other value added products such as juice, cordial, jam, beli latex and dried pulp in confectioneries. Thus, beli is a potential crop with many industrial applications. Therefore, there is a great potential for this fruit both commercially and environmentally.

Although beli has been in use from time immemorial, hardly any effort has been made for the improvement of the crop or to cultivate it in an organized manner. Socio-economic studies have shown that beli is a popular home garden crop with versatile uses. However, most of the existing trees are naturally regenerated and there are no selected or improved varieties in cultivation. Therefore, introduction of good varieties or cultivars of beli fruit and cultivation of these in large scale mainly for the development of industrial uses have become necessary at present. For increasing the cultivation, a large quantity of planting materials of elite cultivars or varieties is required.

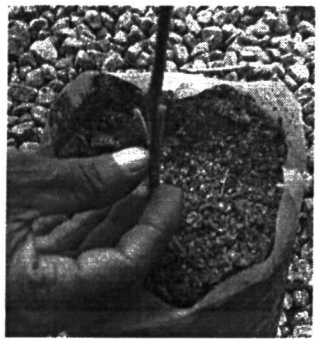
Beli is usually propagated by seeds (Wickremasinghe, 2002; Misra, 1999; Morton, 1987). However, it is a heterozygous crop and therefore seedlings show much variation in form, size, texture of rind, quality and quantity of pulp, flavour, number of seeds etc. Also, seedling plants take about 6-7 years to reach the bearing stage (http://www.worldagroforestry.org). Thus to overcome these defects and for rapid multiplication of superior types, vegetative propagation is essential. Beli could be vegetatively propagated by root cuttings, grafting, air layering and budding (Wickremasinghe, 2002). However, scientific information on vegetative propagation of beli fruit is very scarce and further there are no such records in Sri Lanka. Therefore, present study was conducted at the Horticultural Research Unit 2, Horticultural Crop Research and Development Institute, Gannoruwa with the objective of identifying a suitable grafting method for beli fruit propagation.

MATERIALS AND METHODS

Beli seedlings were produced from healthy seeds collected from a single plant from outstanding germplasm found from Polonnaruwa under plant house conditions. Root stock seedlings were raised in 8" x 12" polythene pots filled with normal potting mixture (sand: top soil: compost = 1:1:1). Seedlings those reached 5 mm stem girth were selected as root stocks and the bud woods having 4 nodes and similar size to rootstock were taken as scions from a characterized promising mother tree. The grafting methods of wedge, splice and side vineer were practised for beli at the same time under equal conditions with the objective of selecting the best performing grafting method.

For the wedge grafting (Plate 1) root stocks were cut down at about 5cm above the soil surface to a depth of 1.5-2 cm. Then edge of the scion was cut to a "V" shaped wedge with long even sloping sides and the scion and root stock were fitted together. The bud union was bound with a polythene strip and kept those grafts under propagator condition.

Preparation of the root stock

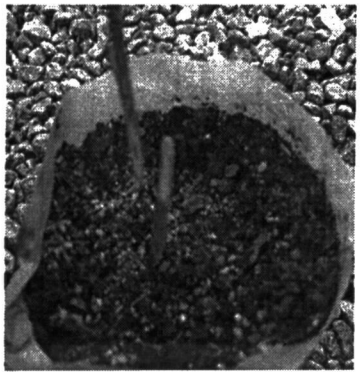


Insertion of the scion into the stock

Tying with polythene strips

Plate 1. Main steps of wedge grafting

For splice grafting (Plate 2), after removing the top of the root stock, a clear horizontal cut was made 5 cm above the soil level. Then a downward cut was made at an angle of 45° about 2.5 cm above the soil level. Then a downward cut was made starting from top to bottom until the second cut met the first cut. Then the scion with 4 nodes was taken and made a cut similar to the cut in root stock. Scion and root stock were fitted together and tied with a strip of polythene and kept under propagator condition.



