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Review Article

Asexual Propagation Techniques: Novel Approach for Raising Quality Planting Material of Guava

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Abstract

The greatest handicap in guava plantation is discriminate multiplication and non-availability of quality planting material that adversely affect the guava production and productivity. The initial planting material is basic requirement on which the final crop depends both in quality and quantity. In view of the high return and the potential for processing, there is a tremendous scope for bringing substantial additional area under guava crop in India. Therefore, rapid methods of propagation become very important when planting materials are limited due to scarcity of clone or varieties or due to sudden expansion in acreage. Thus, it has become imperative to standardize the time and propagation methods for guava under open conditions. A comprehensive work done in India and abroad on propagation studies in guava have been reviewed under different techniques for guava propagation.

Keywords : Guava; Propagation Techniques; Quality Planting Material.

Introduction

Guava (*Psidium guajava* L.) belonging to family Myrtaceae has originated in tropical South America (Pathak and Ojha 1993). It is considered to be one of the exquisite, nutritionally valuable and remunerative crop. Besides its high nutritional value, it bears heavy crop every year and gives good economic returns (Singh *et al*., 2007). The tree is fairly salt and drought-resistant and can be grown on a variety of soils. This has prompted several farmers to take up guava orcharding on a commercial scale (Singh *et al*., 2003). In recent years, guava is getting popularity in the international trade due to its nutritional value and processed products (Singh, 2005). Guava exceeds most other fruit trees in productivity, hardiness and adaptability. The fruits are used for both fresh consumption and processing and has great market potential due to their delicious taste and aroma. The fruits after removal of seeds may be utilized to make products such as jam, jelly, cheese, juice, canned segments, nectar etc. They are used mostly for squashes and juices, however the most commercial use of guava is for jelly preparation due to good source of pectin (Adsule and Kadam, 1995).

In view of the high return and potential for processing there is tremendous scope for bringing substantial additional area under guava crop in India as well as with the changing horticultural scenario in India, demand of genuine planting material has been increased tremendously. Demand of planting material has encouraged establishment of a large number of nurseries to cater the acute shortage of quality planting material. Non availability of quality planting material and consequent substitution of poor quality seedling has adversely affected the guava production and productivity (Singh *et al.,* 2005). Therefore, rapid and successful propagation technique is required to meet the requirement of

quality planting material of guava throughout the year. While, choosing a particular technique for propagation of guava, the time of operation and method should be taken into consideration. As the success of each method vary from region to region due to variation in agro climatic conditions. Any particular method which may be successful at one place may not prove useful at other. Similarly, a particular method successfully adopted will vary from place to place due to environmental factors such as temperature, relative humidity etc.

Guava is multiplied by many methods of propagation and different degree of success have been achieved by various propagation techniques viz., 93.3% with patch budding (Kumar *et al*., 2007), 77.33% with wedge grafting (Gurjar *et al*.,2012), 71.22% with cuttings (Rahman *et al*., 2003) and 83.15% rooting success with air layering (Rymbai and Reddy, 2010). Propagation by patch budding, wedge grafting, air layering and cutting have been attempted by various investigators (Samson, 1986) and are presented below.

Propagation by Patch Budding

Pandey *et al*. (1979) reported that swollen buds gave better bud take than dormant buds and patch-budding showed highest (90 percent) bud take in May as compared to chip budding performed during April to August in guava. Similarly, Mehrotra and Gupta (1984) revealed that the highest (70.12 percent) success in patch budding of guava was obtained when seedlings were budded during May. Results of Rao *et al.* (1984) revealed that July and August months were optimum time for budding of guava where maximum success of 74 percent in patch budding during July and 62 percent in August with forket budding were obtained. Similarly, Gupta and Mehrotra (1985) obtained highest (82.50 percent) patch budding success in May which was closely followed by 80.00 percent success in June where, the patch budding success in May and June was significantly better than that from April to September. Kaundal *et al.* (1987) obtained maximum success (87.50 percent) in patch budding during May as compared to shield budding performed at monthly intervals from April to September. Results of Aulakh (1998) showed highest (95.60 percent) percentage of successful survival of plants in guava when patch budding was performed on 14th June. Singh and Pandey (1998) reported that the best time for budding in guava was July.

Results of Patel *et al.* (2005) revealed that in patch budding highest (84.08 percent) success and minimum number of days (27.67) for sprouting in cultivar Allahabad Safeda was observed when budding was performed on seven guava cultivars in the month of February-March.

Kumar *et al.* (2007) conducted an experiment at ZRSKA, Ballowal, Saunkhri during 2005-06 on guava to standardize time of patch budding under the rainfed conditions in lower Shivaliks of Punjab and reported maximum (93.30 percent) success in mid June patch budding and observed minimum number of days (18.0) were required for bud sprouting in mid June.

