

<b>COURSE CODE:</b>	<b>HRT 505</b>
<b>COURSE TITLE:</b>	<b>Dessert Fruit Crops</b>
<b>NUMBER OF UNITS:</b>	<b>2 Units</b>
<b>COURSE DURATION:</b>	<b>Three hours per week</b>

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## COURSE DETAILS:

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## COURSE CONTENT:

Definition of dessert fruit crops. Major classes of dessert fruit crops. Indigenous, wild and exotic fruits. Economic importance of fruits. Factors affecting their cultivation. Climatic and soil requirements. Distribution of dessert fruit crops – mango, plantain, banana, pawpaw, guava, pineapple, apple, passion-fruit, citrus, grape, date-palm etc. site selection, layout, land preparation, planting. Crop improvement practices. Orchard maintenance. Harvesting, grading, storage, packaging, processing and marketing.

**Practical:** Land preparation techniques, nurseries and management. Visits to orchards of the crops named above. Seed and fresh fruits identification. Grape and vine pruning and training. Grape and resin processing.

## COURSE REQUIREMENTS:

The course is compulsory for all students in the Department of Horticulture. All students must meet 75% attendance in the class in order to be eligible to write the examination on the course.

## READING LIST:

Opeke, L. K. Tropical Tree Crops. Spectrum Books Ibadan, Nigeria. 2005.

Nakasone, H.Y. and Paull, R.E. Tropical fruits CAB International, U.K. 1998.

R. E. Litz. The Mango: Botany, Production and Uses. CABI. 1997.

R. H. Raemaekers. Crop Production in the tropical Africa. Directorate General for International Cooperation. Ministry of foreign affairs, External trade and International Cooperation. Brussels, Belgium. 2001.

## LECTURE NOTES

## **DEFINITION OF DESSERT FRUIT CROPS**

The term fruit can have different meanings but in the botanical biology it is the ripened ovary of a flowering plant which contains seeds. However fruit as food limits the usage to those fruits that are sweet and fleshy.

A dessert is a sweet food served as a part of a main meal or after the main meal. Dessert fruit therefore is sweet fruit served and eaten with or after a main meal.

Example include Mango, Banana, Pawpaw, Guava Pineapple, Apple, Passion fruit, Grape, Date palm e.t.c

### Major Classes of Dessert fruits

#### Indigenous fruits/Wild

**Indigenous fruits** are those which are native to Africa, where they have originated and evolved over centuries.

Most indigenous fruit trees generally grow wild. The fruits are harvested and eaten at home, sold at the market or processed into jams and juices to add additional value. Indigenous trees, such as marula, baobab, African plum, are mostly found wild, although some are now planted, but they all evolved in the African environment.

**Exotic fruits**, are imported from other continents, although they may now be quite commonly grown in many areas such as Citrus and Mango. Mango particularly is common across much of Africa but actually originated in southeast Asia.

#### **Factors affecting cultivation of dessert fruits**

##### **i) Ecological requirements**

- ❖ altitude,
- ❖ wind,
- ❖ rainfall,
- ❖ temperature,
- ❖ irradiation /photoperiod
- ❖ soil type

##### **ii) Establishment and management practices –**

#### **Papaya**

Indigenous to southern Mexico, Central and South America, papaya plants are relatively short lived (1-3 years) and are easily propagated from seed. Seedlings are spaced on the field at 2- 4m spacing. Papayas are relatively easy to grow so long as they are sited in full sun and have excellent drainage. Common throughout the tropics, papayas are small to large fruits born on the stem of upright semi-herbaceous trunks. Fruit are sweet, have orange to reddish-salmon colored flesh and contain numerous small black seeds in the interior cavity. Papaya fruit is typically peeled, sliced and consumed fresh. Papaya ringspot virus can be a problem causing stunting and fruit loss; at present there is no control for this disease. Papaya fruit fly is another problem but can be overcome by placing a paper bag over developing fruit. Papaya needs light well drained soil, avoid water logged condition

Amend the soil with plenty of organic matter and fertilize often. The young fast growing plant needs regular application of N – fertilizer, deficiency of P- fertilizer results in dark green foliage. Season: year round.

## **Passion Fruit**

Native to South America, passion fruit is a vigorous vine that produces purple, yellow, or reddish colored fruit containing seeds surrounded by an orange, sweet, watery pulp. The juice is very aromatic and is commonly used to make juice or punch. Plant vines next to a fence or along a trellis in a well drained soil area with full sun. Vines begin to bear within 3-6 months of planting. Season June-Dec.