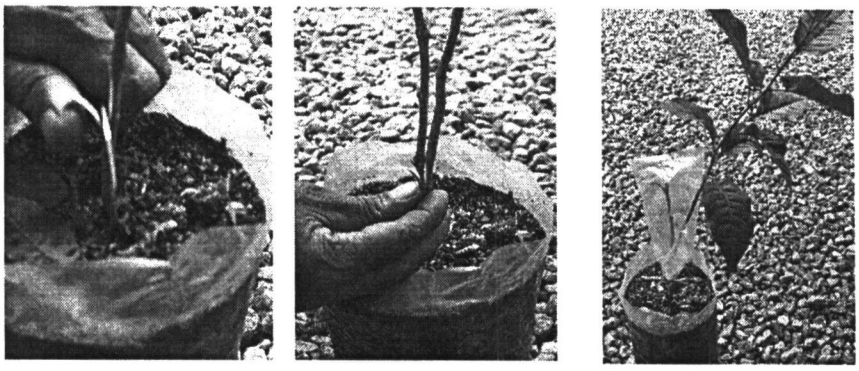
Preparation of the root stock and scion wood

Fitting the scion and root stock

Plate 2. Main steps of splice grafting.

For the first step for the side vineer (Plate 3), short downward cut about 5-6mm in length was made at 45° angle. Then the stem was carved by a downward cut to meet the first and it was about 2.5 cm above the first cut. Then a part of the silver wood was removed. The scions with 4 nodes were taken and a piece of wood having same length as the wound in root stock was stripped off from its base. Scion was put into the wound made in stock

plant and tied it well by polythene strips. The top of the root stock was left intact, until the union had taken place.



Preparation of the root stock | Insertion of the scion into the stock | Kept under single propagator

Plate 3. Main steps of side vineer grafting.

All the grafts were kept under single propagator condition until the bud took on and then at the time of shoot emergence, hardening process was started. Misting was done regularly to keep the grafts moist.

The experiment was laid out with Complete Randomized Design with 3 replicates. The plot size was 5 plants per replicate. Percentage success or percentage bud take on (total no. of successful grafts/total no. of grafts/100), the days taken to initial bud take on, number of buds in a successful graft, average shoot length, leaves per shoot, average number of leaves in the successful grafts were recorded at weekly intervals. The data were statistically analyzed using SAS package.

RESULTS AND DISCUSSION

Percentage success (Percentage bud take on)

Present study was undertaken to identify a suitable method for grafting beli. The method which gave successful results in the shortest duration would be the best out of all the methods. In spite of that, vegetative growth after the bud union had taken place was also measured.

The percentage of initial bud take on which indicates the success of grafting was recorded weekly and indicated in Figure 1. Percentage success was higher in wedge grafting compared to other two grafting methods tested. Mean percentage success was 86.67% for wedge grafting and it was 80 % and 66.67% for splice and side vineer grafts, respectively. Interaction effect also indicates higher percentage of success in wedge grafting over the

other grafting methods. However, there was no difference (P= 0.05) between the 3 methods tested on percentage success (Table1).

Average days taken for success in grafting was different (P= 0.05) between wedge and side vineer methods (Table 1). Side vineer grafting recorded the highest time period of 46.2 days compared to the wedge grafting (31.6 days)

