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PERFORMANCE OF DIFFERENT GRAFTING METHODS IN CHIKU *ACHRAS SAPOTA*

AMIR HUSSAIN

Sind Horticulture Institute, Mirpurkhas

AND

MUSHTAQ AHMED BUKHARI

Department of Horticulture, Sind Agriculture College, Tandojam.

Abstract

Six different asexual methods of propagation tried in chiku, (*Achras sapota* L.). revealed that percentage of success was significantly affected by different methods of grafting. The highest percentage of success was found in veneer grafting followed by side inarching, side grafting, saddle grafting, whip grafting, and tongue grafting. The success of veneer grafting over other methods can be attributed to the loss of vegetative tops of stock plants at the time of grafting to support the growth in the cambial layer of the union.

Introduction

Achras sapota L. is known by different names in literature as chiku, sapota, sapodilla or marmalade plum. The original home is Central America but the distribution extends to Florida, Jamaica, Phillipines Ceylon, India and Pakistan. This fruit crop was introduced about thirty years ago in the province of Sind. Four districts of Sind viz., Karachi, Hyderabad, Tharparkar and Sanghar are exceptionally suited to its growing on the basis of soil and climatic requirements (Jagirdar & Bhatti, 1968).

The practice of multiplying the plants are through seed, airlayering (gooty), mounding, budding, inarching and veneer grafting. Though the fruit of chiku gives viable seeds but the performance is poor, therefore the method of inarching is generally followed. In the use of this method, rootstock and scion is combined to obtain a graft which is further used at actual sites (Cheema, Bhat & Naik, 1954; Bailey, 1956; Chandler, 1958 ; Jagirdar, 1968).

The nursery plant propagators tend to discourage present practice of propagation i.e. inarching because it is cumbersome time-consuming and costly. Moreover the plants prepared by this method of grafting are weak and the percentage of success is too low. These grafts cannot withstand the strong effects of winds which results in breakage at the point of union (Jegirdar, 1968). On the other hand expenses incurred on operation of inarching are high and unbearable, due to high cost of labour required in carrying the vegetative operations in nursery.

Keeping in view these problems, an attempt was made to evolve an efficient and acceptable technique which should be easy to do further multiplication of chiku plants and reduce the period of combining of stock and scion. Normally it takes years to obtain a successful grafted plant of chiku from nursery. One of the main causes of lesser attraction to grow this fruit crop in Sind is that nursery plants are not easily available or they are too costly. These considerations provided a basis for the present investigation on the performance of different grafting methods in chiku. The studies were designed to evaluate and assess the existing methods and to recommend biologically most efficient method of propagation of chiku as a horticultural practice for the province of Sind.

Review of Literature

The graftage has been opined by various authors as an operation done on plant portion in which insertion of a piece of shoot (scion) in another plant (stock) is done so that tissues of two portions of plant should unite with each other to give a new form of plant, known as graft or scion (Mahlstede & Haber, 1957; Chandler, 1958). The kinds of graftings are many and are followed in different ways on different species of tropical fruit trees. These are veneer grafting, side grafting, inarching, whip/splice grafting, tongue grafting, cleft grafting, forkert grafting, approach grafting, and other types depending on various factors. The few recommended types on mango are side grafting tongue grafting, inarching and whip grafting (Burns & Prayag, 1920). In India, side grafting is advocated as best technique of grafting especialiy on mango. Some workers believe that side grafting is best suited to majority of tropical fruit trees and this includes chiku tree (Naik, 1941).

