EFFECTIVE PROPAGATION TECHNIQUE AND TIME OF GRAFTING / BUDDING IN BER (*ZYZYPHUS MAURITIANA* LAMK.)

Naseem Sharif, Javaid Iqbal Gill, Malik Mohsin Abbas, Muhammad Afzal Javaid* and Noor-ul-Nisa Memon**

ABSTRACT

A study was conducted to assess best asexual propagation method and time in ber at Horticultural Research Institute AARI, Faisalabad, Pakistan during 2010-12. Attempts were carried out through T-grafting and T-budding during seven different months of year i.e. February, March, April, May, June, July and August. The results on different parameters showed that maximum success percentage (99.15%), survival percentage (96.23%), number of leaves (120.33), circumference of scion (8.34 cm), higher number of scion shoots (7.33) and maximum number of roots in rootstock (69.333) were noted in T-grafting during first week of May. It was also concluded that T-grafting proved comparatively to be more successful in all propagation seasons than T-budding. The study provided useful information on selecting best time and propagation method for asexual multiplication of elite germplasm of ber for developing commercial nurseries.

KEYWORDS: ***Zyzyphus mauritiana*** **lamk; asexual propagation; T-budding; T-grafting; grafting time; pedigree plants; ber; Pakistan.**

INTRODUCTION

Ber or Indian jujube (*Zyzyphus mauritiana* Lamk.) belonging to family *Rhamnaceae* is one of the hardy minor fruit crop suitable for successful cultivation in both arid and semi arid conditions (9). Ber is widely grown in many parts of the world including Australia, India, China, Pakistan, Australia, Syria, Nepal and Afghanistan. World documented species distribution shows that it is exotic in Ethiopia, Mozambique, Philippines, Sudan, Zambia and Mauritania. China has world's largest market of jujube, and Chinese people use it as traditional medicine. It is rich source of vitamins B complex, vitamin C, vitamin A and many essential minerals. (19). It is an excellent source of vitamin C and this need can be fulfilled by adding three ber fruits in

***Horticultural Research Institute, AARI, Faisalabad, **Department of Horticulture, Sindh Agriculture University, Tandojam, Pakistan.**

daily diet (7). Naturally ber is produced through seed, but reproduction through seed cause heterzygosity due to cross pollination (2). True to type plants cannot be produced in this way. Like other cross pollinated fruit crops, vegetative propagation is highly desirable in ber. Ber plants produced through seeds cannot be used directly for plantation in orchards as seedlings produce fruit very late (6 to 7 years) as compared to vegetative propagated plants which bear fruits within three to four years. Desirable (growth, fruit yield and quality) of newly introduced ber germplasm can be preserved through asexual propagation only.

For obtaining true to type plants, ber seedlings are produced in nurseries by sowing seeds in seedbeds, polythene bags or polythene tubes. Quality of plants in nursery is prerequisite for planting successful orchard. Any plant which looks healthy and vigorous in nursery does not mean a quality plant, until it does not survive and establish well in orchard. (6). Conventional vegetative methods like cutting or layering are not successful in ber. Budding and grafting are major methods for propagation in ber and can be successfully carried-out under appropriate conditions. Success ratio of asexual propagation depends on appropriate time, suitable methods, climatic conditions and person expertise (4). Ber comes under neglected and underutilized fruits, but with passage of time many new cultivars have been introduced which fetch high market price and have export potential as well but problem is scarcity of good quality nursery plants.

For establishing new ber orchards demand of grafted ber plants is increasing but only few nurseries supply ber plants which have low survival percentage in field. Considering the commercial value and cultivation potential of this underutilized fruit. There is a dire need to standardize a technology for vegetative propagation. So that true to type plants may be produced and certain characters of any variety may be preserved and multiplied.

Present study was designed to compare different vegetative propagation methods and seasons to find out most effective method and time for farmers and nursery growers.