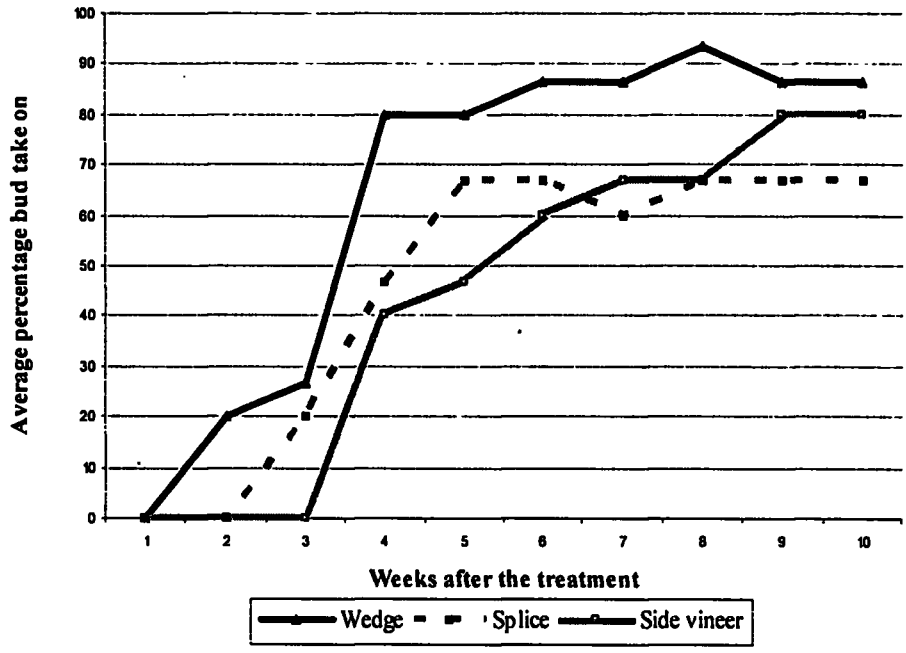


Figure 1. Effect of different grafting methods on percentage success.

Table 1. Mean effect of the method of grafting on percentage success and average days taken to success (alpha =0.05).

Treatment	*Mean % success*	*Mean average days taken to success*
Wedge	86.67 a	31.617 b
Splice	80.00 a	39.290 ab
Side Vineer	66.67 a	46.240 a
LSD (P=0.05)	29.783	9.1131

Means with same letter are not significantly different at P=0.05.

The average days taken to union under 3 grafting methods is illustrated in Figure 2. It shows the average data of 3 replicates. For wedge grafting it took 21 days for initial bud take on and percentage success observed at that time was 20%. It took 28 days for splice and 35 days for side vineer. The initial percentage success was 20% and 40%, respectively for splice and side vineer.

According to the results, percentage success and days taken for success were comparatively better with wedge grafting. There were variations within the same treatment with time and it may be due to the physiological variations among the scion wood used (Fig. 2).

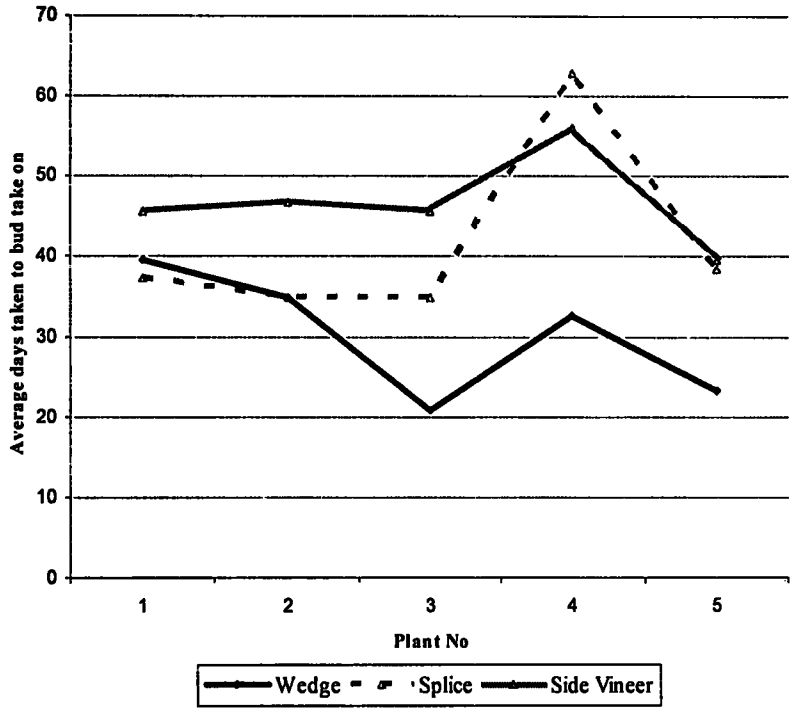


Figure 2. Effect of different grafting methods on days taken to bud take on.