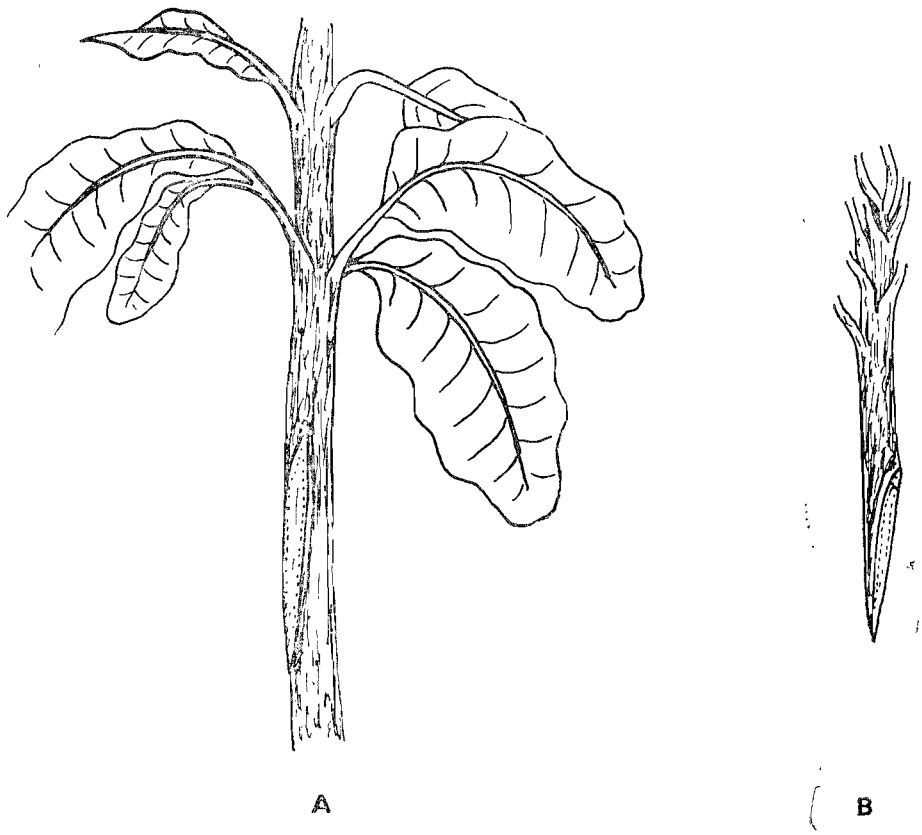
Veneer grafting is a proven technique on broad and narrow leaved evergreens. Veneer grafting is an easy, in-expensive, successful and profitable technique over side grafting (Mahlstede & Haber, 1957; Chandler, 1958; Mukerjee & Majumdar, 1961). It resembles side grafting with exception of smaller tongue on the stock. The other advantage in this technique is that even on failure operation the stock can be reused, regrafted and no loss in number of rootstocks propagated by veneer grafting (Subra, 1954). The reasons of success in veneer grafting are more due to contributory effects of climate which brings the union of stock and scion by help of prevailing high humidity present in tropical regions. The other factors like medium temperature coupled with reduced diurnal temperatures benefit the method of veneer grafting (Ahmed, 1964).

Casual attempts were tried on chiku tree on different techniques of grafting but was found that side grafting and inarching are the types suited to local conditions with remark that these methods are expensive, time-consuming (Jagirdar & Bhatti, 1968).

Materials and Methods

Khirni (*Mimusops hexandra*) seedlings of about 6-9 inches height were selected for transplanting. They were intercultured at monthly intervals and were irrigated at weekly intervals in summer and fortnightly in winter. The natural growing tendency of Khirni plants are very slow therefore they had taken 18 months after transplanting to reach the stage of grafting and had attained operational height of about 24 to 30 inches. During the growing period individual plants were regularly trimmed by removing the rudimentary portion and cutting of the side shoots. This operation had helped in keeping the seedlings erect and upright. These were ready for grafting in September, 1970. Seedlings of uniform height and thickness were selected for observing and testing the behaviour of different grafting methods.

The age of the Khirni stock was 18 months (after transplanting of the seedlings) at the time of grafting. The scion shoot was 4 inches in length and consisted of a mature terminal shoot. The stock was prepared 10 inches above the ground level. Healthy and vigorous stock and scion shoots of equal maturity were used. The details of the grafting methods followed are as under:



A. Khrini stock prepared to received the scion wood.

B. Chiku scion prepared for inserting in the stock.

1. Side grafting

A tongue of $\frac{1}{4}'' \times 2\frac{1}{2}''$ in length was prepared on the side of the stock without removing the cut portion of the stock. Similar cut of $\frac{1}{4}'' \times 2\frac{1}{2}''$ on both sides of the scion was given by making a wedge. The scion was inserted in the tongue of the stock and then wrapped firmly with plastic tape. In this method of grafting the cambium layers come in contact on both sides of the scion. Since growth takes place in the cambium and other closely associated meristematic cells it is very essential to bring the stock and scion in contact with each other (Fig. 1).