MATERIALS AND METHODS

This study was carried out in Horticultural Research Institute AARI, Faisalabad, Pakistan during 2010-2012. Ber seeds of Gohr variety locally called Desi ber or Katha ber *(Zyzyphus rotundifolia)* were sown at a depth of 2-3 cm at 30 cm x 30 cm spacing in seedbed. These varieties were allowed

to grow until these attained pencil thickness. One year old healthy and uniform root stocks were selected for grafting and budding operations. The one season old scion shoots (cv. Suffon) of pencil thickness free from pest and diseases were selected for scion purpose. The scion sticks were detached from mother tree on the day of grafting and budding. The equipment used for grafting included clean sharp budding knives, secateurs and polyethylene tape. Two propagation methods T-grafting (P_1) and T-budding (P_2) were used during first week of seven months of year i.e. from February to August and meteorological data during this period was recorded (Table 1). The observations on percent graft success and number of days taken to sprout were recorded on weekly basis after budding and grafting operations. Data on survival percentage, was recorded three months after propagation, while other parameters like number of leaves, scion sprout length (cm), scion circumference (cm), number of roots in rootstock and number of scion shoots were measured one year after propagation, when plants were ready to transplant in field. All 60 grafts were prepared each month, 30 for T-grafting and 30 for T-budding, considering ten grafts per replication in factorial randomized complete block design. Length of sprouted scion was recorded by using measuring scale from base to terminal end of sprout. Circumference of scion was measured using digital vernier calliper (cm) at the base of sprouted shoots. Following methodology was used to bud and graft ber plants.

Table 1. Metrological data of experimental area for ber propagation during 2011 and 2012.

	February	March	April	May	June	July	August
Mean maximum temperature (°C) 2011-2012	23.30 21.80	27.2 28.80	33.8 32.80	34.00 33.40	40.70 39.20	36.2 39.10	35.00 36.70
Mean minimum temperature (°C) 2011-2012	7.60 9.10	20.5 13.20	16.3 15.30	19.70 19.50	25.20 27.00	27.40 27.40	26.21 27.00
Average relative humidity % 2011-2012	93.00 64.00	85.00 58.0	47.00 45.00	45.00 46.00	40.00 41.00	58.80 56.00	64.00 65.00
Rainfall (mm) 2011-2012	6.2 26.80	6.90 6.00	18.00 19.50	6.00 34.40	52.00 20.00	300.00 164.4	22.00 240.00
Total sunshine hours 2011-2012	179-25 153-05	277-05 269-0	283.8 277-10	240-52 250-50	256-45 256-45	214-15 219.57	210-20 203-20

Source: Observatory of plant physiology AARI, Faisalabad

T-budding: T-budding was performed at an area of 16 cm from ground level. A vertical cut through the bark at about 1.5 inches on selected area was made and then cut horizontally to form a T with the vertical cut. Scion buds from the bud stick was removed in one smooth stroke for insertion into the cuts made on the rootstock. Polyethylene was wrapped to cover the graft

portion. Top of the seedling rootstock was removed when growth of bud occur (11).

T-grafting: Leaves of scion sticks were removed without damaging the buds and slanting cut was made at lower end of the scion stick. The length of scion stick was made 18-20 cm long. A T-shaped cut was made in stock bark to insert scion stick. It was firmly wrapped with polythene tape. Lopping and topping of rootstock from 8 to 15 days after budding and grafting in the nursery beds was practiced to ensure maximum success percentage (18).

RESULTS AND DISCUSSION

Graft success

The results (Fig.1) showed that T-grafting performed in first week of May gave maximum success percentage (99.15%) followed by T-grafting performed in first week of April (89.89%). Minimum success percentage was found in T-budding performed in first week of August (26.74%). Favourable climatic conditions in the month of May might be due to mean maximum and minimum temperature i.e. 34°C and 19°C respectively (Table 1) with 45-47 percent average relative humidity promotes growth of cambium cell. New callus is initiated from the cambium tissue consisting of thin walled cells, sensitive to high temperature and low humidity. Graft union success highly depends on suitable environmental conditions (10). Kaundal *et al.,* (14) recorded maximum success for bud wood union (80-87%) in 30-34°C temperature ranges with high changes in atmospheric relative humidity (45 to 73.5%). Similar results have also been recorded by Jose and Valasalakumari (13) in jackfruit. Madalageri *et al*. (17) reported propagation in Jamun (that is also perennial fruit tree, surviving in subtropics, have tap root system also reported 97.5 percent success by T-grafting during the month of May. The results are also in line with the of Desai (8) who reported grafting success in Jackfruit in May (69.33%) followed by April (56.0%). Chovatia and Singh (5) also reported that grafting method in mango and jamun proved superior to budding when it was performed in May.