Vegetative growth after the bud union was measured weekly in terms of number of buds, average shoot length, number of leaves per shoot and number of leaves per graft. A vigorous vegetative growth is important in large scale planting material production. Therefore, special attention was given to the growth parameters to select the best grafting method out of the tested techniques.

Number of buds

Buds are the starting points of leaves. Number of active buds in the scion wood in different grafting methods is shown in Figure 3. Though there were 4 nodes in almost all the scion woods taken, the highest number of bud emergence was observed in the wedge grafted plants while the lowest was in side vineer grafts (Figure 3). The time taken to emergence of initial bud was 3 weeks in wedge grafted plants and it was 5 weeks for side vineer grafts. Number of buds in the successful grafts of splice grafts was almost similar to wedge grafts and the reason for the lower number of buds in side vineer grafts may be due to the remaining rootstock until the union had taken place. Statistical analysis indicates that the response of grafting method affected the number of buds activated ($P=0.05$). Among the grafting methods tested,

number of buds in scion wood was higher in the wedge grafts while it was significantly lower in side vineer grafts (Table 2).

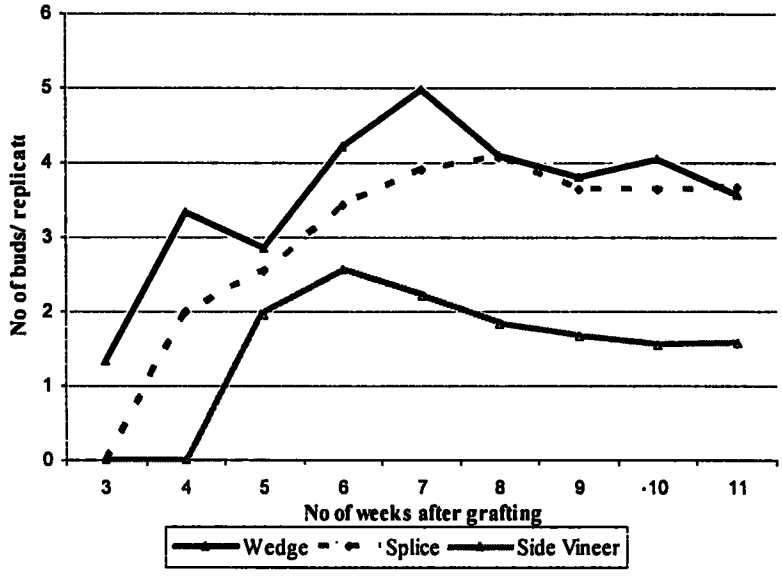


Figure 3. Number of buds in the wedge, splice and side vineer grafts.

Average shoot length

Average shoot length in the wedge and splice grafts was almost similar throughout the experimental period and the values were significantly higher than in the side vineer grafts (Fig. 4 and Table 2).