Fig 2

A. Khirni stock prepared to receive the scion wood

B. Chiku scion prepared for inserting in the stock.

2. Side inarching

A strip of $\frac{1}{4}''$ thick and $2\frac{1}{2}''$ long was cut on the side of the stock. Similar strip was cut on the side of scion wood and was brought in contact with the stock. The stock and scion were tied firmly with plastic tape (Fig. 2).

3. Veneer grafting

A tangential cut of $2\frac{1}{2}''$ long was given to the stock leaving a notch of $\frac{1}{2}$ inch at the base of the cut. Similar cut of $2\frac{1}{2}''$ in length was given on the base of scion shoot. The two cut surfaces of the scion and stock were patched together, the basal end of the scion was fitted in the notch of the stock. The stock and scion were then bandaged firmly with the plastic tape (Fig. 3).

Fig 3

A. Khirni stock prepared to receive the scion wood.

B. Chiku scion prepared for inserting in the stock.

4. **Tongue grafting**

The stock was cut $2\frac{1}{2}''$ in a sloping direction. The scion was then similarly cut through obliquely. A thin tongue of 1" was cut in the scion in an upward direction and a corresponding cut of 1' was made in the stock. The scion was fitted into the stock so that the inner barks of the stock and scion come in contact with each other. The union was bandaged firmly with plastic tape (Fig. 4).

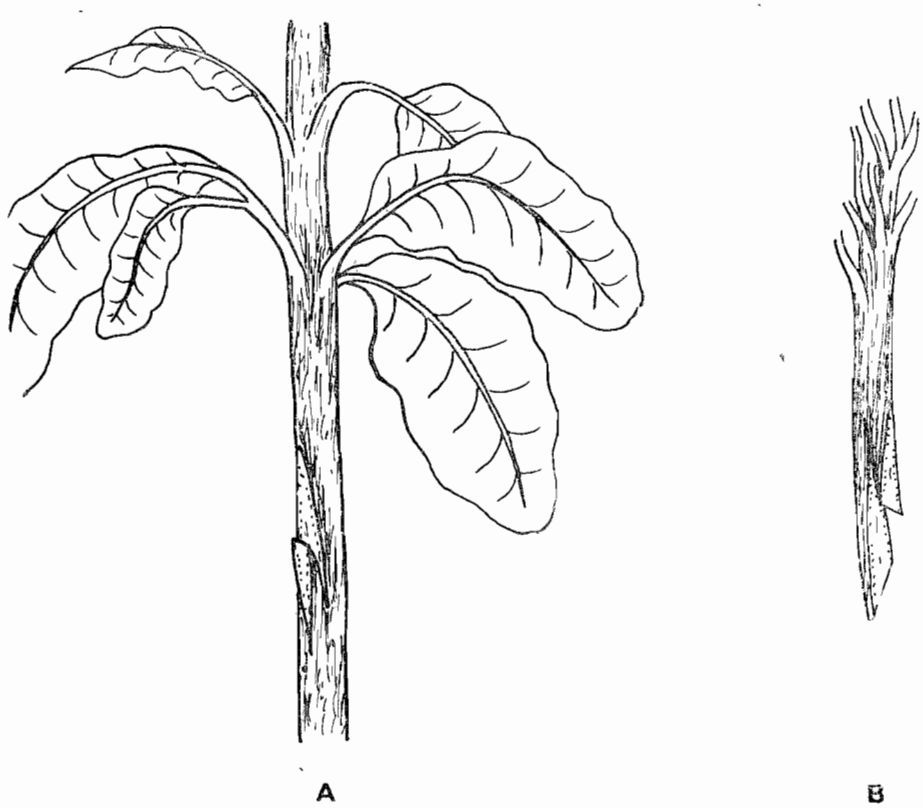


Fig. 4 A. Khirni stock prepared to receive the scion wood.
B. Chiku scion prepared for inserting in the stock.

5. Whip/Splice grafting

The stock was prepared 10" above the ground level and a diagonal cut of 2½" was made in this end. Similarly diagonal cut of 2½" was also made at the lower-end of the scion shoot. Both the cut surfaces were brought together and bandaged firmly with the plastic tape (Fig. 5).

