

Cultivation of Avocado and Post Harvest Handling



Introduction

The Avocado (*Persea Americana Miller*) is an evergreen tree of the family Lauraceae with seedling plants reaching 67ft (20m) in height with small large, single seeded fruits having yellow to yellowish green butter-like flesh. Mature fruit vary in colour and may be green, yellow, purple or red.

Cultivation

There is always a great demand for Avocado plants and the NARI Plant Nurseries are finding it difficult to keep up with this demand. Consequently, the availability of plants at the Plant Nurseries cannot be guaranteed at any time.

Although there are seedling trees around, Avocado plants are commonly grafted as this reduces the time taken for bearing, combines the best characteristics of varieties and improves resistance/tolerance to diseases.

Fruits are collected from healthy, vigorous, mature trees and deseeded; the seeds are washed, dried and sown individually in black plastic bags, broad side down and covered with not more than 1 inch (2.5cm) of soil.

Grafting is done when plants have attained a height of about 1.5ft (0.5m). Wedge grafting is the type commonly used. The scions for grafting are collected from healthy, vigorous, mature trees having desirable traits e.g. fruit size, flavour and shape. The graft is wrapped securely and covered with clear plastic until it catches. This is seen if graft remains green and buds start to burst into leaf after 2-3 weeks.

During this entire process the plants should be protected from severe sunlight and receive adequate water until transplanting in field.

Avocado plants are ready for planting out in the field approximately 6-9 months after grafting.

Site Selection

Avocado can be grown on a variety of soils but it does not thrive on the coastland. Nevertheless, wherever the avocado is planted there is need for good drainage since its shallow root system makes it sensitive to poor drainage and water logging.

Selection of Varieties

There are numerous varieties of Avocados but they all have either of two flowering patterns: A or B.

The A type flowers are those which show receptive female parts in the morning and receptive male parts in the afternoon of the following day. The B type flowers show receptive female parts in the afternoon and receptive male parts in the morning of the following day. With this mechanism the female parts of the A type flowers are thus receptive to pollen from the B type flowers in the mornings, whilst the female parts of the B type flowers are receptive to pollen from the A type flowers in the afternoon.

Avocado is not commonly self-pollinated, therefore it is important to encourage crosspollination by having A and B type trees in the orchard or backyard.

Avocado varieties can be further separated into two groups based on their season of bearing. There are the early-bearing varieties which fruit in March/April, and the late bearing varieties which fruit in late July/ August. A commercial grower would be advised to plant early and late bearing varieties to ensure an extended fruiting sea son and thus capitalising on the markets when the early types are out of season.

Planting

Planting should be done during the wet season while there is an adequate supply of moisture for quick establishment of roots. When planting, the vigour and growth pattern of the trees should be considered. Those that have a spreading habit would require more space than upright types. Generally, plants are spaced 20-25 ft apart (6-7.5m) giving approximately 100-70 trees/acre (250-175 trees/ha).

Normal areas:

In areas where there is no water logging, planting holes are dug to a size that would accommodate the plant in the bag. The size of the hole should therefore be around 1ft (30cm) in length, width and depth. The roots of bare root plants are more spread out and a larger hole will have to be made to accommodate these plants.

The topsoil removed in digging the hole could be mixed with rotted manure and/or some phosphate fertiliser. Some of the soil is then returned to the hole filling about half way up.

The plastic bags are carefully removed to keep the root ball intact and the plants are placed in the holes. The balance of the topsoil is then returned to fill the hole and thoroughly compressed. The plants should then be watered.

After planting, it is recommended to stake the plant to prevent movement by wind.

Waterlogged areas:

In areas where water-logging is suspected, the same system is used except that planting is done on mounds.

AFTERCARE

Training and Pruning

Avocado plants should be pruned to encourage branching to ensure a good framework. Pruning should be practiced after harvest to remove dead wood as well as to maintain the framework of the tree. Avocado plants are brittle and break easily thus windbreaks should be planted.

Fertilising

Fertiliser needs are directly related to the type and nutrient status of the soil. It is essential therefore that a soil analysis be conducted to determine these factors for the particular location.

However, in the absence of a precise soil analysis, the following might suffice:

Clay Soils - Compound Fertiliser 12:12:17:2 at the rate of 1/21b (225g) to 2lbs (0.9kg) depending on the age and size of the plant is applied twice per year, usually at the beginning of each wet period.

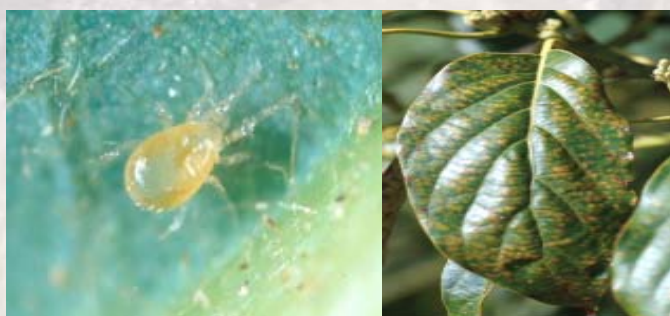
Sandy Soil - the above is to be used at the higher rate as well as 9:27:9 +FTE at the rate of 1/41b (112 g) to 1/21b (225 g) per plant once per year.

