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Grafting efficiency of different scion cultivars on local rootstock of Ber (*Ziziphus mauritiana*. L)

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Abstract

A field experiment was conducted in Department of Horticulture, Ghazi University Dera Ghazi Khan-Pakistan to study the efficiency of different scion cultivars grafting on the local desi rootstock of Ber (*Ziziphus mauritiana*) under field conditions. T-grafting of different scion cultivars was done in the March-April by using different scion cultivars viz. Delhi White, Suffen Karela and Mahmud Wali. The results of experiment presented that an early initiation of sprouting of Ber graft in 07-13 days was recorded in Delhi White followed by Mahmud Wali scion. Grafting success (88.66%), survival (71.6.00%), number of branches (6.99), canopy volume (10.63), fruit setting% (7%) and yield kg/plant (52kg) was higher in Dehli white grafts followed by Suffen and Mehmud wali scion grafts. Rate of vegetative growth of grafted plants was excellent in Dehli white scion grafts. Biochemical characteristics of fruit i.e TSS (Brix°) was higher (16.25) in cvs. Suffen, TA%, pH and Vit-C content was found maximum in Dehli white followed by Mehmud wali scion graft. Dehli white grafts performed better for vegetative as well as quality characters so it is recommended that this variety can be used for grafting with local desi ber varieties.

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Introduction

Ber (*Ziziphus mauritiana*. L) is an important minor fruit crop which fits well into the marginal ecosystem of arid and semi-arid regions of the world. It belong to family Rahmanaceae and appropriately known as poor man apple owing to its nutritional value and used as food for millions of poor people during winter. It is indigenous to China and Indo Pak subcontinent. Ziziphus species are mostly cultivated in several Asian countries, including India, China, Pakistan, Korea, Thailand, and Vietnam. In Pakistan, Ber is produced over an area of 5425 hectares with an annual production of 27950 tones (Sharif *et al.*, 2013). Farmers can get extra income by cultivating Ber trees on marginal agriculture lands. Ber fruits are rich in protein, calcium, carotene, phosphorus and vitamin C contents than apple (Mukhtar *et al.*, 2004).

The fruits are not only eaten fresh but also used in other forms such as dried, candied, pickled, juice, syrup, squash and fruit butter. Ber trees can be raised from seed (sexual method) or propagated vegetative (asexual method). The wild species like *Zizyphus rotundifolia* Lamk. is most commonly used as root stock. It can also be grown on *Z. nummularia* root - stock but it shows incompatibility with inverted bottle neck symptoms budded with 'Gola' cultivar (Verma *et al.*, 2000). Ber plants naturally produced from seed, though it is easy and cheap, but unable to perpetuate characters of the parent tree due to heterozygosity. Like other cross pollinated fruit crops, vegetative propagation is highly encouraged in Ber. The plant produced through seeds cannot be used directly for plantation in orchards. The asexually propagated fruit plants are true to type, uniform in growth and fruit quality and take lesser time for fruiting as compared to sexually propagated plants which bear fruits within three to four years.

Desirable Ber germplasm having good characteristics in term of growth, fruit yield and quality can be preserved only through asexual propagation. Grafting is a common and preferred vegetative propagation method for ber trees. Furthermore, proper alignment of scion and rootstock cambium tissues could determine the graft success. The rootstock greatly affects vigor, longevity and productivity of the scion variety. Even the quality and composition of fruits also have been affected by it. A stock is called "seedling root stock" if it is grown**.** Keeping in view the food insecurity situation and climate change scenarios of the country, present study was conducted to check the efficiency of graft to grow more plants fast having good quality. In addition to quality and shelf life, it would be a good carbon sink.

Materials and methods

Present investigations were carried out in Department of Horticulture, Ghazi University Dera Ghazi Khan-Pakistan during 2014-15 to study the grafting success of four different scion cultivars viz. Delhi White, Suffen Karela and Mahmud Wali on the local desi variety of Ber under field conditions.

