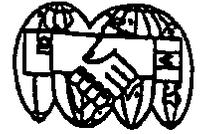




Government of St. Vincent
and the Grenadines



Taiwan Technical Mission
to SVG

Production and Processing of the

TAIWAN JUJUBE (Taiwan Apple)

May
2007

by
Ming-Zing Lee
Sen-chuan Su
Jonathon Chen



Produced by
The Communications Unit
Ministry of Agriculture, Forestry and Fisheries
St. Vincent and the Grenadines.

6. Second cooking (1/2 hour)

Soak in a sugar solution for one night (5~10% sugar of the wt of the cut fruit flesh) (1~1.5% citric acid of the wt of sugar.)



7. Drying

Dry in hot air circulation dryer. Dry for 90 mins at 55~60°C when the fruits should be half-way dried; then dry at 45-50°C until sufficiently dried

Fully dried candied Jujube

Dried fruits are about 30 - 35% in weight to the fresh fruits. Fruits that are properly dehydrated have a shelf life of close to 1 year.



PACKAGING

the 21 Century.

The shelf life of a dehydrated fruit product is widely influenced. Packaging must conform to certain special criteria such as:

- Protecting the dehydrated product against moisture, light, air, dust, micro flora, foreign odor, insects and rodents
- Strength and stability to maintain original container properties through storage, handling, and marketing
- Size, shape, and appearance to promote product
- Composition approved for use in con-



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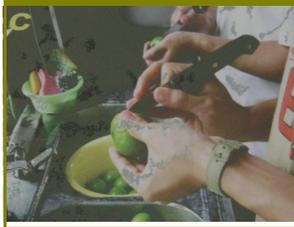
CONTENTS

Background	5	
Micro-climate and Soil	6	
CROP HUSBANDRY		
Propagation	6	
Planting	8	
Trellising and Training	8	
Fertilization	8	
Irrigation	9	
Pruning	9	
Flower Induction	10	
Thinning	10	
PEST MANAGEMENT		
Insect Pests, Diseases and Weeds control	11	
HARVESTING		12
PROCESSING - Candied Jujube		13

Processing of Jujube

“CANDIED JUJUBE”

PROCEDURES

	1. Selecting raw materials Choose good varieties, large size and fruits harvested at around 80~90% maturity.
	2. Wash the fruits removing all trash from harvesting.
	3. Pre-processing Split the fruit into a number of vertical sections with a knife, but do not cut off the skin.
	4. Blanching Put cut material into boiling water until the flesh becomes soft (10 - 15 mins). The temperature should not be more than 85°C
	5, First cooking (½ hour) Soak in a sugar solution for one night (35~40% sugar of the wt of the cut fruit flesh + the wt of the water.)

Some conditions of Importance



The discolored pale green appearance of the leaf show a deficiency in magnesium, which can be supplied by the 'banana' fertilizer used in SVG.

In rare cases, fruit fly damage may be observed on some fruits. This damage is manifested by small holes bored from the outer skin of the fruit extending inside damaging the flesh and resulting in discoloration. The fruit eventually rots.



Mealy bugs are observed especially at the top of the fruit.

Birds are a common problem. They peck and damage the fruits, which may in turn expose the fruit to damage from other insects and disease causing organisms.



HARVESTING

The jujube fruits can be harvested twice per year; in August to September and February to March. The young fruits are light green in colour and ripe the ones turn a golden yellow. During the rainy season, jujube fruits are not as sweet but in the dry season they are perfect.

Taiwan Jujube

(Taiwan apple)

Scientific name: *Zuzyphus mauritiana* Lam.

Family: *Rhamnaceae*.

English name: Indian jujube, Malay jujube

INTRODUCTION

The Indian jujube is believed to have originated in India and Sri Lanka. The species is an evergreen shrub that can grow 10 m high. Plants prefer warm areas and therefore can be successfully grown in St. Vincent and the Grenadines.

In 1997, the Taiwan Technical Mission introduced two varieties into the St. Vincent and the Grenadines. They were:

1. Kung Lo jujube - oblong shaped fruit
2. 21 Century jujube - round shaped, big sized fruit.

A third variety, the Tai San Honey jujube, a round shaped middle sized fruit was introduced in 2005. These varieties have been successfully grown, with good yields, at the Taiwan Technical Mission's Demonstration Farm at Orange Hill.



