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ICAR-Indian Institute of Horticultural Research (IIHR)

Hessaraghatta Lake Post, Bangalore, Karnataka - 560089



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Compilation and Editing

P.C. Tripathi

G. Karunakaran

T. Sakthivel

V. Sankar

R. Senthilkumar

B. Muralidhara

S. Rajendran

V. Venkattaramanappa

G.S.Madhu

Nesara Begane

Publisher

Director

ICAR-Indian Institute of Horticultural Research

Hessaraghatta Lake Post,

Bangalore- 560089

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Avocado (*Persia americana*) is a native of tropical America. It originated in Mexico and Central America, possibly from more than one wild species. The early Spanish explorers recorded its cultivation from Mexico to Peru but it was not in the West Indies at that time. It was introduced into Jamaica in 1650 and to Southern Spain in 1601. It was reported in Zanzibar in 1892. It was first recorded in Florida in 1833 and in California in 1856. In India it was brought during first decade of nineteenth century. Avocado is the most nutritive among fruits. The pulp is rich in proteins (up to 4%) and fat (up to 30%), but low in carbohydrates. The fat is similar to olive oil in composition and is widely used in the preparation of cosmetics as they work well on skin ailments. Avocados have the highest energy value (245 cal/100 g) of any fruit besides being a reservoir of several vitamins and minerals (Table 1). It is rich in copper and iron, two mineral constituents of antioxidant enzymes, proving their nutritional quality. Avocados are rich in Potassium and it has one of the highest potassium rates among tropical and non-tropical fruits and vegetables additionally all amino acids are found in this fruit. Avocados are associated with lower blood pressure as it is high in monounsaturated fat. In addition, avocados have been shown to maintain good cholesterol while reducing bad cholesterol. Avocados being rich in folate maintains a healthy heart. Avocado is mainly used fresh, in sandwich filling or in salads. It can also be used in ice creams and milk shakes and the pulp may be preserved by freezing. Three antifungal compounds have been isolated from the peel extracts of immature fruits of the Green cultivar. The avocados are found to contain high proteins, their caloric value ranges from 1500 to 2250 calories per Kg (i.e., 2.3 pounds). Our food analysts are of the view that the protein content of an avocado is three times that of an apple, nearly equal to that of the local plantain and less than olive fruit.

Table 1. Chemical Composition of Avocado Fruit (per 100g of edible portion)

Nutrients	Quantity	Nutrients	Quantity
Protein	1.7 g	Calcium	10.00 mg
Fat	26.4 g	Chlorine	11.00 mg
Total carbohydrates	5.1 g	Copper	0.45 mg
Crude fibre	1.8 g	Iron	0.60 mg
Vitamin A as carotene	0.17 mg	Magnesium	35.00 mg
Ascorbic acid	16.00 mg	Manganese	4.21 mg
Niacin	1.10 mg	Phosphorus	38.00 mg
Riboflavin	0.13 mg	Sodium	368.00 mg
Thiamine	0.06 mg	Sulphur	28.50 mg

(Source: Madhav Rao and Abdul Khader, 1977)

Historical Background

Avocado was introduced from Royal Botanical Gardens, Ceylon by an American missionary, residing in Bangalore between the years 1906 and 1914. No extensive propagation of these with an eye on their commercial possibilities was attempted till 1940, though the climatic conditions and soil requirements in the region were ideal for their large scale cultivation. In fact, on account of its close

resemblance to butter and identical lack of any taste it is so named in these parts as ‘Butter Fruit’. A few seedlings of their choice varieties were also occasionally brought from their home country by the American missionaries who came for periodical stays in India during 1912 and 1940. This is the reason more than a dozen varieties of Avocado grown in many parts of this region and hill stations like Kallar near Nilgris, Pulney hills of , Kodaikanal, Shrevery hills of Yercaud, Coorg, etc. The small avocado orchard in the Maharaja’s Palace at Bangalore and in the bungalows of a few Britishers were planted during that period. The influx of Americans in very large number soon after the outbreak of the Second World War renewed interest in the propagation of avocados. In the mean time the Government of Mysore opened a research station for non-citrus fruits at Hessaraghatta, Bangalore and about 150 avocado seedlings of different species were introduced in the research station. Later on these trees were removed but many seedlings were planted in Bangalore and parts of Karnataka and Kerala. Occasionally, several of promising varieties avocado were brought for planting in Karnataka, Kerala, Tamil Nadu, Sikkim and other states. The avocado cultivation has gained an overwhelming popularity during last one decade due to nutritional properties of the fruits.

Area and production

The Avocado is originated in Central-South American countries. A lion’s share of the Avocado production of world, produced in these countries. Avocado production of the world was 8.06 million tonnes in 2020. Mexico is the largest producer of Avocado in the world followed by Colombia, Dominican Republic, Peru, Indonesia, Kenya Brazil, Ethiopia etc (Table 2). The Avocado production in Asia is limited to some of the countries like Indonesia, China, Israel, Vietnam, Philippines, Korea. Mexico supplies 45 percent of the international avocado market. The avocado market is still growing. Since 2012 the global avocado market has seen rise and it expected to reach a valuation of about 23 million dollars by the end of the year 2027. The USA is the number one importer in the world, followed by the Netherlands, which plays an important role as transit country in the international trade. The top ranking export countries are Mexico, Peru, Colombia and Chile.

Table 2: Major avocado producing country of world (2020)

Country	Production (Tonnes)	Country	Production (Tonnes)
Mexico	2,393,849	Chile	160,535
Colombia	876,754	Israel	147,000
Dominican Republic	676,373	Guatemala	137,024
Peru	660,003	Venezuela	132,448
Indonesia	609,049	China	117,338
Kenya	322,556	Spain	99,070
Brazil	266,784	South Africa	98,018
Ehiopia	245,336	Malawi	93,619
Haiti	191,713	Australia	77,295
United States	187,433	Cameroon	74,963

Source: Food and Agriculture Organization Corporate Statistical Database

The production in India is very limited and they are not commercial plantation of Avocado. The agro-climatic conditions prevailing in various parts of the country appear to be favourable for bringing more areas under avocado. Presently, plantations are not well organized and they are scattered. Also, quite a good number of improved varieties are now available with higher yield potential. Avocados are grown scattered in southern tropical states like Tamil Nadu, Kerala, Karnataka and Maharashtra. Also popular in the northeastern Himalayan states at elevations of 800-1,600 meters. There are three main production regions of avocado in India, the Kodaikanal area, Ooty area of Tamil Nadu, Gundlupet and Kodagu region of Karnataka and a minor area in North Eastern India. These areas may be producing around 5000 tonnes of avocados every year and the production is increasing rapidly as more and more areas are being brought under cultivation. Avocado is grown successfully in neighboring country Sri Lanka, where good-quality fruits are harvested during May to August and December to January at different regions. Similar agro-climatic conditions to Sri Lanka are available in the Andaman and Nicobar Islands and in the tropical southern India. With proper varietal selection it should be possible to exploit the possibility of out-of-season production, thus enhancing the availability of fruits for a longer period during the year. Avocado fruits produced in the country can be marketed without much difficulty, particularly to meet the requirement of the growing tourist industry. The mainland India and the Andaman and Nicobar Islands are attracting foreign tourists in a large number of places, where avocado could find a good market access. Avocado has also a good export potential.

Soil and climate

Avocados cannot tolerate the hot dry winds and frosts of northern India. Climatically, it is grown in tropical or semitropical areas experiencing some rainfall in summer, and in humid, subtropical summer rainfall areas. Intolerant to saline conditions and optimum range of pH is from 5 to 7, are characteristics of this unique fruit. Depending on the race and varieties, avocados can thrive and perform well in climatic conditions ranging from true tropical to warmer parts of the temperate zone. Avocados can be grown on a wide range of soils, but they are extremely sensitive to poor drainage and cannot withstand water-logging. In India, avocado is not a commercial fruit crop. It was introduced from Sri Lanka in the early part of the twentieth century. In a very limited scale and in a scattered way it is grown in Tamil Nadu, Kerala, Maharashtra, Karnataka in the south-central India and in the eastern Himalayan state of Sikkim.

