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PROPAGATION OF SEEDLESS WAX APPLE (*Syzygium samarangense*)

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ABSTRACT

Wax apple (*Syzygium* spp.) shows distinct variations in fruit size and quality. Recently, superior forms have been identified at the Fruit Crop Research and Development Centre, Horana under the SL/USA germplasm development programme. As it bears seedless or low-seeded fruits, selection programmes have to be combined with development of appropriate propagation techniques. For perpetuation of seedless forms, identification of a compatible root-stock is also important. Therefore, studies were undertaken during 2000-2004 with the objectives of developing propagation techniques to multiply wax apple. Results of the study indicated that out of 2 species tested, S. *jambolana* was found to be the most promising root-stock for wedge grafting of wax apple with 93% success. Further, wax apple can be successfully raised from cuttings (10-15 cm long) taken from apical soft wood shoots, semi hard shoots and also from leafless hard shoots, grown in a non-mist propagator for 21 days (soft and semi hard) and 45 days (hard wood), with success rates of 72%, 70% and 72% respectively. Grafts and plants raised from rooted stem cuttings of all maturity stages and layered plants (the control) initiated fruits in about 30 months, 16-18 months, and 81/2 months after field planting, respectively. During the first year, a mean yield of 25, 18 and 16 fruits/plant was obtained from plants grafted to S. *jambolana* stems cuttings and layered plants respectively. Thus, in germplasm conservation programmes, wax apple can be multiplied by using S. *jambolana* as the root-stock and by means of stem cuttings.

KEYWORDS: Seedless, Wax apple, Propagation

INTRODUCTION

Syzygium spp. a native to Tropical South America and the Indo-Malaysian region, has become naturalized throughout many other regions of South East Asia. (Panggabean, 1992). The genus *Syzygium* comprises of several fleshy fruit bearing species, such as *S. aqueum* (rose water apple), *S. aimini* (Java apple), *S. malaccense* (Malay apple) and *S. samarangense* (Wax apple). Among them, due to its sweet taste and seedless nature, the wax apple has become the most popular *Syzygium* species in Malaysia, Australia and Central and South America in commercial cultivations and as a home-garden crop (Nakasone and Paull, 1998). In Taiwan, it is extensively grown as a commercial crop (Wang, 1989). Wax apple can be grown throughout the tropics and sub tropics, up to an elevation of 1200 m, on a variety of fertile soils with adequate soil moisture content.

Surveys carried out to identify different *Syzygium* species grown in home gardens in the wet zone region of Sri Lanka under S.L. /USA germplasm development programme, indicated that there are introduced types of wax apples (Anon., 2004). The fruit shows distinct variations in size,

quality characteristics and peel colour. There are promising accessions that could be developed as superior varieties (Plate 1).

Since wax apples are often seedless or very low seeded, multiplication on its own root stock is difficult and selection programmes have to be combined with development of efficient means of vegetative propagation techniques. *Syzygium* species can be propagated by approach grafting, inarching, forkett budding, veneer grafting and air layering (Singh, 2003). It can also be multiplied by bud grafting on to *S. pycnanthum*, *S. densiflora* and *S. jambos* (Nakasone and Paull, 1998). However, for the rapid multiplication of selected plants found in various locations in the country, the practice of air layering encounters certain practical difficulties as it is an *in-situ* method of propagation. No attempts have been made so far to identify a compatible and readily available root-stock plant for shoot grafting and also to multiply through stem cuttings, which is more convenient than air layering. Therefore, studies were undertaken at the Fruit Crop Research and Development Centre, Horana during May 2000-Jan 2004 to develop suitable techniques.

MATERIALS AND METHODS

Experiment I: Evaluation of suitable rootstock for wedge grafting

This experiment was carried out in a completely randomized design with 3 replications, having 10 uniformly grown seedlings per treatment. Two species, namely *S. jambolana* and *S. aqueum* were raised as rootstocks. When seedlings had a stem girth of 1.5-2.0 cm and were 20-25 cm high, they were wedge grafted at a stem height of 8-10 cm of the stock plant. A uniform set of 6-8 cm long scion shoots with apical buds was obtained from a mother plant. Grafted plants were enclosed in a 100-guage transparent sealed polythene bag with bottoms tied to serve as a propagator. Plants were uncovered 25 days after grafting. The success of the graft was recorded 3 months after grafting.