Survival percentage

The data showed that T-grafting performed in first week of May had significantly higher survival percentage (96.23%) followed by T-grafting performed in first week of April (82.18%) (Fig.2). Minimum survival percentage (19.58%) was observed in T-budding performed in first week of

August. These findings may be due to swelling of axillary and apical buds which resulted in easy healing of graft union, growing better growth during May as compared to healing up of bud union. Higher success of survival percentage in Sapota was recorded during January to July under Dharwad conditions by Madalageri *et al.* (16) and Pampanna *et al.* (23). These results are also in line with Singh and Sen (25) who recorded maximum survival percentage (upto 95%) in ber grafts.

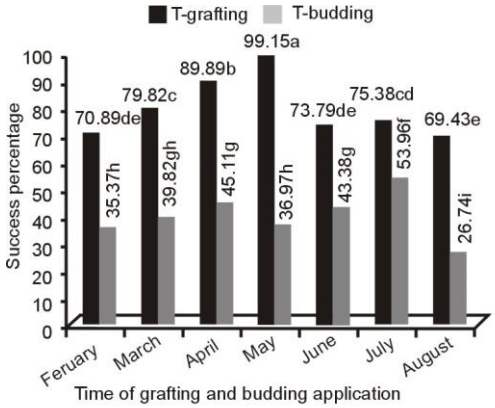

Fig. 1. Percent graft success in ber after propagating through T-grafting and T-budding in different months of year.

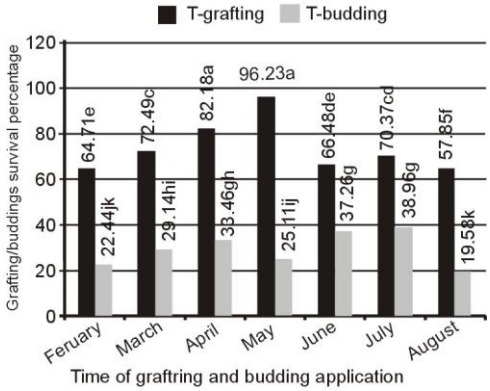

Fig. 2. Survival percentage in ber after propagating hrough T-grafting and T-budding in different months of year.

Days taken to sprout

The time taken for initiating new growth (sprout) by budding and grafting showed significant results. It was noted that union was established earlier in T-grafting as compared to T or shield budding. Minimum number of days (14.33) were taken to sprout when T-grafting was performed during first week of May followed by T-grafting in first week of April (18.66). Maximum number of days were taken to sprout when T-budding was performed during first week of May (56.00) and April (53.0) (Fig. 3). It may also be due to unfavourable climatic conditions for bud wood union i.e. mean maximum and mean minimum temperature (34°C and 19°C) which did not favour cambium contact and required more days to spout. It may be due to the growth of more number of sprouts, extra meristematic activity and superior healing of grafts during the recorded months. Similar results were obtained by Nachegowda and Vasanth (20). Pampanna and Sulikeri (22) also worked on grafting of young scion and obtained maximum graft success with maximum number of leaves during month of May for sapota under Bangalore conditions Bandenawaj (3), has reported similar findings that days taken for sprout

initiation differed significantly among treatments (months). Significantly less number of days (26.67) were taken for initiation to sprout in May over rest of the treatments in grafting.

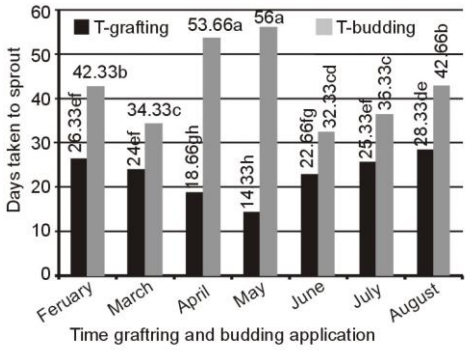

Fig. 3. Days taken to sprout in ber after propagating through T-grafting and T-budding in different months of year.