Varieties

All three horticultural races i.e., West Indian, Guatemalan and Mexican are adapted to tropical and sub-tropical conditions and have been tried in India. The cultivars of West Indian race are grown in localized pockets in Maharashtra, Tamil Nadu and Karnataka. In tropical and near-tropical areas, only West Indian race is well-adapted but its hybrids with Guatemalan (e.g. both selection) perform well and are considered valuable for extending the harvest season. In less tropical regions, hybrids of Guatemalan with Mexican race predominate since they combine the cold hardiness of the latter with the superior horticultural traits of both and also bridge the two seasons of maturity. In the eastern

Himalayan state of Sikkim, avocado has been introduced successfully in hill ranges with an altitude of 800 to 1,600 metres. Both the Mexican and Guatemalan races are grown successfully in Sikkim. In avocado-growing areas of Sikkim, temperatures range from 12 to 30 °C with an average annual rainfall of 2,000 millimetres. The Mexican race is cultivated on mid-altitude hills (pH 5-6). The fruit of Mexican race are Small (250 g) fruit type, ripening 6 to 8 months after flowering. Fruits have thin smooth skin with a large seed fitting loosely in the central cavity. Oil content is up to 30 per cent in the fruits. Trees of this race are cold hardy. The fruits of Guatemalan race are fairly large, weighing up to 600 g and borne on long stalks. The fruits ripen 9-12 months after flowering. Fruit skin is thick and often warty. Seeds held tightly in the hollow of the fruit are small. The oil content in fruits ranges between 8 and 15 per cent. The fruits of West Indian race are medium in size and the fruit skin smooth, leathery and glossy. Fruits are borne on long stalks and require up to 9 months for ripening from the date of flowering. Its seeds are large, fitting loosely in the cavity. The oil content of the fruit is low (3-10 per cent). This race is suitable for warm tropical climate (Table 3).

Table 3: Characteristics of three horticultural races - West Indian, Guatemalan and Mexican

Characteristics		Mexican	Guatemalan	West Indian
General	Native region	Mexican highlands	Guatemalan highlands	Tropical lowlands
	Climatic adaption	Subtropical	Subtropical	Tropical
Leaf	Size	Smallest	Large	Largest
	Flush colour	Greenest	Reddest	Yellowish green
Flower	Season	Early	Late	Early – intermediate
	Bloom to maturity	5-7 months	10-18 months	6-8 months
Fruit	Size	Tiny –medium	Small – large	Medium – very large
	Shape	Mostly elongate	Mostly round	Variable
Skin	Colour	Usually purple	Black or green	Pale green / maroon
	Surface	Waxy coating	Variably rough	Shiny
Seed	Seed	Large	Often small	Large
	Tightness in cavity	Often loose	Tight	Often loose
	Oil content	Highest	High	Low

The varieties Fuerte, Bacon, Zutano, Hass, Booth 7, Booth 8, Sharwil and Ettinger are reported to be promising (Table 4).

Table 4: Avocado cultivars grown in major avocado growing areas

USA	Fuerte, Hass, Zutano, Bacon, Reed, Gwen, Pinkerton, Pollock, Simmonds, Nadir, Booth 8, Lula, Hardee, Ruchle, Hall, Hickson, Monroe.
Australia	Zutano, Sharwd, Bacon, Purete, Hass, Green Gold
New Zealand	Fuerte, Zutano, Hayes, Hopkins, Hass, Polock, Booth, Simmonds, Reed
Israel	Fuerte, Hass, Nabal, Ettinger, Horshim, Wurtz, Ardith, Adi, Iriet, Gil
Brazil	Fuerte, Hass, Carlsbad, Nabal, Ryan, Edranol, Corona, Solano, Quintal, Fortuna, Ouro Verde
South Africa	Fuerte, Hass, Edranol, Ryan, Hayes, Pollock
Mexico	Fuerte, Hass, Bacon, Reed, Criollor, Zutano
Spain	Hass, Bacon, Furete, Reed, Sutano, Gwen
India	Green Type, Purple, TKD-1, Nabal, Linda, Puyevla, Gott-Froid, Furete, Pullock, Waldin, Arka Supreme
Indonesia	Alpukat Hijau Panjang, Alpukat Hijau Bundur, Alpukat Merah Panjang, Alpukat Merah Bundur

The cultivar *Fuerte* from Mexico; *Bacon*, *Zutano* and *Hass* from California; *Booth* selection from Florida; *Sharwil* from Australia and *Ettinger* from Israel are reported to be promising. The cultivars, *Pollock* and *Waldin* of West Indian race; *Nabal* and *Linda* of Guatemalan race; *Puyevla* and *Gott Froid* of Mexican race; West Indian x Guatemalan hybrids *Collins* and *Booth No.8* and Mexican x Guatemalan hybrid *Fuerte* are recommended for commercial cultivation. The salient features of some of the important ones are:

‘A’ Cultivars

Choquette

A seedling from Miami, Florida originated on the property of Remi Choquette. Now it is a flavored commercial cultivar in south Florida.

Hass

While dozens of cultivars are grown, the Hass avocado is today the most common. It produces fruit year-round and accounts for 80% of cultivated avocados in the world. All Hass avocado trees are descended from a single “mother tree” raised by a mail carrier named Rudolph Hass, of La Habra Heights, California. Hass patented the productive tree in 1935. The “mother tree”, of uncertain subspecies, died of root rot and was cut down in September, 2002. Hass trees have medium-sized (150–250 g), ovate fruit with a black, pebbled skin. The flesh has a nutty, rich flavour with 19% oil. A hybrid Guatemalan type, it can withstand temperatures to -1 °C.

Gwen

A seedling bred from Hass x Thille in 1982, Gwen is higher yielding and more dwarfing than Hass in California. The fruit has an oval shape, slightly smaller than Hass (100-200g), with a rich, nutty flavor. The skin texture is more finely pebbled than Hass, and is dull green when ripe. It is frost-hardy down to -1 °C.

Lula

A seedling reportedly grown from a 'Taft' avocado planted in Miami, Florida on the property of George Cellon, named after Cellon's wife Lula. It was likely a cross between Mexican and Guatemalan types. Lula was recognized for its flavor and high oil content and propagated commercially in Florida. It is also very commonly used as a rootstock for nursery production. Hardy to -4 °C.

Pinkerton

First grown on the Pinkerton Ranch in Saticoy, California, in the early 1970s, Pinkerton is a seedling of Hass' Rincon. The large fruit has a small seed and its green skin deepens in color as it ripens. The thick flesh has a smooth, creamy texture, pale green color, good flavor and high oil content. It shows some cold tolerance to -1 °C and bears consistently heavy crops. A hybrid Guatemalan type, it has excellent peeling characteristics.

Reed

Developed from a chance seedling found in 1948 by James S. Reed in California, Reed has large, round, green fruit with a smooth texture and dark, thick, glossy skin. Smooth and delicate, the flesh has a slightly nutty flavor. The skin ripens green. A Guatemalan type, it is hardy to -1 °C. Tree size is about 5 by 4 meters.

'B' cultivars

Bacon

Developed by a farmer, James Bacon, in 1954, Bacon has medium-sized fruit with smooth, green skin with yellow-green, light tasting flesh. When ripe, the skin remains green, but darkens slightly, and fruit yields to gentle pressure. It is cold-hardy down to -5 °C .

Brogden

Possibly a cross between Mexican and West Indian types, Brogden originated as a seedling grown in Winter Haven, Florida on the property of Tom W. Brogden. The variety was recognized for its cold-hardiness to -5 °C and became commercially propagated as nursery-stock for home growing. It is noted for its dark purple skin at maturity.

Ettinger

A Mexican/Guatemalan cross seedling of Fuerte, this cultivar originated in Israel, and was put into production there in 1947. Mature trees tolerate four hours at -6 °C. The fruit has a smooth, thin, green skin that does not peel easily. The flesh is very pale green.

Fuerte

A Mexican/Guatemalan cross originating in Puebla, the Fuerte earned its name, which means strong in Spanish, after it withstood a severe frost in California in 1913. Hardy to -3 °C, it has medium-sized, pear-shaped fruit with a green, leathery, easy to peel skin. The creamy flesh of mild and rich flavour has 18 % oil. The skin ripens green. Tree size is 6 by 4 meters.