### **TOPIC: IMPROVEMENT PRACTICES IN DESSERT FRUIT CROPS**

Practices aiming at introducing, selecting or breeding of dessert crops with higher percentage of desirable traits and lower percentage of undesirable traits.

#### **Why Improving Dessert Crops?**

- **Improve on the desirable agronomic characters at the expense of undesirable ones:**
- **Production of disease- tolerant varieties:**
- **Production of crop types adapted to adverse environmental conditions:**

- **Production of crop varieties that are higher-yielding:**
- **Production of crop varieties adapted to modern cultivation technology:**
- **Production of crops with improved quality and processing characteristics:**

#### ❖ **ECONOMIC IMPORTANCE OF DESSERT FRUIT CROPS**

- Reservoir of nutrients
- Industrial raw materials
- Sources of employment
- Ecological usefulness (the root and canopy check erosion thus ameliorate climate change)
- Sources of local herbs for therapy

#### ❖ **PRINCIPLES OF CROP IMPROVEMENT**

A living cell has a nucleus inside which there are several thread-like bodies, the chromosomes. Along the chromosomes are located the unit of inheritance, the genes. It is the gene that determines the various characters of an individual.

### **METHODS OF IMPROVING DESSERT CROPS**

#### **Introduction.**

In most parts of the world, farmers in a location only cultivate some species of particular crop that are resistant / tolerant to the prevailing infection / infestation but low-yielding. Farmers in another location may be cultivating another species of same crop which may be better in yield or quality characteristics but susceptible to the prevailing infections / infestations. Introductions of the crop's species with desired traits would bring about economic cultivation of the crop in both locations.

#### **Selection.**

This process of choosing the desired individuals for continued propagation while discouraging the propagation of unsuitable individuals is described as selection. The meiotic gamete formation and subsequent fertilization results in the production of a large number of different types of zygotes. From these pools of different individuals, the farmers make selections of individuals that will produce the best crops while discarding those that are of low productivity.

#### **Cross-breeding.**

In self-pollinated crops, natural processes will continue to produce the same type of individuals, though, the number of the offspring may be much, but the desirables among them may be few.

Even, at times under natural pollination, the number of individuals (zygotes) produced may not be sufficient for the farmer. It is therefore desirable in crop improvement to make deliberate pollinations from certain plants to others. This phenomenon is cross-breeding.

**Improvement of asexually propagated dessert crops.**

- Perpetuation of desirable characters.

**Improvement of sexually propagated dessert crops.**

- Mass selection
- Pure line selection
- Back crossing
- Hybrid breeding.

**Comparison of an improved and an unimproved dessert crop varieties.**

- Earliness
- Sensitivity to day length
- Plant growth habit
- Fruit location
- Disease tolerance
- Yield
- Seed coat texture
- Palatability

**MANGO (*MANGIFERA INDICA*, L.)**

Other Varieties Include:

*M. castury*  
*M. laurina*  
*M. odorata*  
*M. gebede*, Miq.

**Origin:**

Mango is one of the oldest cultivated fruit trees. It probably originated from India or the Malaysian archipelago and its cultivation dates back a very long time. Mango has been cultivated in India for at least 4,000 years. Apparently, it was introduced into Africa around 10<sup>th</sup> century, by the Arabs, as far south as the Congo basin. The crop had been in West Africa since 16<sup>th</sup> century through the Portuguese and the Dutch.

**Description**

*M. indica* (2n=40), like other *Mangifera species* mainly present in Southwest Asia and Malaysia. It belongs to the family *Anacardiaceae*. The tree can grow up to 15-20 m and its trunk diameter can reach 1.50 m.

Vegetative growth of mango is different from that of other fruit trees and it follows a distinct pattern. Each flush is followed by a distinct period of dormancy. There are several flushes per year. Flushing in mango is irregular.

When the branches have accumulated sufficient reserves, the apical bud transforms into a flora bud. This happens only to 1-year-old shoot/flush.

The fruit is a drupe suspended on a long peduncle.

**Production Regions:**

Production of mango spread throughout the tropics, where it is grown for its fruit and as a shade and ornamental tree.

**Environment:**

Mango grows well in tropical regions with distinct dry and wet seasons. Mango produces very well within Latitude 2°N and 2°S of the equator.

The optimal temperature is between 23°C and 27°C (larger internodes and leaves are indicators of optimum temperature).