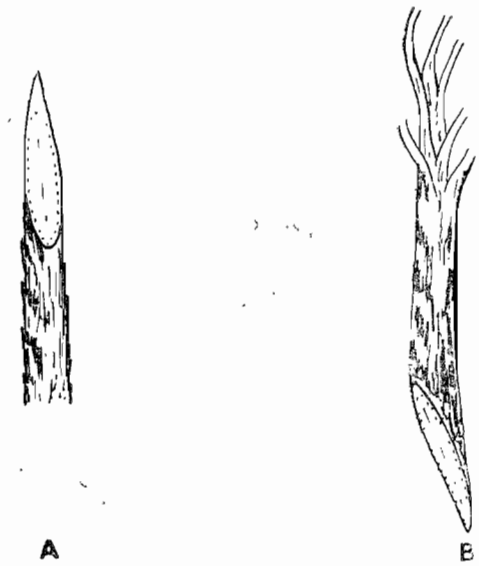


Fig. 5 A. Khirni stock prepared to receive the scion wood.
B. Chiku scion prepared for tying with the stock.

6. Saddle grafting

The stock was cut 2" sloping-wise on each side like a wedge. In the scion shoot a corresponding notch of 2" was made so that the outer surface of the tongue was not paired. The wedge of the stock was fitted into the groove of the scion. After interlocking the stock and scion the two surfaces of the cambium were bandaged firmly with the plastic tape (Fig. 6).

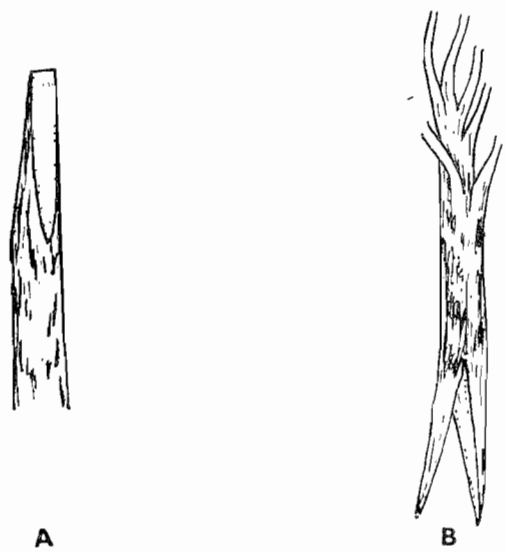


Fig. 6 A. Khirni stock prepared to receive the scion wood.
B. Chiku scion prepared for saddling on the stock.

TABLE 1. Evaluation of different grafting methods in chiku.

Observations	Side grafting	Side inarching	Veneer grafting	Tongue grafting	Whip/ Splice grafting	Saddle grafting	S.E.	Cd_1
Days taken to sprout	23.13	23.14	22.89	26.0	25.80	24.85	1.344	N.S.
Number of shoots	10.51	11.39	11.79	11.38	11.19	13.88	1.083	N.S.
Linear length of shoots.	99.98	107.66	106.92	111.34	103.25	120.88	8.385	N.S.
Number of leaves	181.53	162.84	158.76	173.67	150.63	188.75	17.07	N.S.
Circumference of scions	1.24	1.22	1.22	1.26	1.06	1.32	0.079	N.S.
Weight of plants	548.00	622.25	398.50	673.00	504.00	540.00	50.49	N.S.
Weight of roots	90.50	100.75	61.50	114.75	86.50	90.50	2.95	8.86
Weight of stem	248.13	269.25	189.45	289.38	235.75	233.75	26.31	N.S.
Weight of leaves	234.50	252.50	172.58	269.0	182.25	216.50	29.05	N.S.
Number of roots	37.75	72.25	56.25	44.50	66.25	70.25	6.59	19.79
Linear length of roots	239.50	425.50	279.25	338.0	340.50	359.75	38.08	N.S.
Volume of water displaced by roots	80.75	91.25	56.25	96.25	76.75	81.25	7.84	23.62
Weight of individual root	2.42	1.49	1.10	3.06	1.33	1.37	0.41	1.23
Leaf area	1753	1979	1434	1833	1615	1552	160	N.S.
% of success	60.0	75.0	87.5	25.0	37.5	52.5	4.11	12.38

Ten Khirni seedlings were grafted with Chiku scion under each treatment and the treatments were tested in four replications. Thus in all 240 stocks were grafted under this trial. When the union took place, showing new growth of scion, the stock was cut back partially. The heading back of the stock was completed after the growth of the second flush of the grafted scion.