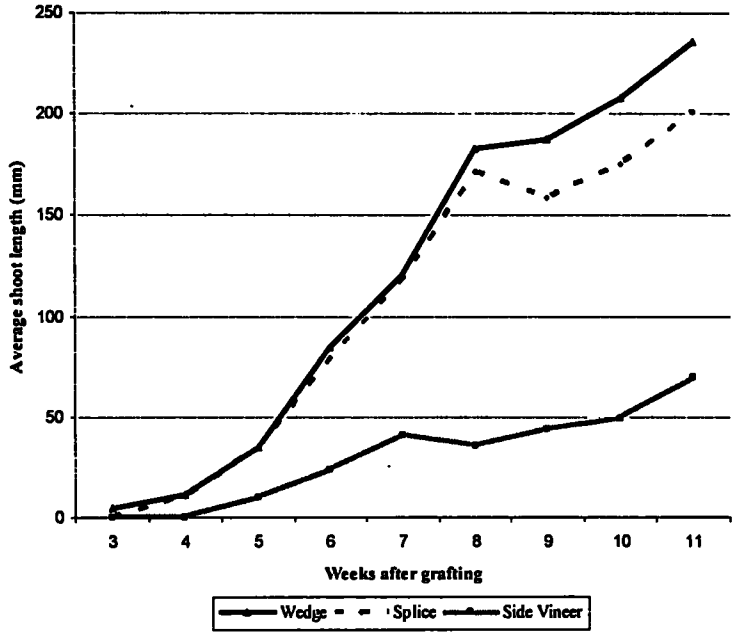


Figure 4. Average shoot length for the wedge, splice and side vineer grafts with time.

Leaves per shoot

Leaves are the sources of photosynthesis and the number of leaves produced from the scion may enhance growth and increase the assimilates. Figure 5 shows the number of leaves per shoot in the different grafts. It is evident that the wedge grafts produced leaves 3 weeks after grafting, while the side vineer grafts took 5 weeks. The leaves per shoot in side vineer grafts fluctuated drastically and the reason may be the continued growth of root stock. Wedge and splice grafts behaved in a similar manner. Differences in number of leaves per shoot between wedge and side vineer and that between splice and side vineer, were significant. Shoot growth showed no significant difference in the wedge and splice grafts (Table 2).

Number of leaves per graft

The effect of grafting method on number of leaves was recorded weekly (Fig. 6). Average number of leaves in the wedge and splice grafts were similar and significantly higher than in the side vineer grafts (Table 2). The low leaf production observed in the side vineer grafts may be due to the antagonistic effect of the growing root stock.

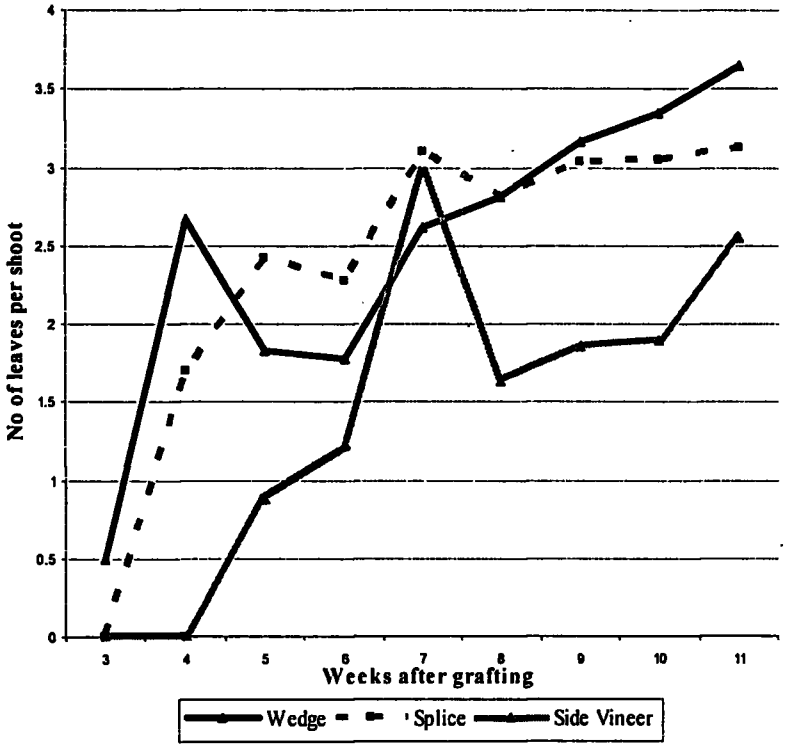


Figure 5. Leaves per shoot for the wedge, splice and side vineer grafts with time.