If the average annual rainfall is less than 700 mm, irrigation becomes inevitable in commercial mango production. Below this average, mango can be grown in a family orchard or backyard. Mango is resistant to strong winds because of its strong tap-root system.

**Site selection:**

The current status of vegetation and nearness to water source determine the cost of establishment and maintenance. It thrives in a wide variety of soils but, prefers deep, fairly light or medium soils. The pH must be between 5.5 and 7.5. Mango is sensitive to excess salts at very high concentrations.

**Land preparation:**

- Traces across regrown forest
- Selective felling of trees
- Cross cutting
- Packing

**Field layout:**

- Pegging in line with planting spacing and envisaged farming technology.
- Consideration is given to fire tracing.

**Propagation:**

Mango is propagated by seed (resulting in seedling) or grafting (resulting in ramets). Only the polyembryonic varieties are true-to-type (owing to the existence of nucellar embryos) and can be propagated by seeds.

**Sowing:**

Mango seeds (stones) are non-dormant. At the time of harvests, they are morphologically and physiologically matured.

For direct sowing on seed-bed, germination is better when the stone is hulled and the kernel extracted and sown. Sowing is done on seed-beds enriched with manure.

**Grafting:**

Mango is commonly propagated by side-grafting or whip and tongue grafting. The preparation of the graft is very important for its success. Many failed grafts would appear to be due to the scion's terminal but being at the wrong developmental stage.

**Planting:**

The best time for planting is when the rains are steady. Plant spacing and density is influenced by-

- Climate
- Soil type and depth
- Rootstock and scion vigour
- Growth habit and ultimate tree-size

- Cultural practices like tree-size control practices, fertilizer and irrigation availability, current technology and necessity for orchard access by farm machinery.

The recommended spacing has been between 7 m x 7 m and 15 m x 15 m. High-density planting (HDP) (3 m x 2.5 m) has been tested with grafted trees.

**Other plantation management operations include**

- fertilizer application
- irrigation
- improvement of flowering

**Harvest:**

The best quality fruit is obtained at full maturity. The fruit left on the tree until this stage acquires the characteristics mango scent and flavour. Mango fruit for export must be harvested as soon as the green colour of the peel begins to turn.

**Yield:**

Yields of mango vary considerably. The crop is prone to the phenomenon of alternation, particularly in extensive cultivation. An average of 20 – 30 t/ha serve as a basis for productive varieties cultivation without extra irrigation, yields can range from 5 - 15t/ha.

**Use:**

- Mangoes rank among the best tropical fruits. They are eaten fresh, when they can be easily detached from the peduncle.
- The flesh (mesocarp) can be sliced length-wise and cross-wise. Small cubes, which detach easily on either side of the seed, are thus obtained.
- Mangoes are also of industrial purposes. Green mangoes are used in compotes and particularly for the manufacture of condiments. The ripe fruit ends up in desserts, sherbets and drinks. Freezing, unlike cooking, preserves the flavour.
- Bees are strongly attracted to the flowers. The wood is of relative importance. Various parts of the tree have several uses in popular medicine.
- As an ornamental tree near homes, mango has the disadvantage of attracting flies at fruiting time.

**Marketing:**

The crop's world market is growing rapidly. Mango is one of the most popular tropical fruits in Europe

## **GUAVA (*PSIDIUM GUAJAVA*, L.)**

### **INTRODUCTION:**

Guava belongs to the family *myrtaceae*, which has more than 80 genera and 3000 species, distributed throughout the tropics and subtropics, mostly in the Americas, Asia and Australia. Species range from tall trees to shrubs and woody creepers

Important genera and species:

There are four genera of interest because of their fruits:

- *Psidium*
- *Eugenia*
- *Syzygium*
- *Feijua*.

### **ECOLOGY:**

#### **Soil**

Guava is adapted to a wide variety of soil types. The crop will thrive on shallow and infertile soils, although growth and production may be low with pH range from 5 to 7.

### **CLIMATE:**

#### **Rainfall**

Guava performs best with abundant rainfall but 1000 – 2000 mm rainfall per year is optimal, although it tolerates drought. The ideal rainfall pattern for guava is monsoon .

#### **Temperature**

Guava does best in warm areas with abundant moisture and it is cultivated from sea level to elevations exceeding 1500 m, if frost-free. The optimum temperature is between 23°C and 28°C.

#### **Light**

Light saturation for this C3 plant is high, above 925  $\mu\text{mol m}^{-2} \text{s}^{-2}$  photosynthetic photon flux.