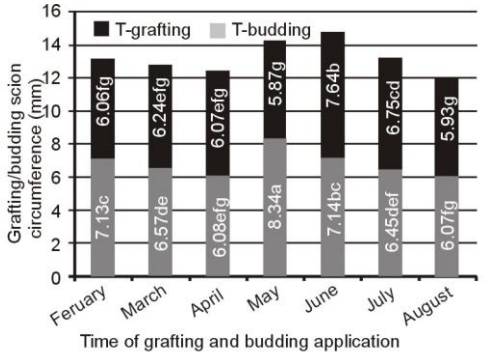

Fig. 4. Scion circumference (mm) in ber after propagating through T-grafting and T-budding in different months of year.

Number of leaves per plant

Maximum number of leaves (120.33) were observed in T-grafting practiced during first week of May followed by T-grafting during first week of February (94.00), March (93.33) and April (92.67) (Table 2). It may be due to the reason that total sunshine hours during month of May (240-52 and 250-50) favoured more photosynthetic activity which ultimately resulted in more number of leaves. Minimum number of leaves (49.67) were observed when T-budding was done during first week of May and August (44.33). These results confirm Bandenawaj (3) who reported maximum number of leaves were observed in May grafting over the rest of treatments (months) in Jamun.

Table 2. Number of leaves in sprouted scion shoots in *Zyzyphus mauritiana.* Lamk.

Grafting technique	February	March	April	May	June	July	August	Mean
T-grafting	94.00b	93.33b	92.67b	120.33a	82.00de	84.00cd	83.67cd	92.85a
T-budding	70.00f	62.67g	70.00f	49.67h	89.67bc	75.33ef	44.33h	65.95b
Mean	82.00ab	78.00b	81.33ab	85.00a	85.83a	79.66b	64.00c	

LSD for propagation methods = 2.76 LSD for propagation time = 5.17 LSD for propagation method x propagation time=7.31.

Scion circumference

Circumference of scion was observed maximum (8.34 mm) in T-grafting done during first week of May (T4) followed by T-budding performed during first week of June (7.64 mm) which was at par with T-grafting during first week of June (7.14 mm). Smallest circumference value of scion was observed when T-budding was performed during first week of May (5.87mm) (Fig.4).

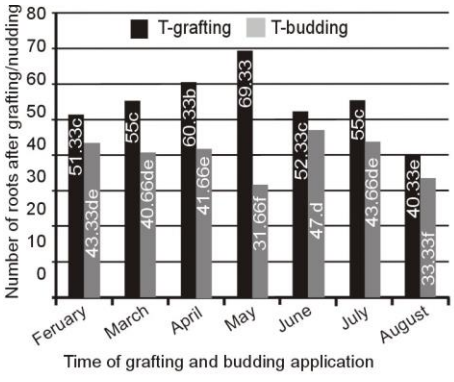

Fig. 5. Number of roots in ber after propagating through T-grafting and T-budding in different months of year.

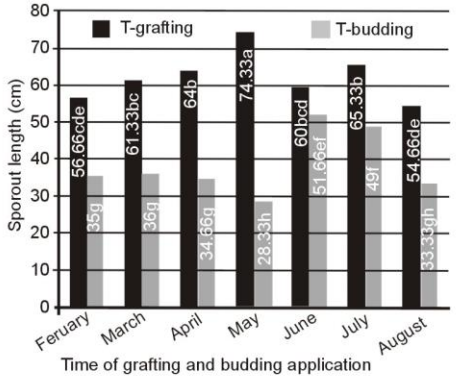

Fig. 6. Sprout length (cm) in ber after propagating through T-grafting and T-budding in different months of year.

Number of sprouted scion shoots

Maximum number of sprouted scion shoots (7.33) were observed when T-grafting was done during first week of May followed by T-grafting during first week of February, April and August (5.33 each). Minimum number of scion shoots (2.33) were observed in T-grafting done during first week of July and in T-budding performed during first week of February (5.33) which are also at par with T-budding during April and August (Table 3).