PEST MANAGEMENT

There are no major pest problems in Avocado.

The most serious are Mites (Figure 1) and Scale Insects and these could be controlled by the use of Danitol (Fenpropathrin) or Rogor (Dimethoate) at 0.02 pts per gallon (10 mls/4L).

- It should be noted that the occurrence of any unusual pest or disease must be reported to the Crop Protection Section at NARI for investigation.



Mite Mite damage
Fig 1. Mite and damage caused

DISEASE MANAGEMENT

Three main fungal diseases affect avocado:

- Avocado root rot (*Phytophthora spp.*)
- Anthracnose (*Colletotrichum gloeosporioides*)
- Scab (*Elsinoe perseae*)

1. Avocado Root Rot (*Phytophthora spp.*)



Fig 2. Symptoms of Avocado root rot.

Symptoms:

Leaves are smaller, pale, wilted, and fall giving the tree a sparse appearance. This is accompanied by dieback of twigs and branches, fruit drop or small fruits, and defoliation (Figure 2).

Watering too often or with excess amounts increases avocado root rot.

Control

The best method of control for this disease is its prevention in the first place. This is done by the use of disease-free planting material, use of sterile tools in grafting, efficient drainage and irrigation, and use of resistant rootstocks. The disease may be treated with a soil drench of Metalaxyl (Ridomil) at the rate of around 0.15g/ml. The measurement here refers to the canopy of the tree.

2. Anthracnose (*Colletotrichum gloesporioides*)



Healthy fruit



Symptoms of anthracnose

Fig 3. Healthy fruit and symptoms of anthracnose

Symptoms

This disease affects immature fruits and shows up when fruits ripen as small, brown, sunken lesions, which soften 7-15 days after harvest. This leads to fruit deterioration (Figure 3).

Control

Control may be achieved by the routine spraying of a Copper Fungicide such as Kocide from the onset of flowering to fruiting at a rate of about 5 ozs. (140g) in 1 gallon (4.5 L). The fruits may also be dipped in a fungicide solution, e.g. benomyl mixed at 1/2 oz/0.8 gallons (1 5g/4L) water. This treatment prevents the disease from showing up on the fruits.

3. Scab (*Elsinoe perseae*)

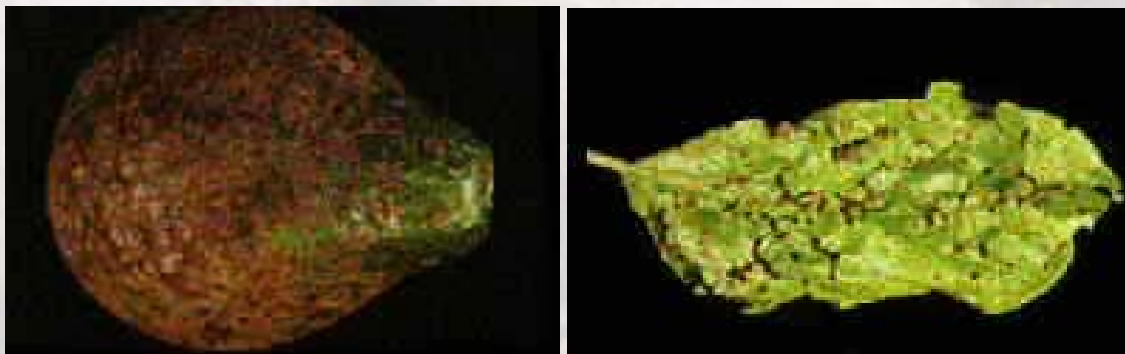


Fig 4. Scab on fruit and leaf



Fig 5. Scab on fruit

Symptoms

Raised cream coloured to pale brown / orange warts are seen on the fruit and leaf surface (Figures 4 and 5).

Control

Pruning to increase air-flow within the canopy of the tree may be done to reduce the incidence of this disease.

Harvest Maturity Indices

The flowering period in avocados ranges from about 4 to 14 weeks, depending on cultivar and environmental conditions. Therefore, fruits from the same tree will vary in maturity dates. Determination of the correct harvest time is important because it affects the fruit quality and market life. It is important to pick the fruit when mature, as immature fruits will shrivel and not ripen properly. Determining the appropriate harvest maturity may be difficult and experience is important. Fruit of some avocado cultivars, particularly of the West Indian race, fall from the tree when physiologically mature and must be picked prior to fruit drop. In cultivars from the Guatemalan race and its hybrids, the fruits remain attached to the tree for as long as three or four months after physiological maturity has been reached. Avocados generally do not ripen while they are attached to the tree. Fruits are still hard when mature and ripen only after being picked.