#### **Photoperiod**

Guava has not shown any visible response to photoperiod

#### **Wind**

Guava trees grafted on seedling rootstocks have tap roots that provide substantial anchorage. However trees from rooted cuttings are subjected to uprooting by strong winds within the first 3 years.

### **GENERAL CHARACTERISTICS:**

#### **Tree**

Guava is shrub but under high moisture conditions, grows to a height of 6 – 9 m and spread to form a canopy. The trunk diameter is 30 cm or more.

#### **Flowers**

Flowers are single or in clusters of 2 to 3 at the leaf axils of the current and preceding growth flushes.

#### **Fruit**

Guava fruit is botanically a many seeded berry, ovoid, elongate or pear-shaped, with size varying from 2.5 to 10 cm in diameter.



## **PROPAGATION:**

### **Sexual**

Seed germination is used to generate seedlings for improvement programmes on the crop or to produce rootstocks for grafting of desirable cultivars.

### **Asexual**

Polybags-grown seedlings may be budded or grafted when stem diameters are 12 – 20 mm, with higher diameter being especially suitable for budding. Budding is preferred to grafting techniques.

### **Site selection:**

Thickly forested sites or sites with regrown forest or a cropped land being converted to guava plot. The site must not be water logged.

### **Field layout:**

This is done according the available technology

### **Field preparation**

Field preparation follows conventional method. Soil pH is best maintained between 5 and 7.

### **Transplanting and Plant Spacing**

Well-grown rooted cuttings (ramets) 6-8 months old can be transplanted into the field after hardening in the direct sun for several weeks. Generally the transplanting spacing is between 4.0 m x 6.0 m and 5.2 m x 7.6 m.

### **Irrigation**

Guavas thrive in areas with long dry periods and a wide range of rainfall. Adequate moisture is required during vegetative growth for optimum flowering and fruit development. Drip irrigation is being increasingly used in guava production to replenish the daily water loss. Fertigation is carried out in larger orchards.

### **Pruning**

The objective of pruning is to open up the canopy in order to permit more sunlight which leads to more shoot production and increased yield. Pruning begins at the early stage of the plant growth.

### **Cycling**

Guava produces varying amount of fruit yield throughout the year in the tropics. Under natural conditions of drought and / or low temperatures followed by irrigation and warm temperatures, there is prolific flowering especially if the trees have shed their leaves.

### **Weed control**

Weed control is crucial during the first 2-3 years of orchard establishment. Thereafter, the canopy of the trees provides adequate shade to minimize interference by weeds.

### **Orchard protection**

Windbreaks are essential in a guava orchard meant for orchard markets.

### **Yield**

Fruit yield depends on

- cultivar potential
- planting density
- weather conditions
- all other factors involved in orchard management especially for fruit cycling.

### **Harvesting**

For dessert guavas harvesting is done manually and carefully handled to avoid injury to the fruits.

**Grading;**

Grading in guava is size-based.

**Packaging:**

The fruits are packed carefully in cartons for shipment/transportation to markets.

**Marketing:**

Over-ripped, bruised, infested and infected fruits attract low market premium. They are therefore culled rather than allowing them to fall and become sources of infection/infestation in the orchard especially the fruit flies.

**Postharvest treatment**

Guava is generally grown for processing, but in areas free from fruit flies or where fruit bagging is practised, low-acid cultivars can be grown for fresh consumption.

**Utilization**

Guava is widely grown throughout the tropics and subtropics and is either consumed fresh or processed. India and Mexico are by far, the largest producers of guava in the world. Guava is an excellent source of ascorbic acid (in the skin), pectin (in the flesh), dietary fiber, vitamin A and Ca.

### **VITICULTURE (GRAPE (*Vitis vinifera*, L.))**

The **science, practice and study of grapes and/or vineyard production** is known as viticulture.

The history of viticulture is closely related to the history of wine with evidence of man cultivating wild grapes to make wine as far back as Neolithic period. The earliest domestication of **grape (*Vitis vinifera*, L.)** occurred in the area of modern day Georgia, Near East. This domestication favoured the hermaphroditic members of *Vitis vinifera* species against the barren male vines and female vines which were dependent on having a nearby male vine to pollinate them. With its ability to pollinate itself overtime, the hermaphroditic vines were able to sire offspring that was consistently hermaphroditic. Therefore, grape production became an important component of the world economy around 3000 BC and 2000 BC.

### **VINE CULTIVATION**

The vast majority of the world's wine producing regions are found between 50<sup>o</sup> and 30<sup>o</sup> north and south of the equator.