Results of Babu and Yadav (2007) showed that the response of guava to patch budding during third week of February, was found to be excellent with respect to time taken for bud-take (18 days), percent bud sprout (95 percent) and survival percentage (90.0 percent) at two months after patch budding. Similarly, Patel *et al.* (2007) reported highest (84.08 percent) patch budding success and minimum (27.67) number of days taken for sprouting in guava cultivar Allahabad Safeda during February-March. Babu *et al.* (2009) conducted an experiment on budding at the experimental farm of the Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2004 and 2005. Budding was practiced in both white flesh (Hybrid-1, Selection-11, Allahabad Safeda and Lucknow-49) and red flesh (Selection-1 and hybrid-4) genotypes.To fix the appropriate method of budding for vegetative/ clonal propagation of guava, two budding methods viz., patch budding and shield budding were tried out during the third week of January 2004 and 2005 where it was revealed that patch budding was superior over shield budding for per cent bud sprout.

Results of Mehrotra and Gupta (1984) recorded maximum (20.5 cm) sprout length with patch budding in June. Gupta and Mehrotra (1985) in their study of patch budding recorded that highest (22.7 cm) shoot length was obtained in May. Similarly, Kaundal *et al.* (1987) while, comparing patch and shield method of budding recorded maximum (25.26 cm) budling length in May with patch budding which was significantly greater than the budling length in case of patch budding done in August (10.79 cm) and September (5.29 cm). Aulakh (1998) reported that maximum (46.6 cm) shoot length was obtained on 14th June. Kumar *et al.* (2007) reported maximum (14.9 cm) shoot length and number of leaves (12.7) in patch budded guava plants. Patel *et al.* (2007) reported maximum (36.89 cm) length of sprouts, number of leaves/plant (29.67) and leaf width (5.59 cm) with patch budding in cultivar Allahabad Safeda among different cultivars of guava under mid hills of Meghalaya.

Sohnika *et al*., 2015 reported that among all propagation methods, patch budding performed during 15 to 21 August under Jammu sub-tropics showed highest per cent success (92.07%) recorded after 90 days of propagation.

Propagation by Wedge Grafting

Patil (2004) reported that maximum success was achieved through wedge grafting (91.6 percent) in mid- August among all propagation methods and mid-August wedge grafting took minimum days to sprout. Results of Singh *et al.* (2007) revealed that maximum success of wedge grafting was obtained in greenhouse (88.63-94.33 percent) as well as in open field conditions (66.6-78.63 percent) during November to February in guava (*Psidium guajava* L.) cultivars Allahabad Safeda and Sardar. Similarly, Visen *et al.* (2010) reported that wedge grafting has tremendous potential for multiplying plants rapidly either in greenhouse or open conditions in guava (*Psidium guajava* L.) and obtained maximum (81.71 percent) success of wedge grafting in greenhouse during September and December. Singh *et al.* (2011) reported wedge grafting success ranging from 28-99 percent being maximum (99 percent) in guava cultivars in the month of February in open field conditions.

Syamal *et al.* (2012) carried out an investigation during 2009 at the Banaras Hindu University, Varanasi where Wedge grafting performed on Allahabad Safeda (V1), Lucknow-49 (V2) and Allahabad Surkha (V3) during four months, viz., July (M1), August (M2), September (M3) and October (M4) under polyhouse as well as in open field conditions and was revealed that wedge grafting in the month of July gave better result in polyhouse (77.17 percent) when in open field condition (66.43 percent). Similarly, Gurjar *et al*. (2012) reported that wedge grafting in guava showed maximum bud bursting percentage in the month of Ist November in polyhouse and open field condition (67.65 percent) in the month of 1st February. The maximum graft survival percentage was recorded in the month of 1st January in poly house (94.08 percent) and open field condition (77.33 percent) in the month of January.

Joshi *et al*., 2014 carried out an experiment during 2010-11 and 2011-12 at BHU, Varanasi where minimum number of days taken for sprouting of buds was recorded in the treatment combination Local guava rootstock + wedge grafting with polycap under polyhouse during February (9.17 days), July (9.70 days) and November (12.56 days) months. However, the bud took maximum time for sprouting in treatment L-49 rootstock + shield budding under open conditions when propagation was done during November (39.16 days). The experiment was repeated during 2011-12, almost similar trends were observed. Earlier sprouting of bud was observed in polyhouse as compared to open field conditions. This might be due to the fact that under polyhouse conditions creation of high humidity around bud scions reduced the desiccation of active tissue of scion bud as compared to open field conditions. Similarly, the maximum sprouting was also recorded in the treatment combination local guava seedling rootstock + wedge grafting with polycap under polyhouse in November (96.08%), February (93.95%) and July (91.13%) followed by local guava rootstock + wedge grafting under polyhouse. However, minimum sprouting was recorded in the treatment L-49 rootstock + shield budding under open conditions when propagation was done during February (49.08%), July (55.59%) and November (45.98%) during 2010-11.