Experiment II: Propagation of wax apple by stem cuttings

Softwood shoots with terminal bud (green to slightly brown in colour), semi hardwood shoots and leafless brown hardwood shoots of 15-20 cm in length, having 4-6 leaf nodes with 1-1.5 cm stem girth were used as stem cuttings. The experiment was arranged in a randomized complete block design having 20 plants per treatment, with 4 replications. Three different types of cuttings (soft, semi hard and leafless brown hardwood) were established in pots (20 cm x 10 cm) containing a mixture of coirdust, well-rotted cow dung, topsoil and sand (1:1:1:1). Just after planting, they were kept in a non-mist polythene propagator. Ten plants of each set were taken out of the propagator at 3 weeks and 6 weeks after planting. The number of rooted cuttings (%) was recorded at 3 months after potting. Data was transformed by

square root transformation and subjected to ANOVA, and the means were separated using new DMR test.

Experiment 111: Evaluation of growth and yield of vegetatively propagated plants

Plants raised from mature apical green cuttings, semi hardwood, hard wood cuttings and grafts of *S. jambolana* along with air layered plants (control), each containing 4 plants, were established in the field to assess growth, development and fruit yield. Plant height and canopy spread were recorded 12 months after field planting. The time taken to first fruiting and number of fruits formed during the first fruiting year were also recorded.

RESULTS AND DISCUSSION

Suitability of root-stock

Of two species tested for root-stocks, *S. jambolana* formed good unions with wax apple, with 93% of graft success, whereas, *S. aqueum* did not show any success (Table 1).

Table 1. Percentage graft take on wax apple wedge grafted on two different root-stocks.

Root stock	*No. of grafts*	*No. of successful grafts*	*Success (%)*
S. jambolana	30	28	93
S. aqueum	30	0	0

Since wax apple does not bear seeds, *S. jambolana* can be considered as an alternative source of root-stock for grafting of wax apple. Researchers have reported variable success of wax apple bud grafted to *Syzygium* species rootstocks. Among them, Nakasone and Paull, (1998) indicated that wax apple plants can be raised by budding to *S. pycnanthum* (wild rose apple) (Argles, 1976). Ninety percent success was obtained when wax apple was forkett budded to *S. densiflora* in India. Budding was done with 11-12 month old stock plants and budwood with petioles intact. Even though Argles (1976) reported that budding wax apple on seedlings of *S. jambolana* and guava *(Psidium guajava)* was unsuccessful, results of the current experiment revealed that wax apple could be successfully wedge grafted on *S. jambolana.*

Rooting of stem cuttings

Success of rooting in both soft and semi hardwood cuttings was significantly ($p=0.05$) higher than that of leafless hardwood cuttings kept for 21 days in the propagator. There were no significant differences in rooting ability when these cuttings were kept for 45 days (Table 2).

Table 2. Effect of stage of maturity of wax apple stem cuttings (grown in non-mist propagator for 21 days and 45 days), on rooting (mean of 10 stem cuttings).

Type of stem cuttings	*Time period in propagator (days)*	
	21	*45*
Soft wood	72.5 [a]	87.5
Semi hardwood	70.0 [a]	82.5
Leafless hardwood	15.0 [b]	72.5
		ns*
CV%	8.42	5.11

* Not significantly different at p = 0.05.
Means followed by the same letter are not significantly different at p =0.05.

However, leafless hard wood cuttings also recorded high percentage of rooting (72%) when kept for 45 days, than at 21 days in the non-mist propagator (Table 2). Leafy, soft apical portion and medium wood cuttings with actively growing apical and auxiliary buds may provide auxins and soluble carbohydrates required for callus formation resulting in rapid root initiation, whereas, leafless lignified firm wood cuttings may contain complex insoluble assimilates which were gradually converted to soluble forms when necessary requirements are provided. This results in the formation of new shoots that may provide necessary growth hormones for root initiation. This may be the cause for delayed rooting in hardwood cuttings. In wax apple, no attempts have been made to raise plants from cuttings. However, *S. malaccense* (Malay apple) can be propagated by firm wood cuttings planted in sandy soils at 13°-24°C (Argles, 1976). He further suggested that rooting of semi hardwood cuttings under mist or in humid, closed environment, is high due to its glossy leaves. In India, 20% rooting of semi hardwood cuttings of *S. jambos* was obtained by treating with 1000ppm NAA (Saha, 1969).