Raising of rootstock

To raise the rootstock nursery, fully ripened desi Ber fruits/stones were collected from disease free, healthy, well managed and actively growing ber trees from Horticultural Research Station Dera Ghazi Khan during the month of March. Because of their resistance to diseases and adaptability to native environmental conditions, local varieties are generally preferred as rootstocks. Collected stones were washed with fresh water and treated with Carbendazim 10gram in 10 litres of water. After drying, stones were sown in polythene bags filled with mixture of sand, silt and clay (1:1:1) and a fair quantity of farm yard manure in the month of April. These stones were germinated in 2-3 weeks and after germination, these seedlings along with stones were transplanted to the main field when the seedling attained a height of 10cm. Seedlings were watered regularly until reached at graftable size.

Grafting Technique

One year old fully grown ber seedlings were grafted with *T*-grafting technique during March and April by using different scion cultivars viz. Dehli white, Karela, Suffen and Mehmud wali. Three to four months old healthy scion sticks were selected and defoliated before grafting operation. Rootstocks were cut just above the active growing point by keeping 3-4 leaves

and a T shape was made by deep cut on the side of the rootstock. A 2.5-3cm long wedge shape cut was made on the bottom of scion, so that it can fit properly in the cut made on the rootstock. Scion stick was inserted into the cut portion of the rootstock and the graft was firmly wrapped with plastic strip. New shoots from the graft union were regularly removed. The experiment was laid out following Randomized complete Block Design (RCBD) with 04 treatment combinations. All treatments were replicated thrice. Data was recorded on days taken to first bud sprouting, graft success (%), survival (%), number of branches, length of branches after 30, 60, 90,120 and 160 days , canopy volume after 60, 90 and 150 days after grafting, fruit setting %, yield Kg/plant and biochemical parameters TSS (Brix°), TA %, pH and Vit-C content were measured. Analysis of variance technique was used to figure out differences as outlined by Steel *et al.* (1997).

Results and discussion

Days to taken to bud breaking

Data presented in Figure-1 clearly shows that cultivars showed significant differences on days to sprouting of ber graft in different scions. It was observed that early union was established in cv. 'Mehmud Wali' that took minimum days (7.33) than other cultivars grafted on local rootstock. While maximum days taken for bud breaking were observed in case of cv. 'Karela' scion that took 12 days followed by 'Suffan' and 'Delhi White'. Generally *Z. rotundifolia* Lamk. is most commonly used as root stock for many cultivars of *Ziziphus* (Verma *et al.*, 2000). The reason behind that the better performance of the young rootstock producing early and number of sprouted grafts seems to be high meristematic activity in just germinating and higher reserved food material in the cotyledon. Time required for sprouting of ber graft and this could be due to enormous food supply by the rootstocks to sprouted growth cambial relation was established, vascular differentiation was observed, regular parenchymatic tissue properties and scleroid (petrosal cell) cells and sclerenchyma bundles were seen in the graft union.