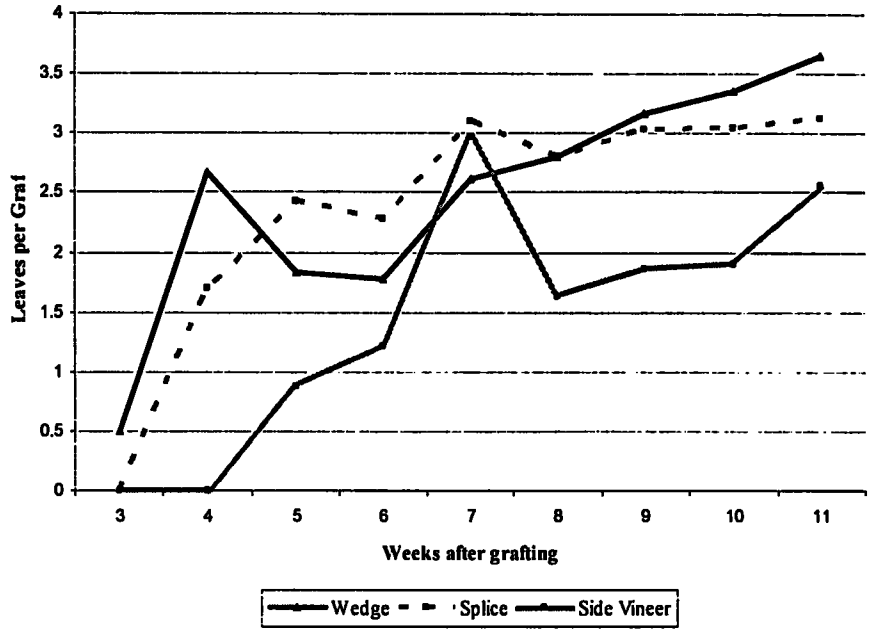


Figure 6. Leaves per shoot for the wedge, splice and side vineer grafts with time.

Table 2: Effect of the method of grafting on vegetative growth of beli.

Treatment	*No. of buds*	*Average shoot length*	*Leaves per shoot*	*Leaves per graft*
Wedge	3.5804 a	118.79 a	2.4852 a	9.9348 a
Splice	2.9922 b	105.40 a	2.3893 a	8.3863 a
Side Vineer	1.4863 c	30.19 b	1.4437 b	2.8667 b
LSD	0.5801	20.499	0.3605	1.5537

Means with the same letter are not significantly different at P=0.05.

Thus it may be generalized, that the vegetative growth parameters of the wedge and splice grafts, were similar, but significantly different to that of the side vineer grafts.

Hence for vegetative multiplication, wedge and splice grafting seem better methods than side vineer grafting. Comparing wedge and splice grafting, the former seemed a better method when considering percentage of successful grafts, growth performances and number of days taken to produce buds. Success of grafting depends on the compatibility between the root stock and the scion wood. The better performances of wedge grafting may be due to the close intact of the scion wood with the rootstock in wedge shape cut. The earliest bud activation in wedge grafting may be also due to the fast callus development and the quick cambial growth on close intact and the shape of the wedge grafting. This may enhance the quicker absorption and translocation of nutrients and water to the scion wood. This could result in quick bud initialization and vigorous vegetative growth. Splice grafting also makes a

close intact between the root stock and scion wood but this method is practically difficult owing to the shape of the cutting edge. In the side vineer method, growth of the scion wood is affected due to the active growth of the root stock.

CONCLUSIONS

Beli can be successfully propagated by wedge, splice or side vineer grafting methods. However, wedge grafting seems better with minimum days taken for initial bud take on and producing 86.7% successful grafts with vigorous vegetative growth.

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