AVOCADO

Several indices may be used to determine avocado fruit maturity. In Guyana, the fruit is considered sufficiently mature for harvest when it reaches a specified calendar date (i.e. days after full bloom) and weight or size. The specific dates, weights, and sizes used to determine maturity vary by variety. Mature fruits are usually picked at weekly intervals over a period of a month or more, the largest fruits being selected each time. The outer waxy surface of the avocado changes appearance upon fruit maturity. Smoothness of the skin is a reliable indicator of maturity in most varieties. As fruit approach maturity, they develop a smoother skin surface. Also, the glossiness or shine of the fruit surface becomes duller as the fruit reaches maturity. External colour can be used as a maturity index. The skin colour of many cultivars changes from green to light green with maturity. Reddish streaks may also appear at the stem end of certain deep green skinned cultivars when the fruit becomes mature. Internally, the seedcoat of mature fruit turns brown with maturity. Also, in some looseseeded cultivars, mature fruit produce a hollow sound when tapped. Oil content is used as a maturity index for those cultivars high in oil. A minimum of 8% oil is used as a maturity index for Hass avocados in California. However, oil content is not used for the cultivars grown in Guyana, since they are relatively low in oil content. The high oil containing cultivars (i.e. >18%) are not adapted to Guyanese growing conditions. Avocado cultivars grown in Guyana contain between 3% to 15% oil. Dry matter is also used as an index of maturity for certain cultivars. A strong correlation exists between the percentage of oil and the dry matter content. The dry matter is determined by drying 10 gm (.4 oz) of chopped fruit tissue in a microwave oven for 5 minutes.

Avocado fruit are attached to the tree by a stem (pedicel) that changes in appearance as the fruit matures. The area of the stem nearest the fruit changes in colour from green to brown or black when the fruit is mature. This colour change signals the formation of an abscission layer in the stem indicating the fruit is mature and ready for harvest.

Principal Postharvest Diseases

Avocados are susceptible to several common postharvest fungal diseases, including Anthracnose, Stem-end rot, Fusarium rot, and Soft rot.

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum gleosporioides*, is a serious postharvest disease of avocado fruit. The fungus does not develop until the fruit begins to ripen. Fruit lesions start as circular, slightly sunken, brown to black spots. These lesions enlarge rapidly under favorable conditions, often becoming conspicuously sunken with cracks radiating from the lesion center (Figure 6). The affected areas become covered with pinkish spore masses in later stages. The fungus can progress into the flesh of the avocado fruit, producing a brownish-black decay and rancid flavour, which eventually may involve a large portion of the fruit.

The *Colletotrichum* fungus is considered a weak pathogen and requires some type of wound to penetrate the avocado and subsequently cause disease. Mechanical damage, scab, and especially *Cercospora* spot lesions are known entry sites for the anthracnose fungus. Insects may also provide wound-infection sites.



Fig 6. Anthracnose lesions on ripening avocado fruit.

Since all cultivars are susceptible, anthracnose control depends on good orchard sanitation and control of other diseases (especially *Cercospora* spot) and avoidance of cuts and bruises to the fruit in handling. Fruits showing any sign of anthracnose should not be packed in cartons with healthy fruit. Dipping the fruit in a 500 ppm solution of thiabendazole may also reduce the incidence of anthracnose. Cooling the fruit to 13°C (55.5°F) and maintaining that temperature during marketing will minimize anthracnose development. Harvesting fruits in an immature condition can contribute to anthracnose appearance since the fungus may infect immature fruit and remain dormant, with subsequent invasion of the flesh through small cracks made during ripening or postharvest handling.

Stem End Rot

Stem end rot is caused by two different fungal organisms, *Botryodiplodia theobromae* and *Dothiorella gregaria*. Symptoms appears as an initial dark brown to black discolouration beginning at the stem end and advancing toward the blossom end, finally covering the entire fruit (Figure 7). Decay develops rapidly as the fruit softens. Stem end rot is usually only a problem with immature harvested fruit and can be prevented by harvesting fruit at the proper stage of maturity. Control measures used for anthracnose will also help minimize stem end rot.



Fig 7. Stem end rot of avocado fruit.

Fusarium Rot

Fusarium rot is caused by several species of *Fusarium*. Infection usually takes place via the stem end or through injuries in the skin (Figure 8). This fungal disease accelerates the rate of softening and ripening. Recommended control measures are similar to those used for combating anthracnose.



Fig 8. Fusarium rot of avocado.

Rhizopus Rot

Rhizopus rot is caused by the fungus *Rhizopus stolonifer*. It is characterized by rapid decay of ripe avocados with the formation of

a coarse white mold on the fruit surface.

Liquid may leak from the fruit and the odour is unpleasant. Infection is associated with wounds and can be significantly reduced by careful harvest and postharvest handling to minimize mechanical injuries.

Chilling Injury

Guyanese avocados are susceptible to chilling injury when kept at temperatures below 10°C (50°F). External symptoms of chilling injury include browning or blackening of the skin, pitting, and sunken lesions. Internal symptoms include browning around the vascular bundles and/or a general grayish-brown discoloration of the flesh (Figure 11).

Chilling injured fruit fail to ripen normally, develop off-flavours, and are highly susceptible to pathogen attack. The amount of chilling injury damage depends on the storage temperature, duration of exposure to chilling temperatures, cultivar, production area, and maturity-ripeness stage.



Fig 9. Internal flesh darkening of chilling injured avocados.