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AVOCADO: A balanced nutritious fruit cultivation techniques

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1. Introduction

Avocado (*Persea americana* Mill., Lauraceae, 2n=24) introduced into India from Ceylon about 50-77 years back and originated in Central America . It is being grown in hill regions of Tamil Nadu, Kerala, Karnataka, and Maharashtra. Leading producers of avocado are Mexico, USA, Dominican Republic, Brazil, Columbia, Indonesia, Venezuela and South Africa. In Tamil Nadu it is commercially cultivates in lower pulney hills, foot hills of Nilgris, agamalai and Megamalai hills.

2. Composition and Uses:

One of the most nutritious fruits rich in fat (26.4%), protein (1.7%) and minerals (1.8%) and low in carbohydrates (5.1%). It can be safely eaten by diabetics. Fruit is used as a dessert in salads, ice creams and milk shakes. Immature fruits may have a bitter flavour that may reduce on ripening; peal of avocado has antifungal compounds. The pulp has a buttery consistency, looks very much like cow's butter and blend in taste with nutty flavour.

3. Cultivars: Avocado has three races namely.

1. West Indian race: No leaf scent, medium to large fruits, large seed, loose cavity, matures in 6 months. Varieties: Pollock, Simmond, Black Prince, Peterson, Waldin, Purple green.
2. Guatemalan race: No leaf scent, moderate to large fruits, smaller seed, tight cavity,

Linda, Queen, Itsamma, Benik.

Mexican race: Leaves scented, small fruit, large seed matures in 6 months. Varieties: Gott fried, Duke. Fuerte: - Is a cross between Mexican x Guatemalan- pear shaped fruits.

Avocado cultivars diurnally synchronized dichogamy and grouped into two types namely. Type A = Flowers functionally female in the morning and male in the next day afternoon. Type B = Flowers functionally male in the morining and female in the next day afternoon.

4. **Important varieties Hass.** (Flower type: A). Hass originated as a chance seedling variety in La Habra Heights, California. The cultivar was selected by Rudolph Hass in the 1920's and patented in 1935. Hass is recognized as the best overall quality avocado available, has the longest harvest season (January – August, June – October). The fruit at maturity being purple in colour and medium in size.

Reed: It is largest known varieties of avocado.

The round fruit is about the size of a softball, and weigh more than a 450g. Its thick, green, slightly pebbled skin is easy to peel, and its flesh is a pale golden-yellow. It has a relatively large seed and seed cavity, but its robust size allows it to still carry a substantial amount of edible flesh. The texture is buttery, and the flavor is bold, rich and nutty. The productive Reed avocado trees are slender and upright, and although their height can be controlled with pruning, they are able to grow up to 37 feet tall. **Fuerte.** (Flower type: B). Fuerte was found by Carl Schmidt. It survives a freeze temperature. The fruit is greenskin when ripe, pear shaped with a flat area on the bottom corner and very high quality. The Fuerte tree is large and spreading. The leaves have a strong anise smell when crushed, and there is red flecking on wood of new shoots. The tree is intermediate in cold resistance to about 27ºF. Fruit set is erratic; some trees never seem to have very much fruit. Groves are alternate bearing. Fruit set in Fuerte improves when planted with varieties of "A" type flowers.

Green: A successfully grown variety of Guatemalan race with oval-shaped, greenish

Zutano. (Flower type: B). This cultivar is believed to have originated as chance seedling in California (Koch, 1983).

Zutano is a vigorous upright tree that produces heavily. The fruits are green at ripening, thin skinned, glossy green skin,

pear shaped and vary from 8 to 14 oz. The quality of the fruit is relatively poor; consumers comment that the flavor is poor and "watery". This a result of low accumulation of oil (or dry matter) in the flesh. Zutanos that are harvested late in their season have a more acceptable flavor, but surface corking, end spots and internal breakdown reduce marketability. Zutanos may be useful in acting as a pollinizer tree for Hass, since Hass is an A flower type and Zutano is a B flower.

Bacon. (Flower type: B). Bacon originated as a seedling tree in California in 1928. Mr. Bacon was screening large numbers of seedlings for cold hardiness. It was

identified as most cold hardy of the commercial varieties. The trees will survive temperatures as low as 24ºF. The fruit is dark green, oval in shape of medium quality and 200 to 400g in weight. The tree is an upright growing tree and is commonly grown on a 15' x 15' spacing. The leaves, when crushed, have an anise smell. Useful as a pollinizer for Hass.

Pinkerton (Flower type: A). Pinkerton

originated as a seedling during 1959 in California. The cultivar is thought to be a hybrid of Hass x Rincon. The cultivar was patented in 1975. The Pinkerton fruit has a green peel at ripening, with a small seed and very good fruit quality and flavor. Pinkerton is mostly of the Guatemalan race. The peel is pebbly like Hass, but the fruit has a longer neck than Hass. Under cooler conditions the neck can be especially long to the point that they are difficult to pack into standard cartons. Pinkerton blooms over a long time period. The harvest season is from January through May.

5. New varieties

TKD-1: It was released from Horticultural

Research Station, ThadiyanKudisai, TNAU during 1996, suitable for high density planting (5X5m), Fruits are dark green coloured, Oval shaped and medium in size weighing 425g.