Propagation by Cuttings

Kilany and Gabr (1986) reported that rooting in hardwood cuttings of guava was very poor (1.67-4.67 percent only), it ranged from 18.3 to 57.5 percent in leaf-bud cuttings and was highest (81.4 percent) in semi-hardwood cuttings treated with 2500 ppm IBA + 10 ppm á-naphthol planted during September in a 1:1 mixture of sand and peat moss. Rahman *et al.* (1988) revealed that leafy tip cuttings of guava gave 90.11 percent, 94.44 percent and 94.44 percent rooting treated with 3, 6 and 12 ppm paclobutrazol, respectively, after six weeks of planting in July-August whereas, no rooting was observed in control.

Rahman *et al*. (1991) reported that 10-12 cm long guava tip cuttings with at least 4 leaves, dipped in paclobutrazol for 24 hours and planted between mid June and end of September in sand under unheated greenhouse with 78-80 percent RH and natural light conditions gave the highest (94 percent) rooting percentage in mid-August planting.

Manan *et al*. (2002) reported highest per cent success (51.24 percent) in guava cuttings treated with IBA at 500 ppm. Rahman *et al*. (2003) observed maximum (71.22 percent) sprouting per cutting within 17.68 days in softwood cuttings treated with 1000 ppm NAA in the month of August. Results of Ayaz *et al*. (2004) revealed that treatment of guava cuttings with 60 ppm paclobutrazol resulted in maximum (73.3 percent) cutting success in fresh softwood cuttings of guava having 3-4 leaves.

Ullah *et al*. (2005) reported maximum (71.22

percent) sprouting in softwood cuttings of guava cv. Allahabadi treated with paclobutrazol in August. They observed more number of branches (3.44), maximum root weight (1.46 g) and better survival (57.22 per cent) in softwood cuttings of guava treated with paclobutrazol at 1000 ppm solution in August. Maximum number of roots (59.66) and lengthy shoot (8.24 cm) were recorded in soft wood cuttings of guava treated with IBA at 1000 ppm in August. Similarly, Abdullah *et al*. (2006) revealed that the guava species is amenable for clonal propagation by mature stem cutting and recorded maximum number (32.7) of primary roots in guava cuttings treated with 0.8 per cent IBA solution which was followed by 0.4 per cent IBA treatment and lowest (58.3) was in cuttings without IBA treatment. The highest (60 percent) rooting percentage was observed in the cuttings treated with 0.4 percent IBA solution which was followed by rooting in cuttings treated with 0.2 percent IBA.

Marinho (2009) reported that fourty day after planting, 76 percent of the mini cuttings rooted and emitted aerial part and thirty-five days after been planted, these mini cuttings, with average length of 13.56 mm, presented 100 percent of rooting. Kareem *et al*. (2013) reported that softwood cuttings of guava treated with IBA 4000 ppm gave maximum (92.17 percent) survival percentage of plants which was followed by 85.50 percent with IBA 2000 ppm in month of August. Similarly, Rahman *et al.* (2003) revealed that softwood cuttings of guava treated with paclobutrazol gave good performance as compared to IBA and NAA in August. They obtained more branches (3.44), maximum root-weight (1.46 g) and more number of branches (3.44) in softwood cutting treated with paclobutrazol at the 100 ppm solution while, maximum (59.66) number of roots and lengthy shoot (8.24 cm) was recorded in softwood cuttings treated with IBA at 1000 ppm. Similarly, early sprouting (17.68 days) and maximum root-length of 12.81 cm was observed in softwood cutting, treated with NAA at concentration of 1000 ppm.

Results of Ayaz *et al*. (2004) revealed that 60 ppm paclobutrazol resulted in maximum rooting (69.5 per cent), shoot length (24.3 cm), number of branches (4.3), number of roots (87.1) and root volume per plant (1.64 cm^3) in fresh softwood cuttings of guava having 3-4 leaves. Among various dipping period five hours dipping resulted in maximum rooting (30.1 per cent), shoot length (10.6 cm) and number of roots (47.2), while, four hours dipping resulted in the maximum number of branches (2.6) and root volume per plant (1.05 cm^3). The highest number of (23.75) roots was recorded in the cuttings treated with IBA at 4000 ppm and significantly maximum root length (4.13 cm) was noted in the cuttings treated with IAA 3000 ppm in April (Wahab *et al.*, 2001). Sohnika *et al*., 2015 under Jammu sub-tropics reported that the time of propagation, soil media and their interaction had a significant effect on percentage of rooted cuttings of guava they observed that after 90 days of planting highest (78.69 per cent) success was recorded in vermiculite + sand + FYM (1:1:1) during 15th-21st of August.