Monroe

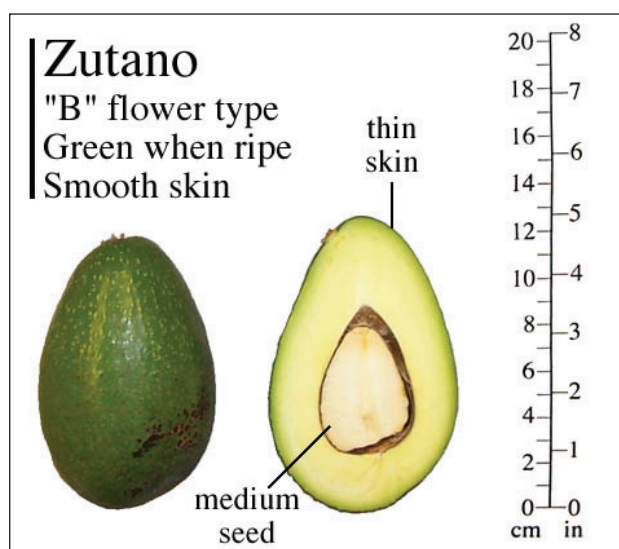
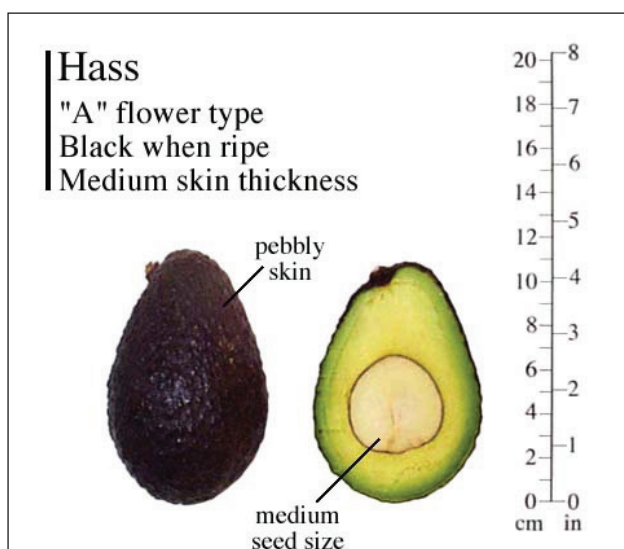
A Guatemalan/West Indian cross that originated from a seedling grown in Homestead, Florida on the property of J. J. L. Phillips, it was patented in 1937 and became a major commercial cultivar due to its cold hardiness and production qualities. The fruit is large, averaging over 2 pounds in weight, has an elliptical shape, and green, glossy skin. Hardy to -3 °C.

Sharwil

Predominantly Guatemalan, with some Mexican race genes, Sharwil was selected in 1951 by Sir Frank Sharpe at Redland Bay, southern Queensland, Australia. The name “Sharwil” is an amalgamation of Sharp and Wilson (J. C. Wilson being the first propagator). Scions were sent from Australia to Hawaii in 1966. A medium-sized fruit with rough green skin, it closely resembles the Fuerte, but is slightly more oval in shape. The fruit has greenish-yellow flesh with a rich, nutty flavor and high oil content (20-24 %), and a small seed. The skin is green when ripe. It represents more than 57 % of the commercial farming in Hawaii, and represents up to 20 % of all avocados grown in New South Wales, Australia. It is a regular and moderate bearer with excellent quality fruit, but is sensitive to frost. Disease and pest resistance are superior to Fuerte.

Zutano

Originated by R. L. Ruitt in Fallbrook in 1926, this Mexican variety is hardy to -4 °C. The large, pear-shaped fruit has a shiny, thin, yellow-green skin that peels moderately easily. The flesh is pale green with fibers and has a light flavor.



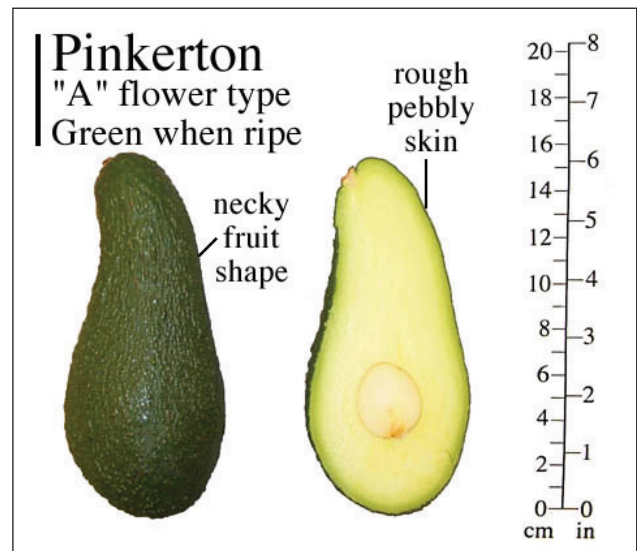
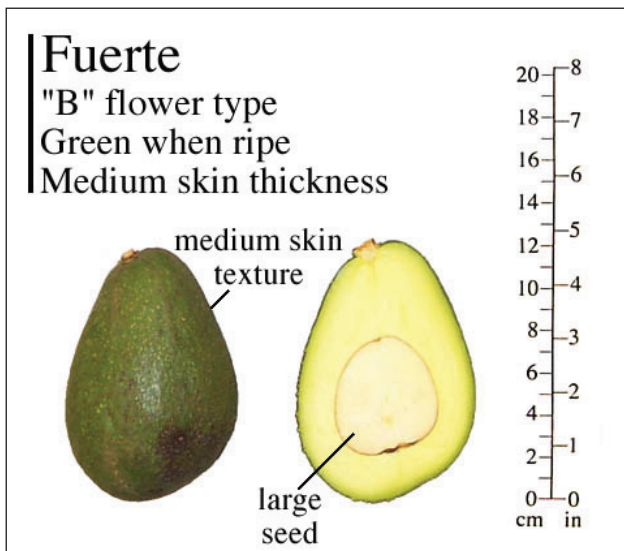


Plate 1: some important varieties

Arka Supreme

This variety is a high yielding hybrid developed from Central Horticultural Experiment Station (IIHR), Chettalli in 2020. This is a high yielding avocado selection with good quality fruits. The flowering behaviour of this variety falls under Type 'A' category. It has the advantages of being regular bearing and high yielding seedling selection with spreading type growth habit. A fully-grown tree yields about 175-200 kg/plant, with an average fruit weight of 367-428 g, 20% fat, and 0.45% fibre. The fruits are oblong with 7.8 °Brix TSS(Plate 2a).



Plate 2a: Arka Supreme

TKD-1

Developed at Horticultural Research Station, Thadiyankudisai of TNAU, Tamil Nadu. The fruits are medium sized and round. Trees upright and semi-spreading hence suited for highdensity planting. Yield 264 kg/tree. Fruits are sweet TSS 8 °Brix, fat 23.8 %, protein 1.35 %(Plate 2b).



Plate 2b: TKD-1

CHESPA-XIII-1

It is another promising regular bearing and high yielding seedling selection from local collection with spreading type growth habit. A fully grown tree gives the fruit yield about 150-200 kg/plant with average fruit weight of 450-600 g. The pulp recovery is very high up to 80 %. The fruits are rhomboidal with thick base with 6.5 to 8.0 ° Brix TSS. The flowering behaviour of this variety falls under Type “B” category. The fat content is around 12 to 14 %.

Propagation

In India, avocado is commonly propagated through seeds. The viability of seeds of avocado is quite short (2 to 3 weeks) but this can be improved by storing the seed in dry peat or sand at 5°C. Removal of seed coat before sowing hastens germination. In India most of the trees grown are seedlings in origin. The seeds taken from mature fruits are sown directly in the nursery or in polyethylene bags. Seedlings (8-12 months old) became ready for transplanting. The seedling trees take more time to start fruiting and the yield and fruit quality is highly variable. Due to cross-pollination, there is great variability in the seedlings, it is impossible to obtain genetically uniform plant as indicated for the formation of commercial orchards. Vegetative propagation of superior clones of avocado by budding or grafting is essential to avoid these problems. Experiments conducted with two methods of grafting (veneer and cleft) and two methods of budding (T and patch) in all the months of the year at CHES (IIHR), Chettalli revealed that after 90 days of grafting, the mean percent success was highest in cleft grafting (32.5%) while lower mean success was observed in veneer grafting (8.3%), T-budding (7.5%), Patch budding (5.8%).