Fig 1. - Jujube varieties introduced into St. Vincent by Taiwanese Mission between 1997 - 2005

MICRO-CLIMATE & SOIL

The plant can tolerate high temperatures and dry conditions. Cultivation in areas of high rainfall is not recommended. Prolonged and heavy rainfall causes flower drop and affects the rate of fruit set.

During long periods of drought the fruits will be small and hard.

Jujube can be grown in almost all types of soil. The ideal soil for cultivation is slightly acidic, sandy clay and well drained, with adequate organic matter.

PROPAGATION

There are 2 methods used in the propagation of Jujube. They are Seed Propagation and Vegetative Propagation. Vegetative propagation is recommended for the commercial production of Jujube. Propagation by seeds is used for the production of rootstock - it is not recommended for commercial purposes as this results in the appearance of off-types.

1. Seed Propagation

Rootstock propagation involves the collection of wild type jujube seeds and subsequent drying. After soaking in water for 2-3 days, sow the seeds in a nursery bed. In about 30-60 days they will germinate. When plantlets develop, (5-6 true leaves and 30cm (1ft) in height) transplanting to field or potting bag should be done.

2. Vegetative Propagation by Grafting

Cleft graft, side graft and re-grafting are the methods used to propagate plants for commercial production.

Procedure for Cleft Graft

1. Select one year old rootstock, the size of a pencil (minimum diameter 0.5 cm).
2. The rootstock stem should be between 20-30 cm long; cut off all buds.
3. Select a branch from the mother plant, at minimum 2 months

PESTS AND DISEASE CONTROL

In St. Vincent and the Grenadines the major pests and diseases affecting Jujube are: Powdery Mildew, magnesium (Mg) deficiency, Ring spot, Anthracnose, Rust, Mealy bug, Small fly, Red mite and Birds.

<i>Table 2</i>	PESTICIDES	DOSAGE	REMARKS
DISEASES			
Powdery mildews	Benlate	2tbs/gallon	Spray every 7-10 days
Ring spot	Control flowable	2-3tbs/gallon	
Anthracnose			
Rust			
INSECT PESTS			
Mealy bug	Diazinon Malation	1tbs/gallon of water	Full cover spray tree.
Small Fly		2tbs/gallon of water	
Red mite			Full cover spray tree.
Bird	Cover news paper or bag		

Powdery mildew is of major importance as a disease affecting the Taiwan Jujube. It inhibits the quality of the fruit and lowers yields. This disease occurs all year round specially during the rainy season. It affects branches, leaves, flowers and fruits. In addition, it causes fruit drop, and wilting of the leaves which become dry.

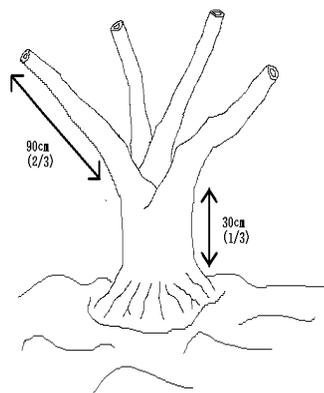
At the Taiwan Technical Mission's demonstration farm at Orange Hill, it has been observed that the Kung Lo and Tai San Honey are more resistant to powdery mildew than



Different stages of Powdery Mildew ► affecting the fruits.

(b) Main limbs pruning

After harvesting prune the main limbs 3.5ft - 4ft height from the graft union. This will induce new buds to emerge. *Fig. 5 - main limb pruning*



(c) Regular pruning

Dry, diseased, parallel, inner part of branch and old twigs and rootstock are removed. Pruning is best carried out after harvesting and in the dry season.

Flower induction through Pruning

Renew main stem pruning is done to adjust harvesting time in jujube production; while Main limb pruning and Re-grafting are used to control it. In St Vincent, after the jujube tree is pruned or re-grafted, flowering occurs 3-3½ months after. At about 3-3½ after flowering, fruits can be harvested.

THINNING

The thinning operation affects the quality of the fruit. In order to produce large fruits, complete thinning must be done. Whenever thinning is not done, fruit size tends to be small.

old, which has 2-3 swollen buds, and cut scion into wedge.