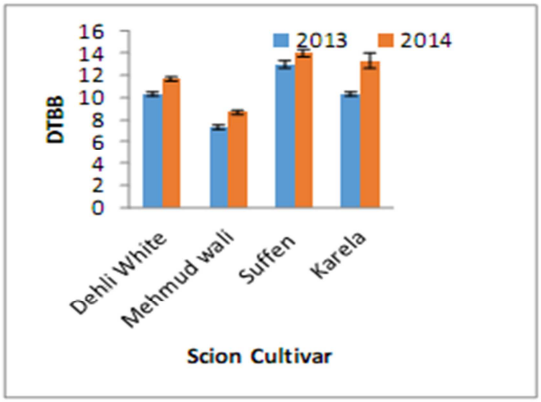

Figure.1 Days taken to bud breaking

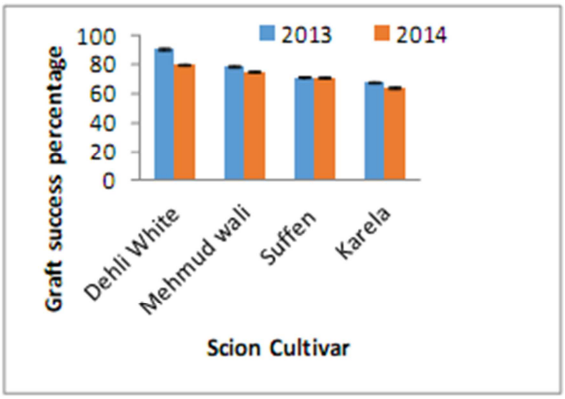

Figure. 2 Grafting success percentage

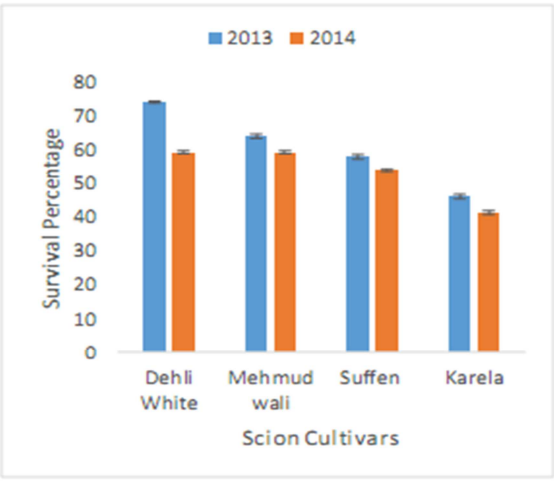

Figure. 3 Survival percentage

Graft percentage and survival percentage

Maximum graft success (88.66 & 83%) was achieved by cvs. 'Delhi White'; while, ber cv. Suffen' showed minimum success (66.00% & 55.33%) and maximum survival percentage (71.66%) was obtained in cv. 'Delhi White' while lower survival percentage (44.33% & 41.00%) was obtained in cv. 'Suffan' in both years

2013-14. Singh and Sen (2004) observed maximum graft and survival percentage in *Z. mauritiana* species grafted on local rootstock. Present results are in agreement with Sanou *et al.* (2014) who reported that grafting on local rootstock resulted in highest grafting success on ber cvs. 'Seb', 'Umran' and 'Sotubata' with more flowering and fruiting enhancements.

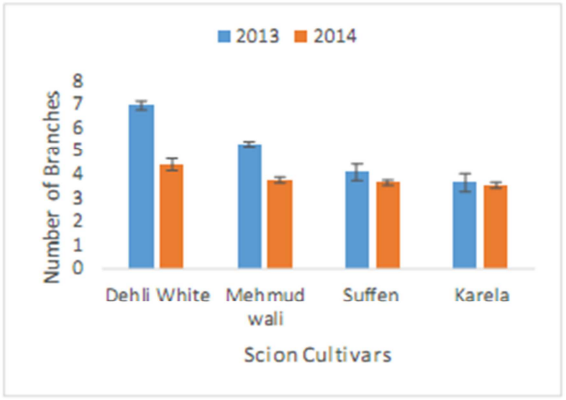

Figure. 4 Number of branches

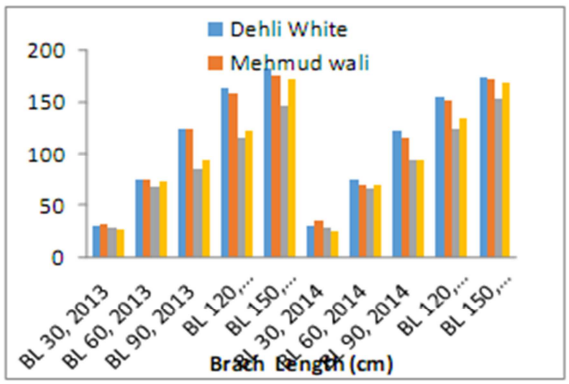

Figure.5 Length of branches

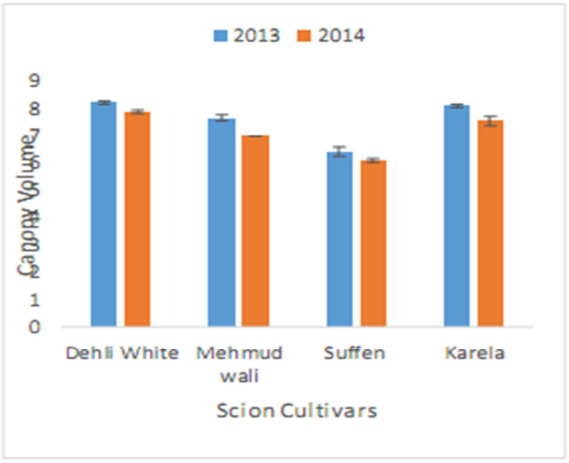

Figure. 6 Canopy volume

Number of branches

Similarly highest number of branches per graft (6.99 & 6.70) was observed in cv. 'Delhi white' followed by cv.'Mehmud Wali' and cv. 'Suffan' in both years (2013-14), while the lowest number of branches per graft was recorded in cv. Karela. Meanwhile Singh and Bal (2008) also noted that with regard to cultivars\rootstock, *Z. rotundifolia* exhibited more branches per shoot than other two varieties; Banarsi and Umran. Similarly, Cepoiu and Stanica (2002) observed variable number of branches per scion in some persimmon cultivar using various grafting methods.