### **Climate categorization in viticulture / Climatic Types of the Viticultural Regions**

In viticulture, the climates of wine regions are categorized based on overall characteristics of the area's climate during the growing seasons. While variations in macroclimate are acknowledged, the climates of most wine / viticultural regions are categorized as being part of

- **Mediterranean climates**
- **Maritime climates**

- **Continental climates.**

#### **Influence of climates on viticulture**

Before establishing whether or not viticulture is sustainable in an area, the climate of the area goes a long way in influencing the type of grape varieties cultivable in the region and viticultural practices that will be used. Such climatic conditions include

- **Temperature**
- **Rainfall**

#### **CULTIVATION OF GRAPES (VITIS VINIFERA)**

Varieties grown: *Vitis vinifera*, is the most widely cultivated variety but susceptible to Phylloxera infestation. Thus, *V. vinifera* is grafted on *V. labrusca* which is resistant to Phylloxera infestation.

#### **Soil requirement:**

Grapevines for quality wine production generally, do best on freely draining, low-fertility soils.

#### **VINE MANAGEMENT**

Good wine starts from the vineyard. It is the grower's job to deliver a quality crop to the wine maker. The growers must match a grape variety to its site and manage its growth through the seasons.

#### **Planting and Training vines:**

Growing vines need some form of support to hold them above the ground and to maximize sunlight on their leaves. They are therefore, trained onto a wire trellis system attached to posts erected in the ground.

#### **Pruning:**

If grapes are not pruned each year, they develop many unproductive shoots and soon become a tangled mess of leaves and stems. At least 90% of the previous season's growth is removed each winter (when vines are dormant).

#### **Harvest:**

As grapes ripe, their sugar levels increase and acid levels decrease. This fruit is ready for harvest when its sugar levels are between 20% and 24%.

#### **Insects and disease pests of vines**

##### **Phylloxera:**

The main insect pest of grapes is phylloxera (*Dactulosphaira vitifoliae*), a tiny aphid that sucks sap from vine roots. Within a few years of infestation, the vine declines in plant vigour, losing leaves and producing reduced crop yield.

##### **Mealy bugs:**

These are also sap-sucking insects and they also reduce the vine plant growth vigour. Besides, they transmit **leaf-roll** viruses from vineyards to vineyards.

Other pests of grapes include **Birds** and **Rabbits** and fungal infections which include **powdery mildew** and **downy mildew**

##### **Marketing:**

Grapes are either marketed as fruits or processed into wine. Wine production is the most important use of grapes. Wine can be shelved for a longer period compared to grape fruits.

## **DATE PALM (*Phoenix dactylifera*, L.)**

### **ORIGIN**

The exact origin of date palm is not known. However, it is certain that date palm was cultivated as early as 4000 BC, since it was used for construction of the temple of moon god near Ur in Mesopotamia (now southern Iraq).

*P. canariensis* (Canary palm) *P. dactylifera* are not an edible date, but is very good as an ornamental plant.

### **Botanical Description**

#### **Root system:**

It is a monocot plant, thus no tap-root. Instead the plant has fibrous roots that are fasciculated. Secondary roots appear on the primary roots and develop directly from the seed.

**The trunk / stem:** The date palm trunk or stem or stipe is vertical, cylindrical and columnar of the same girth all the way up. The girth does not increase once the canopy has fully developed.

**The leaves:** Depending on variety, age of a palm and environmental conditions, leaves of a date palm are 3 to 6 m long (4 m average) and have a normal life of 3 to 7 years. An adult date palm has approximately 100 to 125 green leaves with an annual formation of 10 to 26 new leaves.

**Fibre, spines and leaflets:** The base of the frond is a sheath encircling the palm. This sheath consists of white connective tissue ramified by vascular bundles.

Spines, also called thorns, vary from a few cm to 24 cm in length and from a few mm to 1 cm in thickness.

Leaflets or pinnae are between 120 to 240 per frond, entirely lanceolate, folded longitudinally and obliquely attached to the petiole.

**Reproductive organs:** Date palm is a dioecious species with male and female flowers being produced in clusters on separate palms.

**Seed:** As with the fruit, seed characteristics vary according to variety, environment and growing conditions. A seed's weight could range from less than 0.5 g to about 4 g, in length from about 12 to 36 mm and in breadth from 6 to 13 mm.