Table 3. Number of sprouted scion shoots in *Zyzyphus mauritiana.* Lamk.

Grafting technique	February	March	April	May	June	July	August	Mean
T-grafting	5.33b	4.00c	5.33b	7.33a	2.33d	3.66c	5.33b	4.76a
T-budding	2.33d	2.00d	2.00d	1.66d	4.00c	3.66c	1.66d	2.47b
Mean	3.83ab	3.00c	3.66bc	4.50a	3.16bc	3.66bc	3.50bc	

LSD for propagation methods = 0.42 LSD for propagation time = 0.78 LSD for propagation method x propagation time=1.11.

Number of roots

The data collected on number of roots in rootstocks at field transplantation stage is of huge value for nursery trade as normally stocks are raised in the field (in situ) rather in pots or polythene bags and while lifting plants root injury is heavy in case of extensively rooted stocks (24). All types of roots including primary, secondary and tertiary were counted and maximum number of roots (69.33) were observed to be formed when T-grafting was done during first week of May followed by T-grafting during first week of April (60.33). Minimum number of roots were observed when T-budding was performed during first week of May (31.66) and August (33.33) (Fig.5).

Sprout length

Sprout length was significantly affected by different season of grafting in terms of proportionate change in scion length at different growth stage of

maximum sprout length (74.33cm) was observed when T-grafting was done during first week of May followed by T-grafting during first week of April (64.00 cm) and August (65.33 cm) (Fig. 6). Minimum number of sprout length was observed when T-budding was practiced during first week of May (28.33 cm). Maximum sprout length of grafts recorded during month of May may be due to early healing of graft union. These results are in line with those Nachegowda and Vasanth (20) and Pampanna and Sulikeri (22) in Sapota. Khattak *et al.*, (15) reported that on 15th April and 15th May maximum shoot length was 18.66 cm and 17.22 cm, respectively.

CONCLUSION

The study concludes that maximum success was obtained in T-grafting done during first week of May. At this stage rapid sap flow in stock and scion might have favoured the healing and established continuity of cambial and vascular tissues for graft union. So callus initiated quickly and sprouts grew fast. Parameters like graft percent success, survival percentage, sprouted scion length, number of leaves, number of roots were significantly higher when T-grafting practiced during May. Moreover, plants produced by this technique were short stature, true to type, and early bearing. These short stature plants can also be used in high density plantations. Unique characters of varieties can also be preserved through this way.

REFERENCES

1. Anon. 2002. Ber (*Ziziphus mauritiana* Lamk.) Field Manual for Extension Workers. International Centre for Underutilised Crops, (ICUC) Southampton. Pp.30.
2. Azam, A. S., E. Bonkoungou, C. Bowe, C. Dekock, A. Godara and J.T. Williams. 2006. Ber and other jujubes. Fruits for the Future 2 (Revised Ed. International Centre for Underutilized Crops, Southampton. UK. Pp. 302.
3. Bandenawaj, R. M. 2007. Studies on Softwood Grafting In Jamun (*Syzygium Cumini* Skeels). M.Sc. Thesis. Univ. Agric. Sci. Dharwad. p. 9-10.
4. Bhargava, R., A. K. Shukla, N. Chauhan, B. B. Vashishtha and D. G. Dhardar. 2005. Selection of superior ber germplasm. Environmental and Experimental Botany. 53(2):135-38.
5. Chovatia, R. S and S. P. Singh. 2000. Effect of time on budding and grafting success in jamun (*Syzygium cumini* Skeel.) Indian J. Hort., 57:255-58.