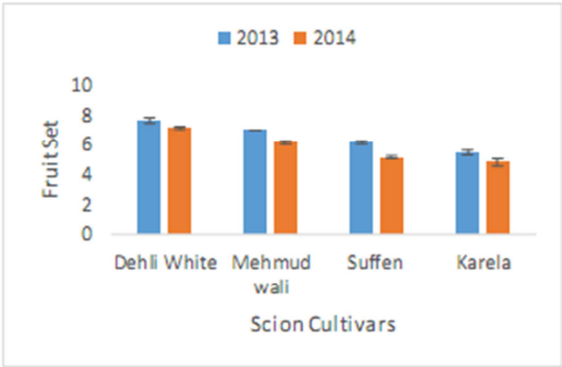

Figure.7 Fruit set %

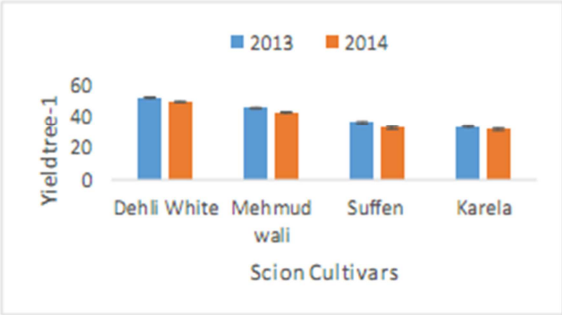

Figure.8 Yield per plant (kg)

Length of branches

Overall excellent growth was observed in scion of cv. 'Delhi White' as compared to rest of scion cultivars acquiring least height of branches after 60, 90, 120 and 150 days. On the other hand, shortest length of branches was recorded in cv. 'Karela' after 60, 90, 120 and 150 days in both years. These results are in consistent with an earlier study that demonstrated maximum sprout length in cv. Gohr by T-grafting (Sharif *et al.*, 2015). Similarly, results of Sanu *et al.* (2014) are in conformity with our findings in a way

that average height of grafts on coppices was four times greater than seedling rootstock. Meanwhile Prasad and Bankar (2006) got maximum length of scion shoot when cv. 'Seb' was grafted on local rootstock *Z. rotundifolia*.