Plate 3 : Avocado Seedling

Among different months highest mean success was recorded in month of September (32.5%) followed by 22.5% in the month of March and August. Among the different combinations of months and propagation methods, highest success was recorded in cleft grafting (70 %) during the month of September. This was closely followed by same method done in month of March month (60%). The success in cleft grafting is higher than other three methods in all 12 months. The growth of the scion was also higher in cleft grafting than other methods. It was concluded that cleft grafting in the

month of September and March were most suitable for the multiplication of avocado (Tripathi and Kuranakaran, 2013). At the Fruit Research Station, Kallar, Tamil Nadu, layering as well as inarching gave up to 75 per cent success, while in West Bengal chip-budding is reported to be successful. In India, presently there is no commercial nursery engaged in vegetative propagation of avocado, nor is there any initiative either at governmental or private level to undertake nursery production of avocado planting material. Recently days, avocados are commercially propagated through softwood grafting. The softwood grafting will give more than 90% success.



Plate 4 : Softwood grafted plants

Field Preparation and Planting

The avocado plantation in a relatively new area required care in selection of the varieties. The varieties of both A and B groups should be selected and their flowering must overlap. The proportion of A and B group varieties can be 1:1 or 2:1. Avocado is planted at a distance of 6 to 12 meters depending on the vigour of variety and its growth habit. For varieties having a spreading type of growth, like Fuerte, a wider spacing should be given. In areas prone to excess water, they should be planted on mounds as avocados cannot withstand waterlogging. In Sikkim, a planting distance of 10 x 10 meters on hills slopes is preferred. While in south India, when it is planted with coffee the planting distance varies from 6 to 12 meters. The pits of 1 cubic meter size are dug during April-May and filled with farmyard manure and top soil (1:1 ratio) before planting. Planting is done in June-July or sometimes in September. In Coorg, a region of Karnataka, avocado trees are planted also as one of the mixed crops in a primarily coffee based cropping system (Tripathi and Karunakaran, 2013).

Nutrient management

Avocados need heavy manuring, and application of nitrogen has been found to be most essential. In general, young avocado trees should receive N, P₂O₅ and K₂O in a proportion of 1:1:1 and older trees in the proportion of 2:1:2. At a pH of above 7, iron deficiency symptoms may appear, which may be corrected by applying iron chelate at the rate of 35 g/tree. Various micronutrients (Fe, Zn, B) have profound influences on tree growth, nutrient uptake and yield of avocado. Integrated nutrient management with inorganic fertilizer, supplemented by organic manuring is advocated for avocado. In Coorg area and the humid tropical region of Karnataka, Kerala and Tamil Nadu the fertilizers should

be applied in two split doses in May-June and September- October. While in Northern India fertilizer may be applied in two split doses in March-April and September-October or just before and after the onset of the monsoon. Foliar application of zinc sulphate (0.5 per cent) and other micro nutrients may be undertaken in April-May or September-October. These micronutrients may be applied as soil application along with other fertilizers (Table 5). Fertilizer should be applied away from tree trunk according to age of the tree and canopy spread. For young plants (up to 3 years old), fertilizer can be applied at least 60 cm away from stem and the distance can be increased further according to age and canopy spread. Fertilizers are to be placed around the trees by digging soil of 15-20 cm band width and 5 cm depth. Applied fertilizers are covered with dug soil and watering to be done.



Plate 5 Fertilizer application in Avocado

Although each harvest removes smaller quantities of micronutrients such as iron (Fe), boron (B), and zinc (Zn), deficiencies do occur and have a negative effect on yield, fruit size, and quality of avocados (Salazar-García, 2002). Micronutrient deficiencies are prominent in high pH soil. Particularly deficiency of Fe and Zn are reported. Whiley et al. (1996) reported B deficiency in avocado and affected trees are yellow and stunted. The affected leaves are becoming distorted and holes also appear in leaves and leaf holes symptoms are more prevalent in the spring leaf flush. B deficiency also affects main stem and branches, flowers and fruits. It also causes sickle-shaped fruit with navel-like lesions. Adequate foliar B concentrations in avocado tree leaves ranged from 40 to 80 mg kg⁻¹, respectively. The misshapen of fruit is associated with low mean foliar B concentrations 20 mg kg⁻¹ which was recorded at less than 10 avocado farms in Kona area during Fall 1989, it seemed to be much below the adequate B levels of 40 mg kg⁻¹. Further B toxicity in avocado occurs when leaf B concentration reach beyond 180 mg kg⁻¹ levels. Generally foliar application is not recommended in avocado plants due to less absorption by leaves. However boron along with urea application may enhance nutrient absorption particularly during floral bud initiation and fruit setting period. Nutrient application during flowering period can be avoided that causes flower dropping. Magnesium deficiency is observed in fruiting plants due to more requirements by fruits. Soil application of magnesium sulphate or dolomite can be done to overcome this problem.

Table 5: Fertilizer schedule recommended for avocado

Elements	Age of Plant (Year)						
	1	2	3	4	5	6	7 & above
Nitrogen (g/plant)	100	200	300	400	500	600	800
Phosphorus (g/plant)	30	60	90	120	150	180	210
Potassium (g/plant)	60	120	180	240	300	360	400
Farmyard manure (kg/plant)	-	10	20	30	40	50	60

Nutritional disorders Due to its high yield potential, avocado requires a large amount of nutrients. Low soil fertility status and inadequate supply of nutrients affect the growth and development of the crop and reduce the crop yield. There are many nutrients disorders reported in avocado (Figure 1).

N deficiency: The N deficiency mainly affects the older leaves. The affected leaves are become small, narrow and pale green because of insufficient N to the tree. The leaves rolled slightly upwards. The plants are also smaller.

K deficiency: Due to insufficient availability of K caused by imbalance of Ca, Mg, and K. The symptoms are yellowing of margin to veins and browning of affected portions.

Mg deficiency: Insufficient available Mg to tree due to imbalance of Ca, Mg, and K and very common in acid sandy soils. The Mg deficiency symptoms appear in older leaves by progressive yellowing from tips and margins to main vein. A dark green band along the main veins is noticed.

Zn deficiency: Mainly due to alkaline soil pH and excessive phosphorus in soil. Uneven blotchy yellowing between the veins are the main symptoms. With a very mild deficiency, the distance between the leaves is reduced and look like feather duster, but minimal leaf distortion and size reduction. Leaf distortion and size reduction is prominent in severe deficiency. Under very severe deficiency incidence of yellowing, small and distorted young leaves and also affect fruits.

Mn deficiency and toxicity: The Mn deficiency in avocado causes color loss of leaves generally between the veins and become pale green. The deficiency occurs mainly due to much use of liming material and in coarse textured sandy soils. Due to excess uptake of Mn caused when soil available Mn level is higher than 40 ppm and soil pH lesser than 6. Under water logged condition and continuous application of ammonium fertilizers. In between the leaf veins, irregular yellowing with small dark spots and sometimes burning of tip particularly in summer leaf growth was reported.

Fe deficiency: This is major problem in high sodic soils (pH > 7.5), with elevated soil Mn levels, also result of excessive use of liming materials and/or phosphorus fertilizer. The affected upper leaves become completely yellow or white color with the green veins. The similar symptoms also appear in lower young leaves of summer flush, whereas the leaves of spring flush remain green.