Results

The data recorded regarding percentage of success was significantly affected by different methods of grafting. The highest percentage (87.5%) of success was observed in veneer grafting closely followed by side inarching. The success percentage in veneer grafting was significantly more than that obtained in side inarching, side grafting, saddle grafting, whip grafting and tongue grafting. The percentage of success was lowest in tongue grafting closely followed by whip grafting (Table 1).

Difference in number of days taken to sprout the grafts was not significant in different treatments though the data indicated that the period required to sprout was the least in case of veneer grafting.

Total weight of roots of each plant was significantly affected by different methods of grafting. More weight of roots was recorded where the plants were grafted by tongue method closely followed by side-inarched plants. There was no significant difference between the weight of roots grafted by side saddle and whip methods. Minimum weight of roots was recorded in case of veneer grafted plants.

Mean difference in the number of roots recorded under different treatments were significant. Maximum number of roots was recorded in side inarched plants closely followed by in saddle, whip and veneer grafted plants. Minimum number of roots was recorded in side grafted plants closely followed by the tongue grafted plants.

Volume of water displaced by roots recorded in plants grafted by different methods was significantly affected, Maximum volume of water displaced by roots was recorded where the plants were grafted by tongue method closely followed by side inarching, saddle grafting, side grafting and whip grafting. Minimum volume of water displaced by roots was recorded from veneer grafted plants. There was no significant difference in the volume of water displaced by roots of veneer grafted and whip grafted plants.

Differences in weight of individual roots recorded under different methods of grafting were significant. Maximum weight of individual root was recorded where the plants were grafted by tongue method closely followed by side grafting. Minimum weight of individual root was recorded from veneer grafted plants. There was no significant difference between weight of individual root recorded from side grafted, side inarched, saddle grafted and whip grafted plants.

Differences in the number of shoots, linear length of shoots, number of leaves, circumference of scions, weight of plants, weight of stem, weight of leaves, linear length of roots and leaf area under different methods of grafting were not significant.

Discussion

The probable reason for higher success in veneer grafting and side inarching compared to whip and saddle grafting seems to be the loss of vegetative top of the

stock plants at the time of grafting to support the growth in the cambial layers of the union. The low success in tongue grafting is perhaps due to the excessive injury caused by splitting open the scion portion of the graft which is already detached from the mother plant. The superiority of the veneer grafting over the side grafting seems to be due to the excessive injury caused resulting in oozing of latex from stock plant. Since in case of both stock and scion the latex oozes out even with slight injury and this after drying on the surface of cambial layer cause blockade in the growth of the cambial cells. Excessive injury in the latex containing plants does not seem to be advisable (Mukerjee & Majumdar, 1961; Ahmed, 1964).

The time taken for initiating new growth (days taken to sprout) by the different grafts though not significantly different indicates that the union was established comparatively earlier in veneer grafted plants. The data on the vegetative growth such as linear length of shoots, number of shoots and the number of leaves borne by them, the scion girth, the weight of plants, weight of stem, weight of leaves, linear length of roots and leaf area have not shown marked differences. However the data collected on the root system seems to be of some interest to the nursery trade. The number of roots was highest in side inarched plants closely followed by saddle whip and veneer grafted plants while the number was minimum in side grafted plants closely followed by tongue grafted plants. The root system in case of veneer grafted plants seems to be moderate and this is very important for nursery trade in Sind because stocks are invariably raised in the field rather than in pots and while lifting plants, root injury is heavy in case of extensively rooted stocks (Jagirdar, Nizamani & Shaikh, 1968).

The weight of individual roots seems to be adversely related to the amount of roots (number of roots) where the rooting was sparse as in case of tongue and side grafting. The individual roots were stouter or heavier followed by a similar situation in side inarching and saddle grafting, the roots were less stouter or heavier in case of whip grafting or veneer grafting. Same was the situation with regard to the total weight of the roots of individual plants.

It is thus evident that veneer grafting is best suited for the production of chiku grafts as the percentage of success in this method is very high and the root system in these plants is moderate as a result of which the plants are more amenable to removal from nursery beds without suffering serious root damage at the time of lifting. The root system developed by veneer grafting seems to be most efficient inspite of minimum weight of its individual roots and the entire root system. The consequent vegetative growth of the top was as vigorous as that developed by plants raised by any other method of grattings (Table 1).

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