4. Insert the wedge of the scion into the cleft on the rootstock and ensure that the cambium layers of scion and rootstock coincide.
5. Tie the scion with laboratory film and cover with a plastic bag to prevent vaporization. Use newspaper to avoid exposure to strong sunlight.
6. Three (3) weeks after, remove the plastic bag. At this stage, the cambium tissues will fuse.
7. Remove all shoots that grow out below the union of the rootstock.

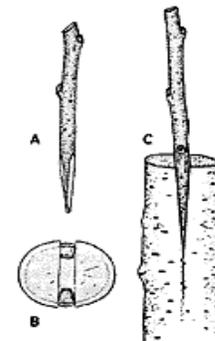


Fig. 2 - cleft grafting - (a) Scion with blunt wedge, (b) top of root stock with cleft, [c] scion grafted onto rootstock

Side graft

1. Select rootstock that is about 15cm long and at least 0.5cm in diameter from the nursery
2. Select a 0.3 - 0.5cm diameter new branch from a healthy and high yielding parent tree.
3. Using a sharp knife, slice away a matching section of bark from both plants and bind the two exposed areas together.
4. The graft will grow in about 45 - 60 days. At this stage, cut off bottom parent tree and top of the rootstock branch.



Fig. 3 - Scion of improved variety grafted onto the side of the root stock

Re-graft

In cases where due care is not taken, other buds around the grafted section grows out of control and the wild type rootstock dominates. In cases like this the scion dies and re-grafting must be done. To do this, graft from about 30-60 cm (1-2 ft) from the ground and repeat the same procedures used as in cleft graft.

Grafting could be done all year round, however the rate of success is higher during the dry season.

PLANTING

In St. Vincent and the Grenadines, it is better to plant jujube in the rainy season (June– Dec). The recommended spacing for jujube is 18ft x 18ft (5½ x 5½ m) with a plant density of 110 trees per acre.

Dig the planting holes 45cm deep and 60cm -100cm wide (1½ x 2 x 3.3ft). Put 10 kg (22lbs) of pen manure, thoroughly mixed with soil in each hole before planting.

TRELLISING AND TRAINING

A trellis should be established for jujube, because the branches are fragile. Fork sticks could be used to support fruit set branches. A trellis could also be built to hold the new shoots and a twin line to hold and train the branches. These practices will ensure ease of manipulation and prevent splitting of bearing branches.



Fig. 3 - Concrete post trellising

FERTILIZATION

Jujube fruit tree has a shallow root system and grows fast. Plants at the young and 'new shoot' stages require more nitrogen, and before flowering stage require more potash and phosphate. Mature plants should be fertilized as shown in table 1. The banana fertilizer and urea, and 20 kg compost manure per year.

In sandy soil, the magnesium (Mg) deficiency needs to be met. Therefore, it is necessary to spray fertilizer on the leaves or use banana fertilizer, to provide the magnesium requirement.

Table 1. Taiwan Jujube fertilizer application chart (g/pant)

Fertilizer \ Years	1	2	4	6	8	10 & over
Urea	100g	170g	230g	270g	320g	350g
Banana Fertilizer	950g	1500g	1875g	2290g	2670g	3040g

IRRIGATION

The jujube fruit tree is tolerant to drought condition. If good yield is to be obtained, irrigation is necessary. However, one month before flowering and fruit set, the drip area around the tree must be kept relatively dry. Care should be taken to maintain adequate soil moisture around the tree, as this could affect flower and fruit setting.

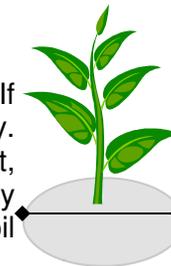


Fig. 4 - the drip area extends outwards from the stem to the edge of the leaves.

PRUNING

Jujube requires heavy pruning; so that the plant can maintain its vigor, and for easy management. The pruning styles are as follow.

- Renew main stem pruning.
- Main limbs pruning.
- Regular pruning.

(a) Renew main stem pruning

First the young plant is cut back to within 30-6– cm (1-2ft) of the graft union. This is to induce the formation of new shoots and keep 3 to 4 new stems. For plants which are two years or more, cut back the main stem after harvesting. Do this every 1 - 2 years. This operation must be performed at about 30-60 cm (1-2ft) away from the graft union. One month after cutting back, the stems will produce new shoots. The new shoots selected must be the most vigorous. Keep 3 to 4 main stems.



Fig. 4 - Pruning is done above the graft union leaving the 3 - 4 most vigorous stems to carry on