B deficiency and toxicity: Affected trees are yellow and stunted. The affected leaves are becoming distorted and holes also appear in leaves and leaf holes symptoms are more prevalent in the spring

leaf flush. B deficiency also affects main stem and branches, flowers and fruits (Whiley et al. 1996). It also causes sickle-shaped fruit with navel-like lesions. Adequate foliar B concentrations in avocado tree leaves ranged from 40 to 80 mg kg⁻¹, respectively. The misshapen of fruit is associated with low mean foliar B concentrations 20 mg kg⁻¹ which was recorded at less than 10 avocado farms in Kona area during Fall 1989, It seemed to be much below the adequate B levels of 40 mg kg⁻¹ (Whiley et al. 1996). Further B toxicity in avocado occurs when leaf B concentration reach beyond 180 mg kg⁻¹ levels. Higher uptake of B and mainly excess and uneven application of B causes B toxicity. The B toxicity symptoms are leaf margin burning with defined edges, pale yellowing areas of burnt portion with innumerable tiny dark spots and leaf fall in case of acute B toxicity.

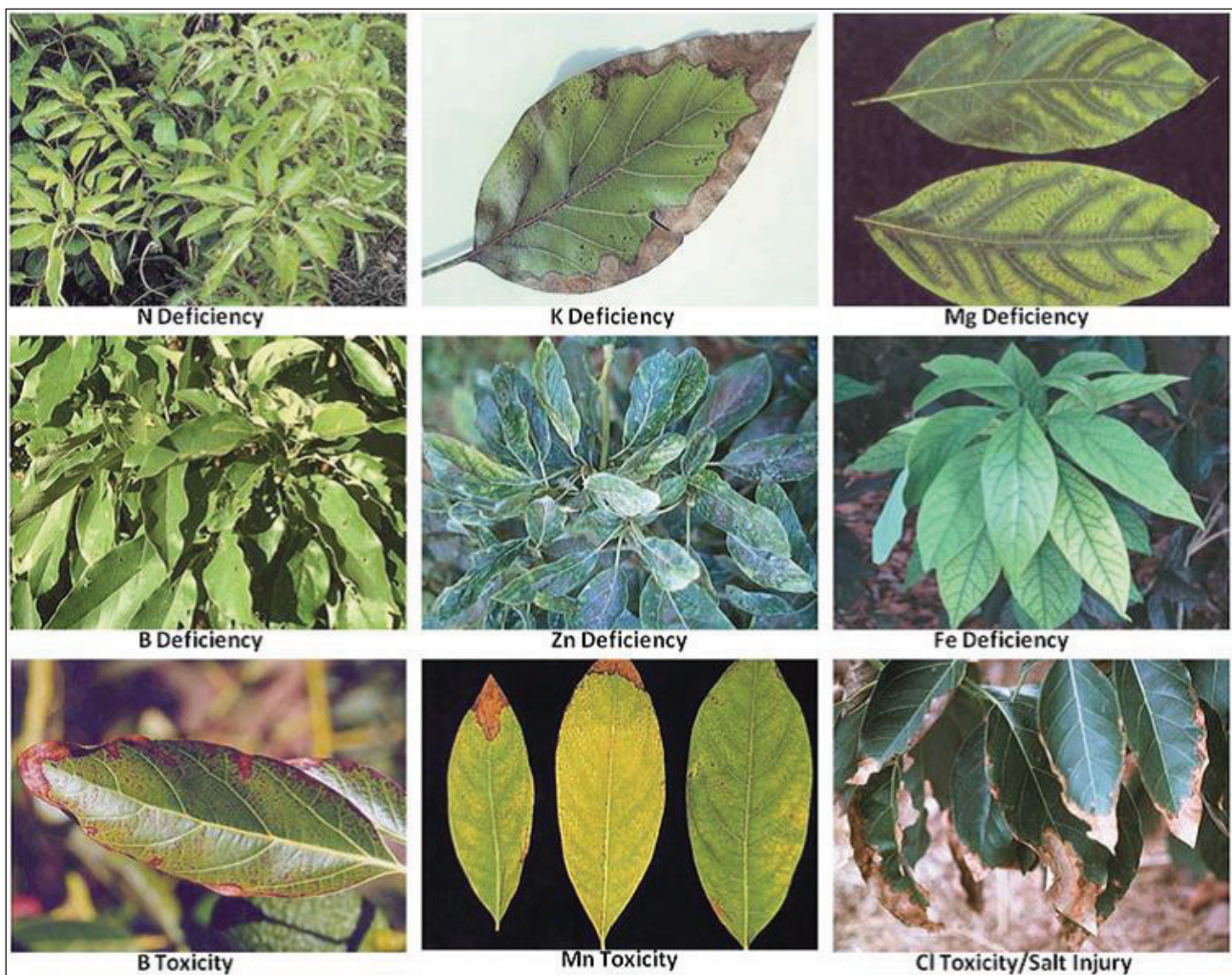


Plate 6 . Mineral nutrient deficiency and toxicity symptoms in avocado

(Rajendiran &Awachare, 2019)

Salt injury: It causes fairly even burning of margins and extends to the veins mainly due to application of salty irrigation water and fertilizers containing high Cl.

Training and pruning

The plants need to be given light pruning in initial stages for developing an open centre canopy, after that pruning is rarely practiced. In upright varieties such as Pollock topping is done to reduced the tree size while in spreading varieties like Fuerte, branches are thinned and shortened. The dropping and

ground touching branches need to be pruned for ease in cultural practices. Heavy pruning has been found to promote excessive vegetative growth, consequently reducing the yield.

Irrigation

In India, avocado is grown in those areas where rainfall is high and fairly distributed throughout the year. Therefore it is grown under rain fed conditions and irrigation is generally not given. Irrigation at intervals of three to four weeks during the dry months is beneficial. Sprinkler irrigation has been reported to improve the fruit size, oil percentage and advances harvesting time. To avoid moisture stress during winter season, mulching with dry grass/dry leaves is desirable. Flooding is undesirable as it promotes root rot incidence.

Intercultural and weed management

Deep cultivation in avocado orchards should be avoided because of surface roots. Intercropping with legumes or shallow-rooted crops can be done in young orchards which can smother weeds also. The monoculture plantation of avocado may be maintained with sod culture. The weeds are major problems in high rainfall zones of south India. The use of gramoxone or glyphosate is recommended to control weeds. In coffee based plantation system, scruffling done for coffee is sufficient to control weed. Care should be taken that the roots of avocado not disturbed during scruffling.

Flowering, pollination and fruiting

Avocado starts bearing at 5-6 years after planting and has a marked tendency to biennial bearing which is prevalent in a number of other fruit trees. But there is specific problem in fruit set as far as avocado concerned. In avocado, the inflorescence is a compound panicle. The individual flowers are morphologically bisexual having fertile male and female organs. But they exhibit dichogamy i.e., the male and female organs coming to maturity at different time thereby avoiding self pollination of an individual flower. In dichogamy, they are protogynous i.e., the female parts coming to maturity before male organs. The type of dichogamy in avocado is a complicated one unique to avocado-the diurnally synchronous dichogamy. The female parts of all flowers that open at a time in a particular tree will mature simultaneously and hence behave functionally as female flower. The male parts of same flowers will come to maturity when the flowers open next time and hence all of them behave as male flowers during that period. By this the cross pollination between flowers of the same tree are also ruled out. The situation is further worsened by the fact that all the trees of a particular group will be exhibiting the same sex phase at a particular time and the opposite sex phase during the next opening of the same flower. So, if the trees of single group are planting in mass, they will not set fruit and each group requires interplanting of trees of mother group, as the two groups being compatible with one another. Based on this unique flower behavior, avocado cultivars can be divided into two groups A & B. In group A, first opening takes place in the morning, second opening during the afternoon of the following day. In group B, first they open in the afternoon then again next morning. Therefore, every morning A-pistils can be fertilized by B-pollen, while during afternoon B-pistils are ready to receive A-pollen. Studies on flowering and fruiting behavior of 40 accessions of avocado was carried out at CHES, Chettalli revealed that number of panicles/shoot ranged from 2.6