## **GEOGRAPHICAL DISTRIBUTION OF DATE PALM**

Date palm is found in both the Old World (Near East and North Africa) and the New World (American continent) where dates are grown commercially in large quantities. The date belt stretches from the Indus Valley in the east to the Atlantic Ocean in the west. In order to have a clear picture on the geographical distribution of date palm, it is worth looking at it from the following aspects:

- (i) Distribution according to latitude,
- (ii) Distribution according to altitude,
- (iii) Number of date palms in the world.

#### **NUTRITIONAL VALUE DATE:**

Dates are very nutritious, assimilative and energy producing. With the present uncertainty in the world food supply and the expected increase in demand, the date palm could be a good source of food of high nutritional value. In fact, date fruit is rich in nutrients, and due to its dietetic values it has always been held in high esteem by people. Compared to other fruits and foods (apricot: 520 calories/kg; banana: 970 calories/kg; orange: 480 calories/kg; cooked rice: 1,800 calories/kg; wheat bread: 2,295 calories/kg; meat (without fat): 2,245 calories/kg, dates give more than 3,000 calories per kilogram.

#### **CLIMATIC REQUIREMENTS OF DATE PALM**

**Temperature requirements:** Date palm is cultivated in arid and semi-arid regions which are characterized by long and hot summers.

**Rain effect:** Date palm culture has mostly been developed in areas with winter rainfall which does not cause harm to the date fruits.

**Air relative humidity:** In fact, the date palm eco-system is mostly of an arid nature where air relative humidity has a large influence.

**Wind:** Compared to other plant species, the date palm shows no damage under windy conditions.

**Light:** The growth of a date palm is inhibited by light rays at the violet and yellow ends of the spectrum

#### **PROPAGATION OF DATE PALM**

There are three techniques to propagate date palm:

- **Seed propagation,**
- **Offshoot propagation (traditional methods),**
- **Tissue culture techniques.**

**Seed Propagation:** Seed propagation, also called sexual propagation, although useful for improvement purposes, is not a proper method of date palm propagation.

**Offshoot propagation:** Offshoot propagation, also called asexual or vegetative propagation is a preferable technique.

**Tissue culture:** The application of tissue culture techniques for date palm, also called *in vitro* propagation.

**Nursery operations and Management of date palm plant:** Transplanting of date should be done properly with no disturbance to the root system.

### **LAND PREPARATION FOR DATE PLANTATION ESTABLISHMENT**

When establishing a new date plantation, certain actions need to be implemented to ensure the long term success of the plantation. One of these actions involves the initial land preparation which should be done prior to transplanting of the plant material (offshoots or tissue culture-derived plants). Critical factors to consider during this planning exercise include the followings:

- Availability and quality of irrigation water
- Field selection
- Mechanical actions to be implemented
- Chemical needs for pre-plant soil improvement

**Planting operations:** This is probably the most critical phase in the establishment of a new date plantation. Mistakes at this point may lead to a poor survival rate of the transplants.

**Plant spacing:** This varies but, examples include, 10 m × 10 m (100 palms/ha). It has, however, changed over time and a plant spacing of 9 m × 9 m (121 palms/ha) or 10 m × 8 m (125 palms/ha).

**Planting time:** The critical factor is to transplant the young tissue culture date palms or offshoots at that time of the year that will ensure a good survival rate and proper establishment before the beginning of a "hard" season.

**Transplanting stage:** The best field survival rate, as well as early plant development, is obtained when the date tissue culture plantlets are transplanted at the four (4) plus pinnae leaf stage.

**Basin preparation:** Immediately after transplanting, a basin is prepared around the palm to prevent run-off and to ensure a sufficient supply of water to the plant. When using a micro irrigation system, it is recommended to have a basin of approximately 3 m in diameter and 20 to 30 cm deep.

**Mulching:** The benefits of organic material as mulching materials are immense.

**Irrigation:** Immediately after transplanting, the palm should be irrigated to limit transplant stress. Once the plantation is established, a frequent irrigation schedule is to be followed to allow sufficient water supply to the young date palm.

**Protection:** Tissue culture-derived plants and young offshoots should be protected from harsh climatic conditions (sun and wind during the first summer and cold the following winter) and against some animals (rabbits, etc.).

**Aftercare:** Beside irrigation applications, the annual fertilizer application schedule, weeding and mulching, the date grower should, for at least the first 10 to 12 months, keep an eye on the plantation in order to detect and consequently correct any adverse situations.

**Harvesting:** Although attempts are being made to harvest the fruit by shaking the trunk of the palm in order to avoid having to climb it, it is still necessary to reach the top of the palm to harvest the fruit. Mechanical harvesting is done in Israel and elsewhere.