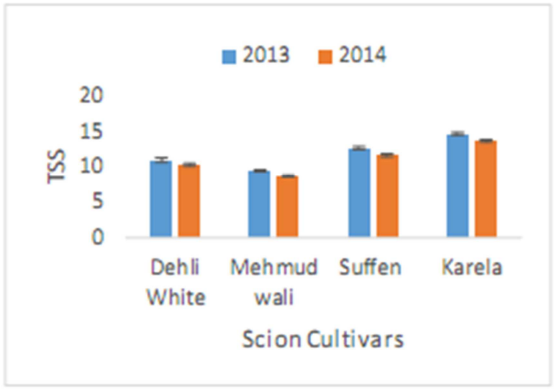

Figure.9 TSS

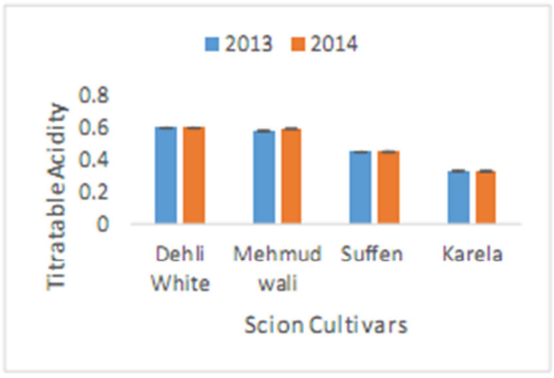

Figure.10 Titratable acidity

Canopy volume

'Delhi White' exhibited significantly denser canopy than all other cultivars in both years (Appendices-31, 32 and 33). While significantly reduced canopy volume was observed in cv. 'Karela' after 60, 90 and 150 days of grafting (Table 2.6a, 2.6b, and 2.6c). Increased canopy volume explains the vigor of scion and rootstocks that ultimately affected the canopy volume. Meanwhile, increased canopy volume in cv. 'Delhi White' then other cultivars could be due to genetic makeup of cultivars. Sanou *et al.* (2014) who observed maximum tree spread in coppice root stock in cv. 'Seb' and Singh *et al.*, 1978 and Singh and Bal (1986) in ber cv. "Umran". Seedlings of *Z. mauritiana* do not tolerate transplanting shock and the heavy mortality after transplanting is due to the fact that the ber plant has a deep tap-toot system. Hence, the practice has been to sow the seeds directly in the field and bud them *in situ*.

Fruit set %

Ber cv. 'Delhi White' exhibited significantly higher fruit set percentage while minimum fruit set percentage recorded for cv. 'Karela' grafted on local rootstock in both years 2013 and 2014. Statistics about fruit set percentage showed that rootstocks could produce and translocate hormones in different quantity to enhance the fruit set. But, the first fruit set could affect the last harvest of the trees. Present results documented the finding of Moeen *et al.* (2001) in Kinnow and Shahid *et al.* (1999) who reported that rootstocks affected the fruit set of ber. In another study, first fruit set and fruit retention of terminal buds % of one year old shoots were the maximum followed by spurs, whereas lateral buds on one year old shoots were the lower percentage of fruit setting (Fouad *et al.*, 1993).

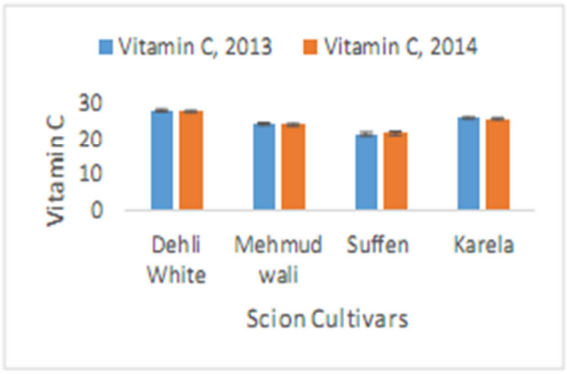

Figure.11 Vitamin C

Yield per plant (kg)

Scion of ber cv. 'Delhi White' grafted on local rootstock performed better than all others varieties by exhibiting higher yield per plant followed by 'Mehmud Wali' and 'Suffan'. While, ber cv. 'Karela' gave minimum yield per plant in both years respectively (Table 2.8). These results are in line with Ibrahim *et al.* (2015), concluding that ber fruit yield is highly variable and scion dependent as cv. 'Umran' exhibited higher yield; whereas, cv. 'Seb' had the lowest. Sanou *et al.* (2014) also found that fruit production significantly affected by the type of rootstock. The results are in conformity with Prasad and Bankar (2006) in ber cv. 'Seb' grafted on *Z. rotundifolia* where fruit yield was significantly increased.

Biochemical parameters

Ber cv. 'Suffen' and 'Karela' exhibited higher TSS; whereas, significantly low TSS was noted in cv. 'Delhi White' and 'Mehmud Wali' cultivars of ber. While ber cv. 'Delhi White' maintained maximum value of TA percentage (0.60% & 0.59%) in both years as compared with the others. Lowest value of TA (0.31% & 0.31%) was recorded in cv. 'Suffan' in both years 2013 & 2014. Ber cv. 'Suffan' of ber showed the highest value of pH (6.45 & 6.39) while the lower pH (4.38 & 4.39) recorded in cv. 'Delhi White' in both years 2013 & 2014). Ber fruit cv. 'Delhi White' and 'Suffan' maintained significantly higher ascorbic acid contents while reduced ascorbic acid contents in cv. 'Karela' fruit grafted on local stock.

Conclusion

It is concluded from the findings of the present investigations that Dehli white grafts could be successfully used scion grafting. So, it may be recommended that this variety should be recommended for general cultivation in arid and semi aroid areas of the world. Dehli white grafts performed better for vegetative as well as quality characters so it is recommended that this variety can be used for grafting with local desi ber varieties.

Novelty Statement

Four varieties were used in t-grafting on local ber varieties and growth as well as biochemical characters were examined in arid area of DG Khan.

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