in PA- I-4 to 13.8 in PA-VII-2. The panicle length ranged from 4.1 cm in PA-XII-1 to 16.1 cm in PA-XVII-2. The number of flowers per shoot ranged from 16.71 to 218.96. The panicles were produced on terminal bud and most of them were determinate type. The flowering period ranged from 15 to 28 days. All the flowers were hermaphrodite. The double opening of flowering was noticed in all the accessions. In first opening only stigma was receptive. In second opening was next day when only anther dehiscence took place. Most of the flowers opened in the morning time between 8.00 to 10.00 AM but some of the flowers opened in the afternoon between 2.00 to 5.00 PM. The average initial fruit set was 3.62%, it was highest (8.74%) in PA-VIII-3 and lowest (0.50%) in PA-VI-1. Average final fruit set was 0.32%. Heavy fruit drop was observed after fruit set. The main reason for low fruit set is peculiar flower opening process. Avocado has perfect flowers produces bisexual flowers but exhibit dichogamy. Thus self-pollination is almost impossible. The pollination is mainly performed by insects. The studies conducted at CHES, Chettalli revealed that *Apis cerena* was major pollinator with 17.56% followed by *Apis florea* with 11.3%. Similarly 8.82% of *Tetragonula* sp. and ants each followed by 6.16 % of wasp were observed. *A. cerena* starts foraging from 6.00 AM and continues till 12.00 Noon. However, it was observed that the peak foraging period for *A. florea*, *Tetragonula* sp. was from 9.00-12.00 hrs. Of total bee population, *A. cerena* had the maximum number of visits (7.87 visits/30min/bunch) followed by *A. florea* (5.06 visits/30min/bunch), and *Tetragonula* sp. and ant species (3.96 visits/30min/bunch) each.

Fruit harvesting and yield

Avocado plants raised from seeds start bearing five to six years after planting while grafted plants starts yielding in 3-4 years. Mature fruits of purple varieties change their colour from purple to maroon, whereas fruits of green varieties become greenish-yellow. Fruits on reaching maturity develop smoother skin surface and glossiness on the skin diminishes. Fruits are ready for harvest when the colour of seed coat within the fruit changes from yellowish white to dark brown. Mature fruits ripen six to ten days after harvesting. The fruits remain hard as long as they stay on the trees, softening only after harvest. Harvesting during rains and exposing fruits to direct sunlight should be avoided. Precaution to be taken to avoid bruises to the skin as it can advance decaying.

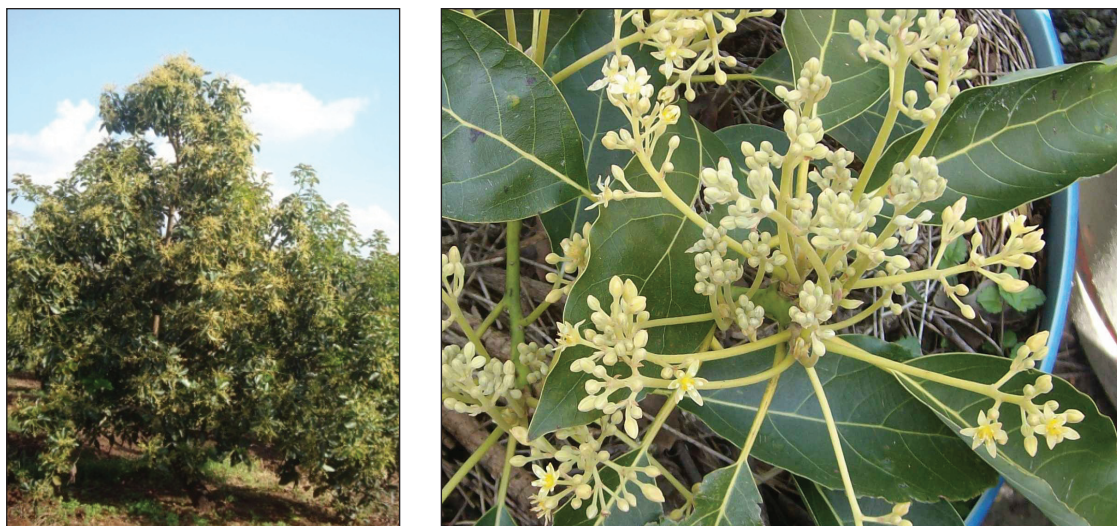


Plate 7: Flowering in avocado

The yield ranges from about 100 to 500 fruits per tree. In Sikkim, fruits are harvested during July to October is the usual harvesting time. In Coorg area fruits are available from June to October while in Tamil Nadu, July-August is the peak harvest time.

Pests and diseases

The Anthracnose root rot, leaf spot, stem rot and scab are the major diseases affecting avocado.

Phytophthora root rot: (*Phytophthora cinnamomi* Rands):

Phytophthora root rot is the main disease affecting avocados around the world causing severe losses in fruit production.

Symptoms: The infected leaves turn pale green, wilted and fall readily. Shoots die back from the tips so that eventually the tree is reduced to a bare framework of dying branches. Death of the tree may take from a few months to several years. Declining trees commonly set large number of small fruit (avocado). Lack of foliage and dieback of small branches exposes fruit and major limbs to sunburn. Feeder roots are black, decayed and few in number and lose the ability to exclude salts from the soil (Plate .7). The fungus is mainly spread through water movement and infected plant debris.

Management:

- Avoiding wounding, especially near the trunk base, ensuring that furrow irrigation water does not come into contact with the trunk by banking the soil upto a distance of 50 cm from and around the trunk base.
- Plant on well-drained soils or improve drainage using mounds preferably on raised beds. Irrigate carefully, avoiding both over and under irrigation.
- Apply gypsum (or lime if pH needs correction) under the canopy of the trees to suppress the formation of spores. High pH favours development of the disease.
- In grafted plants the bud union should be 30-45 cm above the base. Injuries to the plants near the soil line should be avoided.
- The trunk should be painted with 10% Bordeaux paste up to 50-75 cm height from the ground level in pre-monsoon and post monsoon seasons.
- After scraping the diseased parts with a sharp knife, the cut portions should be protected with 10% Bordeaux or copper fungicides paste followed by 3-5 spraying with Fenamidone 10% + Mancozeb 50% WDG (1g/lit) or Fenamidone 4.44% + Fosetyl-Al 66.66% WDG (1g/lit) or Famoxadone 16.6% + Cymoxanil 22.1% SC (1.5g/ lit) of water at 15 days interval, reduces disease spread effectively.
- Soil drenching with Fenamidone 10% + Mancozeb 50% WDG (2g/lit) or Fenamidone 4.44% + Fosetyl-Al 66.66% WDG (2g/lit) or Famoxadone 16.6% + Cymoxanil 22.1% SC (2 g/ lit)

of water in combination with 0.5% *Trichoderma* commercial formulation is also effective in managing the disease.



Plate 7 : Phytophthora root rot

Anthracnose (*Colletotrichum gloeosporioides*)

Anthracnose caused by *Colletotrichum sp*, is one of the major plant pathogenic fungi responsible to cause the disease on a variety of hosts from trees to grasses.

Symptoms: The main symptoms of the disease on avocado are dark, sunken spots or lesions, often with a raised rim, on affected foliage, stems and fruits. Infection in early stage of fruiting with heavy moisture results in fruit drops and total crop loss. Disease development after harvest is the result of quiescent infection of fruit on trees before harvest (Plate 8). The fungus may remain dormant in green fruit for many months. The fungus spreads from diseased organs, from the soil or tree, to healthy organs and sporulates on them. Heavy rains and high winds favour conidial dispersal, although on other hosts, dew has been seen to be enough for conidia spreading.

Management:

Before harvest spray Propaconazole 10% EC (0.5 ml) or Hexaconazole 5% EC (0.5ml/lit) during floral buds begin to swell and fruit development period for effective in managing the disease



Plate 8. Anthracnose on fruits

Scab (*Sphaceloma perseae*)

Symptoms: On the infected fruit, the spots are oval to irregular in shape, brown to purple-brown and slightly raised surface. As the disease progresses, spots enlarge and coalesce. Often there is intersecting raised ridges and large, rough, corky areas may form over the surface of the fruit (Plate 9). Severe infections may crinkle and distort the leaves. Scabby large lesions may occur on leaf veins, pedicels and twigs.

Management:

Chemicals should be applied to protect the fruit, particularly when humidity is above 60%. Sprays the crop with Propaconazole 10% EC (0.5 ml) or Hexaconazole 5% EC (0.5ml/lit) or Copper oxychloride 50% WP (2.5gm/lit of water) and Bordeaux mixture (1%) are helpful in controlling the disease.