Propagation by Air Layering

Sharma *et al.* (1991) revealed that air layering carried out on 10th July resulted in the highest (67.70 percent) per cent success as compared to air layering performed on 10th July, 25th July or 10th August on eight year-old guava tree. Singh *et al*. (1992) reported highest survival (75.63 percent) with 75 per cent defoliation followed by complete defoliation (64.18 percent) in air layers of guava at 45 and 120 days after planting in the field. Bhagat *et al*. (1999) reported highest rooting (94.67 percent) and survival (78.33 percent) in air layers of guava when treated with 4500 ppm IBA.

Results of Rymbai and Reddy (2010) revealed that high percentage of rooting and root characters of air layers of guava have been successfully achieved by exogenous application of IBA at 4000 ppm and air layering performed on 15th August gave maximum rooting success (77.94 percent). Rymbai and Reddy (2011) carried an experiment during 2008- 09 and reported that highest (77.94 percent) rooting was obtained in 15th August air layering of guava and showed a possibility of obtaining good quality planting material using air layering (at 15th June, 15th July and 15th August).

Kumar and Syamal (2005) reported that IBA at 3000 ppm recorded the length (11.30 cm) of primary roots per air layer, average number of secondary roots (10.72) while, IBA at 4000 ppm recorded the highest value for diameter of roots (2.30 mm). Results of Sharma *et al.* (1991) revealed that treatment of air layers with 10000 ppm IBA resulted in the highest number, length, diameter and weight of roots after carrying out air layering on 10 July, 25 July or 10 August in 1990 on eight-year-old guava tree. Patel and Pasaliya (1995) reported that NAA at 9000 ppm applied immediately after ringing gave the highest number of primary and secondary roots and heaviest root fresh and dry weights when IBA, NAA or IAA at 3000, 6000, 9000 ppm was applied after ringing or 10 to 20 days later on rooting in air-layered shoots of guava cv. Lucknow-49. Athani *et al*. (1999) reported that longest (11.15 cm) root length was noticed in cultivars GW-1 and GR-2, SR-1 has the

shortest roots (2.8 cm), CIW-4 had the highest number of roots (12.3) and SR-3 had the lowest number of roots (1.0) when air layering was performed in guava cultivars. Patel *et al*. (2005) reported that maximum (36.89 cm) length of sprout, leaves/plant (29.67) and leaf width (5.59 cm) were recorded in Allahabad Safeda while, maximum rootstock girth (3.82 cm), sprout girth (2.71 cm) and leaf length (10.95 cm) were recorded in cultivar hybrid-1 among air layered seven cultivars of guava.

Sarkar and Ghosh (2006) reported that air layers of guava prepared during June and July showed maximum number of primary and secondary roots in alluvial zone. Results of Rymbai *et al*. (2012) revealed that maximum number of primary and secondary (1.80 + 22.44) roots, length of longest (10.78 cm), fresh (2.72 g) and dry (0.51 g) root weight, establishment percentage (83.33 per cent), number of leaves (6.67) at 45 days after transplanting (DAT) and (13.83) at 60 DAT and minimum (8.67) number of days for buds sprouts were recorded in air layered plants of guava during 2008-09. Ghosh and Ranjan (2005) reported that air layering in September, October and November resulted in highest (85 percent) rooting success when performed on the 10th of each month from January 2001 to December 2002 in guava cv. L 49.

Socio-Economic Impact of the Study

In view of increasing costs of labour and inputs, farming has become less remunerative. Today, farmer is in search of new alternative, especially when several incentives under Horticulture Mission and export promotion are provided by the Government. Fruit plants yield much higher than ordinary field crops and are certainly far more remunerative. Healthy and good quality plant material is the foundation of successful fruit industry in the country. The maintenance of purity is easy in vegetatively propagated fruit crops as compared to seed propagated ones, still it requires a close monitoring at different stages in the nursery to avoid mixing with other varieties. Due to lack of standard propagation technique farmers generally prefer to raise guava plants through seeds which does not give true to type planting material and they do not get good remuneration from their produce. These studies revealed that there is great potential of propagation by vegetative techniques in guava for nursery stock production of commercial scale. The selection of appropriate site adapted phenotypes and elite genotypes with excellent fruit bearing and flesh quality and manipulation of cultural environment are important to improve the quality of planting stock for optimum gains. Further the propagation technique of nursery stock production is simpler and cheaper and can be used even by unskilled nursery growers. Hence the standardization of method of propagation will facilitate the large scale multiplication of genuine planting material by farmers, which will help the farmers to fetch good price in market thus raising their socio-economic condition.

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