6. Darbara, S. and P.C. Jindal. 1999. Studies on flowering and sex ratio in some ber (*Ziziphus mauritiana* Lamk.) cultivars. Haryana Agric. Univ. J. Res. 12 (2):292-94.
7. Daulta B. S. and K. S. Chauhan. 1992. Ber-a fruit with rich food value. Indian Hort. 27 (3): 7-9.
8. Desai, S. A. 1987. Studies on Standardization of Epicotyl and Softwood Grafting in Jackfruit (*Artocarpus heterophyllus*). M. Sc. (Agri.), Thesis, Konkan Krishi Vidyapeeta, Dapoli, Maharashtra.
9. Dogar, J. C., G. Singh and N. T. Singh. 2001. Evaluating forest and fruit trees for rehabilitation of semiarid alkali-sodic soils in India. Arid Land Research and Management. 15: 115-33.
10. Hartman, H. T and D. E. Kester. 1979. Plant Propagation Principles and Practices. 4th Ed. Prentice Hall of India Ltd. Pp. 407.
11. Hartmann, H. T and G. Kester. 1997. Plant Propagation: Principles and Practices. Prentice Hall. New Jersey, USA.
12. Jagirdar, S. A. P., M. H. Nizami and M. A. Shaikh. 1968. Varietal response of veneer grafting in mango. W. P. J. Agri.Res. 68-89.
13. Jose, M and P. K. Valasalakumari. 1991. Standardization of technique of epicotyl and softwood grafting in Jack (*Artocarpus heterophyllus*). South Indian Hort. 39: 164-67.
14. Kaundal, G. S., S. S. Grewal and J. S. Bal. 1984. Influence of meteorological factors on bud take efficiency of ber (*Ziziphus mauritiana* Lamk.) cv. Umran. J. Res. Punjab Agric. Univ. 21(3):372-74.
15. Khattak, M. S., H. Inayatullah and S. Khan. 1993. Propagation of guava *(Pisidium guajava* L.) from semi-hardwood cuttings. Sarhad J. Agri. Res.8: 87-90.
16. Madalageri, M. B., G. S. Sulikeri, N. C. Hulamani and V. S. Patil .1990. Studies on green wood wedge grafting in sapota. Presented in the XXII Int. Congress. 27th August- 1st September. Firenze, Italy.
17. Madalageri, M. B., V. S. Patil and U. G. Nalwadi. 1991. Propagation of jamun by softwood wedge grafting. My Forest. 27: 176-78.
18. Mawani, P. B and S. P. Singh. 1992. Effect of method and time of budding success in ber (*Ziziphus mauritiana*) cv. Gola. Part II. Horti. J. 5(2):79-83.
19. Mukhtar, H. M., S. H. Ansari, M. Ali and T. Naved. 2004. New compounds from *Zizyphus vulgaris*. Pharmaceutical Biology. 42(7):508-11.
20. Nachegowda, N and K. R. Vasanth. 1996. Propagation of sapota (*Manilkera achras* (Mill) Foseberg) cv. Kalipatti by softwood grafting. Proc. Int. Conf. Tropical Grafts. Kwalalampur. Vol. 3. p. 115-19.

21. Sharif, N., J. Jaskani, M. Ishfaq. M. M. Abbas and N. N. Memon . 2013. Categorization of ber varieties in relation to blooming period, fruit setting and harvesting time. Pak. J. Agri. Sci., Vol. 50(3): 407-13.
22. Pampanna, Y and G. S. Sulikeri. 2000. Effect of season on the success and growth of softwood grafts in sapota on invigorated Rayan rootstock. Karnataka J. Agric. Sci. 13:779-82.
23. Pampanna, Y., G. S. Sulikeri and N. C. Hulamani. 1994. Effect of season on the success of softwood grafting in Sapota (cv.Kalipatti). South Indian Hort., 42: 303-308.
24. Shanmugavelu, K. G. 1996. Studies on the effect of plant growth regulators on the seedlings of some tree plant species. South Indian Hort.14: 24-35.
25. Singh, D. K. and B. B. Sen. 2004. Role of pre-sowing seed treatment with different chemicals and seed sizes on the germination behavior and seedling growth of ber (*Ziziphus mauritiana* Lam.). Environment and Ecology. 22(2):439-42.
26. Singh, N. P. and R. P Srivastava. 1980. A new approach towards double grafting in mango. Curr. Sci. 49(17):678-79.

Received: November 22, 2013 Accepted: August 21, 2014

***