Plate 9: Avocado Scab

Insect pests

Mites, mealy bugs, scales are the important insect pests of avocado.

Avocado long tailed mealy bug:

Symptoms: The pest found in clusters on young shoots, fruit and fruit stalks. These pests suck plant sap from the tender plant parts and excrete honeydew, which leads to the growth of black sooty mould on leaves, twigs and on fruits.

Management: Infested branches should be pruned off and burned. Remove all loose bark after pruning from main trunk and primary arms. Then swab with IIHR swab mixture: Carbaryl 6g + copper oxy chloride 10g + (Neem oil 1ml + kerosene oil 1ml + sticker 1ml) /litre after each pruning and after removing loose bark. Spraying with Thiamethoxam (0.05%) or Imidacloprid (0.005%) or acetamiprid (0.005%) or Fenvalerate (0.005%)



Avocado leaf roller:

Symptoms: Terminal leaves of a young twig are joined together by silk webbing; larvae feed within web, thus prevent the twig from continuing its growth.

Management: The infested twigs should be removed and burned. Spraying fenvalerate (0.005%) or quinalphos (0.2%) after pruning and when there is new flush emerges. Need of chemical control only if deemed necessary.



Twig borer and shot hole borer:

Symptoms: Small round bored holes on the infested bark. Pin holes on twigs and branches more conspicuous if the barks are removed. Frass ejected from the bored holes. Wilting and drying of the branches.

Management: Regular removal of loose barks and swabbing of main trunk and primary arms with IHR swab mixture (see under mealybug) preferably after each pruning after removing loose barks. Affected twigs and branches should be pruned off and burned and trunks of remaining plants should be treated with an insecticide (synthetic pyrethroids) and kept under observation.



Avocado leaf miner:

Symptoms: Several mined portion merge where the epidermal cuticle swells up in the mined areas and then appear as **whitish blistered patches** on the leaf surface. Finally **drying and crumbling** of mined portions of the leaf surface.

Management: Removal and destruction of affected leaves to prevent the pest infestation from spreading. Spraying chemical insecticide Monocrotophis 36SL @ 1.5ml/lit of water on new vegetative flush.



Storage diseases

Anthracnose:

Symptoms begin as circular, slightly sunken, brown to black spots on the fruit. These spots enlarge rapidly and often become noticeably sunken with cracks radiating from the spots centre. The affected areas eventually become covered with pinkish spore masses. The fungus can progress into the fruit flesh, producing a brownish-black decay and rancid odour.



Stem-end Rot:

Stem end rot symptoms begin as dark brown to black spots at the stem end that enlarge and advance toward the blossom.

Fusarium Rot:

Symptoms of Fusarium begin as brown sunken spots on the fruit surface that coalesce to form a dry, leathery discoloured peel.

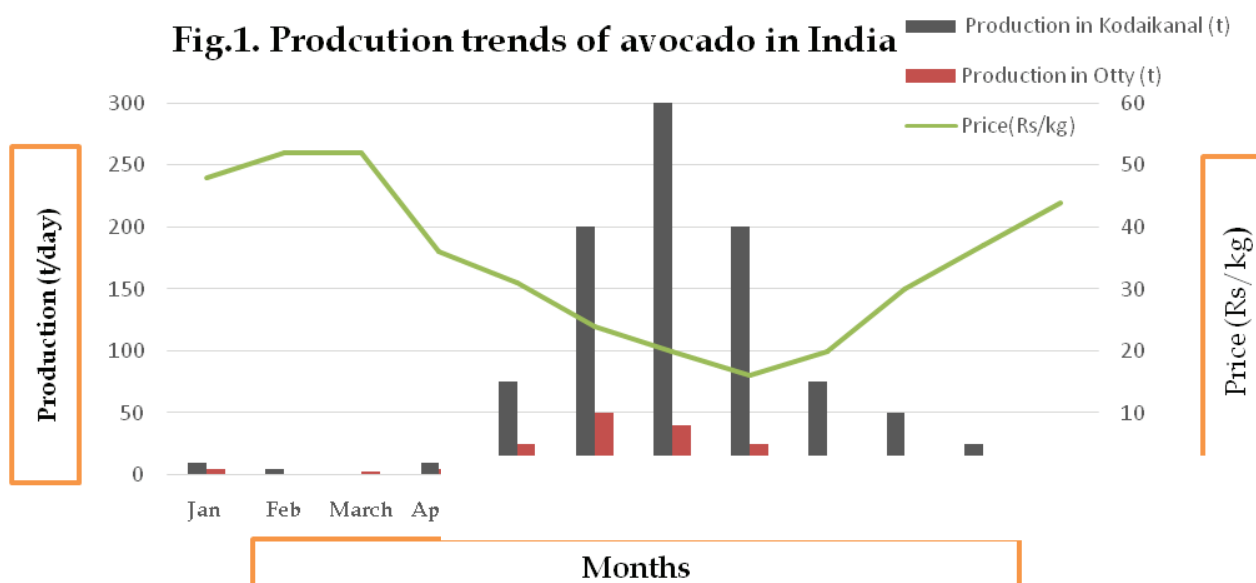


Post-harvest handling, storage and marketing

Avocados are cleaned with soft cloth dipped in 150 ppm hypochlorous acid to diminish infection. Hot water treatment for 3 to 5 minutes at 50 °C along with postharvest fungicide treatment with 500 ppm benomyl or 1000 ppm thiabendazole can reduce disease spread. The avocados are better stored at relative humidity 90 % to 95 % and temperature 12-13 °C. Weight loss and shrivel are much higher at low RH's. Based on size and appearance grading and sorting is done before selling the fruits. Grading can be done based on size: small (250 gm), medium (500 gm) and large (1000 gm) for internal market and for export minimum weight of 125 gm and a maximum weight of 1220 gm can be considered. Food grade waxing can be done to enhance external appearance and reduce moisture loss of fruits. Avocados are packed in strong well-ventilated containers. The count sizes progress in even numbers from 4 to 30 and have the following average fruit weights: 4 count: 780-1220 gm, 6 count: 575-780 gm, 8 count:460-575 gm, 10 count: 366-460 gm, 12 count: 306-365 gm, 14 count: 266-305 gm, 16 count:236-265 gm, 18 count: 211-235 gm, 20 count:191-210 gm, 22-count:171-190 gm, 24 count:156-170 gm, 26 count:146-155 gm, 28 count:136-145 gm and 30 count:125-130 gm (usaid.gov).

In India, fruits of 250 to 300 grams in size are preferred. Most popular varieties are Hass, Fuerte and Green. Hard, mature fruits are harvested and allowed to ripen during transport and distribution. Unripe avocados can be stored for up to four weeks at 5.5 to 8 °C. Hot water treatment of fruits for 3 to 5 minutes at 50 °C can check development of diseases. Food grade wax can be used for preserving quality of fruits prior to packing in well ventilated containers.

Presently, there is no organized marketing system for avocado as the production is small and production areas are scattered. Avocados are mostly produced in Coorg, Chikmagalur, Shivamogga, Kodaikanal, Lower Pulney hills, Kallar and Wayanad. And the most consuming centres include Bangalore, Goa, Mumbai, parts of Tamil Nadu and Kerala. Fruits of 700 grams are preferred for export market while for domestic market 400-500 gram fruits are preferred. There are three main production region of avocado in India, the Kodaikanal area, Ooty area of Tamil Nadu, Gundlupet and Kodagu region of Karnataka and a minor area in North Eastern India. In Kodaikanal area the fruit maturity starts in the Month of March and continue up to January. The peak harvesting season is June to August. Thereafter the production decreases with marginal production in January. There is no production in March in this area. The production in Ooty shows similar trends. In Kodaikanal area during peak season 40-50 tonnes avocados are available every day. While peak harvest production in Ooty area is about 5-10 tonnes per day (Fig. 1). In Gundlupet, H D Kote , Kodagu, Hassan , Chikkamagalur the cumulative production is maximum (3-5 tonnes per day) in peak season. The season of production is lesser than Tamil Nadu .The whole sale price in these growing regions vary as per the arrival. The price is highest (Rs 260/ in the month of Feb -March when there is very negligible production while it is almost lowest in August when the arrival is highest (Fig. 1).