In contrast to the above findings, results of the current experiment revealed that wax apple can successfully be propagated by apical soft wood and semi hardwood cuttings kept under non mist propagator for 3 weeks without any hormone treatment. Similarly, rooting of hardwood cuttings can be achieved by planting in non mist propagator for 6 weeks (Plate 2).

Growth and initial yield characteristics of wax apple plants raised through different methods of propagation

Wedge grafted plants to *S. jambolana* formed evenly grown graft unions with satisfactory vegetative growth by 12 months after establishment. Furthermore, grafts initiated (with a mean of 25 fruits) 30 months after planting (Table 3). Thus, this species of *Syzygium* was found to be a compatible rootstock with wax apple (Plate 3).

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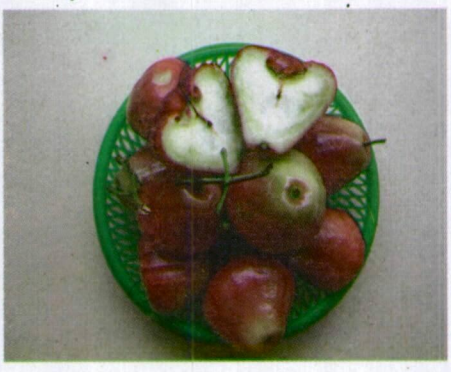

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Plate 1. Two promising accessing of wax apple.

Plate 2. Rooted stem cuttings of soft wood, semi hardwood and hardwood (from left to right).

Plate 3. A wax apple graft on S. *jambolana* in bearing.

Table 3. Growth and yield performance of wax apple (*S. samarangense*) plants raised from grafts and different types of stem cuttings (mean of 4 plants).

Method of propagation	*Plant height (cm) at 12 MAP**	*Canopy spread (cm) at 12 MAP*	*Duration for 1st fruiting (months)*	*No. of fruits formed in 1st fruiting year*
Grafts on *S. jambolana*	70.5^{b}±4.6	68.9^{b}±4.6	30.6±0.5	25±2
Cuttings				
Apical softwood	85.6^{b}±3.8	71.8^{b}±3.8	15.1±0.3	18±2
Semi hardwood	82.7^{b}±5.3	72.2^{b}±4.9	15.3±0.1	15±3
Hardwood (leafless)	81.4^{b}±5.0	60.7^{b}±1.8	18.2±0.1	22±1
Air layering	113.8^{a}±2.7	94.1^{a}±7.4	10.5±0.1	16±2
C.V.%		10.94 14.15		

Means followed by the same letter in each column are not significantly different at p=0.05
*MAP – Months after planting

Both plant height and canopy spread of plants propagated through rooted stem cuttings of all three maturity stages and plants raised from grafts on *S. jambolana* were not significantly different 12 months after planting (Table 3). With respect to fruiting behavior, stem cuttings initiated fruits 15-18 months after establishment, irrespective of the maturity stage. In contrast to above findings, Shu *et al.* (1994) reported a 3-7 year juvenile period in wax apple.

Considering all the treatments, layered plants showed the highest plant growth and early first fruit set of 10 1/2 months after planting (Table 3). This is due to the use of well developed, large sized shoots of 45-60 cm in length for layering in contrast to 15-20 cm long shoots taken for grafting and as stem cuttings. However, plants raised from all types of cuttings and layers (the control) produced almost similar number of fruits (18 and 16 fruits per plant, respectively), in their first fruiting season (Table 3). As such, in addition to air layering (which has a mean rooting success rate of 76%), wax apple can successfully be propagated through stem cuttings of all soft, semi and hard wood portions.

CONCLUSIONS

S. jambolana was found to be a compatible root stock for wedge grafting of seedless wax apple (*S. samarangense*) with 93% success. Furthermore, it can be successfully propagated by stem cuttings (15-20 cm in length, having 4-6 leaf nodes) of apical, soft, semi hard and hardwood (leafless), grown in a non-mist propagator for 21 days (soft and semi hard) and for 45days (hard cuttings), with success rates of 72%, 70% and 72% respectively. Plants raised from grafts and stem cuttings of all 3 maturity stages showed significantly similar vegetative growth, and initiated fruits by 2.5 years and 1.25-1.5 years after establishment and produced a mean initial yield of 25 and 18 fruits per plant during their first fruiting year. Even though

layered plants (the control) initiated fruits early, yield of the first year was almost similar. Therefore, wax apple can be multiplied by using *S. jambolana* as the root- stock and by means of stem cuttings.

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