(Source: Mr. Jaydeep, Personal communication)

The demand of avocado is mainly in metro cities like Chennai, Bangalore, Mumbai, Delhi and Ahmedabad. The retail prices vary from Rs. 150 to Rs 400/ per kg. The lowest average prices are in Bangalore and Chennai and highest prices are in Delhi and Mumbai. It is estimated that presently there is demand of 20 tonnes avocado per day in India which is mainly confined in major cities. Almost 1000 tonnes of avocado are imported from other countries. Some avocados are also imported from Myanmar through road transport. Remaining demand is fulfilled by domestic production. The demand of fruit is increasing every year.

Processed products:

Arka avocado chutney

The product is prepared from Avocado fruit pulp after removing seeds and addition of different ingredients such as sugar, ginger, garlic paste, onion, salt, red chilli powder, oil etc. It can be regularly consumed as fruit jam or jelly due to the incredible health benefits it has due to the butter fruit. The product is highly profitable for start-up entrepreneurs, small and medium enterprises involved in fruit and vegetable processing industry.

Arka avocado bread spread

The product is prepared by washing ripe avocado fruits, cutting, removal of seeds and peel, extraction of pulp and addition of powdered sugar followed by mixing and heating and addition of pectin, cocoa powder, wherever required adjust the acidity and addition of preservative sodium benzoate and finally packing. It can be regularly consumed as fruit jam or jelly due to the incredible health benefits it has. The product is highly profitable for start-up entrepreneurs, small and medium enterprises involved in fruit and vegetable processing industry.

Spray dried avocado powder

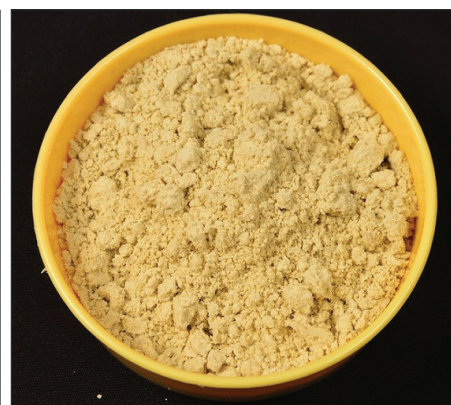
Avocado is a seasonal fruit with important nutraceutical and cosmeceutical properties. This process technology involves spray drying avocado pulp homogenized with acidulant, emulsifier and encapsulating agent, at optimized conditions of inlet temperature, feed flow rate and encapsulator concentration. High quality avocado powder, stable for more than three months at room temperature is obtained. This product will ensure year round demand for avocado fruits, as also supply of the value added spray dried avocado powder, which is convenient to use and transport. There is a promising market both within India and abroad for this product. The Cost:Benefit ratio is 1:1.78.



Plate 10 a :
Arka avocado chutney



b. Arka avocado bread spread



c. Spray dried avocado powder

Table 6 : Do's and Don'ts of Avocado Post harvest management

Don'ts	Do's
Pre harvest management	
Don't spray fungicide/insecticides which have more residual period	<ul style="list-style-type: none"> Foliar application of Copper oxychloride (2g/l) or Tilt (0.1 ml/l) or Roko (1g/l) 15 days before harvesting. This help in reduction of anthracnose and stem end rot
Harvesting	
<ul style="list-style-type: none"> Do not harvest immature fruits. Immature fruits shrivel and do not ripen properly Don't through fruits on ground Don't harvest fruits by shaking branches or trees Fruits should never be pulled off the tree since the stem needs to remain attached. Don't keep long fruit stalk, it may damage of adjacent fruit 	<ul style="list-style-type: none"> Harvest at proper maturity. Avocado is a non climatic fruit. It does not mature after harvesting. At maturity, fruit develop smoother skin surface. Skin becomes duller as the fruit reaches maturity Avocados should be harvested with sharp clippers by severing the stem slightly above the fruit shoulder. The stem length should be 0.5 to 1 cm less, in order to avoid puncture damage of adjacent fruit

- Do not Small cuts, scratches and on fruits
- Do not use nylon bags or bag/crate having sharp
- Do not keep more layers of fruits
- Fruits should not fall from a height above 30cms and also not be kept under direct sunlight for prolonged periods as it will damage the quality
- Should not be harvested during the rainy time as due to moisture more chances of the fungus to grow. If harvested, dry it immediately
- Anthranose problem increases due to harvesting during the rainy time gets prominent on ripening
- Also, the stem end rot due to complete removal of the stem which only gets prominent on ripening



- Harvest carefully even small cuts, scratches and abrasions can spoil the appearance of the fruit and lead to decay
- The harvested fruit should be carefully put into paper-lined crates
- Harvest fruits at right stage of maturity when seed colour changes from yellow to dark brown

Pre packing




- Do not mix ripe and mature fruits
- Don't mix all size of fruits

- Separate the marketable from the unmarketable fruits during filed grading
- Grade fruits as per size and shape
- Clean fruits by gently wiping the surface with a clean soft cotton cloth or gloves

Grading and Packing

- Don't use plastic crates of more than 15 kg size
- Do not make more than 2 layers of fruits
- Don't pack fruits without cushioning

- Avocados are graded according to size and external appearance.
- Fruit may graded in three sizes, small (<250 g), medium (250-500 g), and large (500-1000 g)
- Each alternate fruit should be wrapped in tissue paper to reduce vibration injury and fruit scarring
- Shredded paper placed in the base of the carton also helps to reduce fruit surface damage
- A strong, well ventilated cardboard carton, typically holding 8-10 kg of fruit should be used for packing

<p>Transport and storage</p> <ul style="list-style-type: none"> Do not transport in 25 kg box like such  <ul style="list-style-type: none"> Don't store avocado at low temperature (<10-12°C). They are susceptible to chilling injury 	<ul style="list-style-type: none"> In a one-line tray in a box of 7-10kgs with proper ventilation and papers for keeping   <ul style="list-style-type: none"> Expected market life of fruit at ambient temperature (25 °C to 30 °C) vary between 1 to 2 weeks, depending on harvest maturity Avocado should be held at 12-14°C for maximum market life.
<p>Diseases</p> <ul style="list-style-type: none"> Do not allow diseased leaves and rotted fruits in the orchards. It will spread the disease 	<ul style="list-style-type: none"> Pathogenic diseases can be reduced by keeping the farms clean. Destroy diseased leaves and rotted fruits. Use recommended fungicides
<p>Handling</p>	<ul style="list-style-type: none"> Handle fruits gently & fruit boxes should not be thrown while loading or unloading.

Economics of cultivation

The economics is avocado cultivation revealed that the cost of production is higher than many traditional fruits but the return after 5 years are higher than most of the fruits crops (Table .7)

Table 7. Details of cost cultivation

Details	Cost (Rs)
Cost of Establishment per acre	
Planting material 180x120 = 21,600	
Drip irrigation per acre = 25,000	1,20,600
Land preparation & pit making = 45,000	
FYM application and planting = 29,000	
Cost of cultivation	
a. Maintenance cost	
Inter-cultivation operation = 10,000	
FYM and fertilizer application = 25,000	70,000
Pruning charges = 10,000	
Irrigation and plant protection = 25,000	
b. Harvesting cost	Rs.20,000
c. Watch and ward cost	Rs. 15,000
d. Packing cost	Rs.36,000
e. Ammortized cost	Rs. 20,710
Total cost of cultivation	Rs.2,90,710

Conclusion

Avocado has high nutritional value and usefulness of its high quality fats in promoting health of heart and circular system is attracting many people to use it in their daily diet. The growing use of Avocado oils and fats in cosmetics is also a reason for increasing popularity of this fruit. In India, consumption of Avocado is limited to high elite group of large metropolitan cities but with increasing awareness about the health concerns and its high remunerative nature the demand of avocado is increasing. In India, a large area is suitable for cultivation of Avocado hence, there is good scope of Avocado cultivation in India but there is need to develop better varieties, production technologies and provide good planting materials for farmers.

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Phone : +91-80-23086100, Fax : +91-80-28466291

Email: director.iihr@icar.gov.in Website: www.iihr.res.in