Average yield: 66 kg/tree, Yield: 26.4 tons/hectare, Fat content of 23.8 %.

Lamb Hass. (Flower type: A). Lamb Hass originated as a cross between Gwen and Thille. Lamb Hass was selected because of its good flavor, superior production and a skin that turns black at ripening.

Gwen. (Flower type: A). Gwen is a selection from 'Thille'. (Thille is a seedling from Hass). It has excellent fruit quality and heavy set. It has the Guatemalan traits of thick, rough skin, a small, tight seed and a "nutty"

flavor. Fuits hang on the tree for 1½ years after set and had sensitivity to cold. The skin color remained green at ripening.

Sir Prize. (Flower type B). The fruit of Sir Prize looks like a black, round ball. It has a small seed and has an excellent, nutty rich flavor. The maturity season appears to be during November – March. It is good cross-

pollinizer for Hass.

Gem (Flower type A). Gem is also a black-

skinned fruit. The average fruit weight is

200-400g. The tree has an open and spreading growth. Best character of fruit is when cut in half, has a much slower oxidation rate (the flesh stays greener longer). The tree has less alternate bearing tendency.

Holiday (Flower type A). A very large, attractive fruit with a green skin at ripeness.

Average fruit wt is 500-700g. The tree is a semi-dwarf.

Long-necked' avocados

Pura Vida variety — which are typically gourd-like in shape. They are nearly as big as a squash, too, measuring about 18 inches (three feet). Moreover, they weigh between r 453 grams (g) - 1.3 kilograms (kg).

Avocados Varieties without pits (seeds)

The seedless fruits are only available in U.K. It is smaller and more elongated than traditional varieties and they usually measure just 2 to 3 inches in length. The skin of this avocado is smooth and you can actually eat it. The seedless avocados are the result of an unpollinated avocado blossom that develops without a seed.

A- Seedling root stock, B & C - Soft wood grafting, D - Grafted plants

6. Soil and climate

Prefers well drained and well aerated acidic soils of sandy to clay loams with 4.5 to 5.5 pH. West Indian race can tolerate pH of 7.6 to 7.9. The subsoil texture is very important because it can not tolerate any water logging. The climate requirement varies depending upon the race of Avocado. Mexican type is more cold tolerant (10-15^{0}C), West Indian type is most tropically adopted and Guatemalan type is intermediate. The flowering is very much influenced by temperature, optimum being 20-28^{0}C and fruits are very sensitive to freezing temperature; Strong winds are very dangerous to the tree as the wood is soft and brittle. Cool moist subtropics are best for maximum production. Open sun light is required

7. Propagation

Plants propagated by seeds. Since it is polyembronic, seed can be cut into two halves and sown. The viability period of seed is only 2-3 weeks. Removal of seed coat before sowing enhances the germination. It is propagated by grafting and budding. The root

stocks of 2 to 4 months old can be used for cleft or side method of grafting. Mexican root stocks stocks are best and dwarfing in effect.

Soft wood grafting of Avocados

Persea schiediana is a vigorous root stock. Popular root stock selections are Duke-6, Duke-7, G-6, Huntalas, Dusa and Latas which are resistance to root rot caused by *Phytophthora cinnamoni*. Mexican race can be propagated by cuttings of young plants and two- and three-year-old 'Hass' avocado scions grafted on Duke 7 clonal rootstock were performed by Salazar-García *et al*. (1999).

8. 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 bon 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 plating 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). Different races with overlapping blooming periods should only be planted together. High density plantings of 800 trees/ha gave double yield than normal planting of 400 plants/ha.

9. Irrigation: Irrigation at 2 days interval will be optimum during dry and initial period. Sprinkler irrigation to keep the top 60cm soil moist is the best.

10. Manuring: Bearing trees of 10 years may be given 200g N, 45gP and 165gK in addition to 50kg FYM. Lower doses can be given from early stages depending upon the growth of the plant. Fertilizer should be applied 30cm away from the trunk only. Foliar sprays of boron made at the cauliflower stage but prior to full inflorescence expansion and anthesis increased the number of pollen tubes that reached the ovule and also increased ovule viability (Jaganath and Lovatt, 1998).

11. Training & pruning: Better to train the plants to Pyramidal form. Regular pruning may be done to remove overcrowding, damaged & unproductive branches only. The vertical growing cultivars (Pollock) headed back to spread.

12. Flowering & Fruit set: It flowers during Feb-March. Avocado flowers are entomophilies. Higher relative humidity may help in prolonging receptivity of stigma and retain viability of pollen. Temperature, rainfall, humidity, nutrition (N,Ca) and

hormone levels in the plant affect fruit growth and development.

Synchronous dichogamy

The avocado flower has both functional male and female organs. The male floral organ, which produces pollen, is comprised of the anthers and stamens. The female floral organ is comprised of the stigma (which receives the pollen), style and the ovary. The avocado exhibits a type of flowering behaviour known as "synchronous dichogamy". An individual flower will be open for 2 days, however the timing of the male and female phases are distinct. When the flower first opens it is in

the female phase and the stigma is receptive to pollen. At the end of the female phase, which lasts 2 to 4 hours, the flower will close. On the second day the same flower re-opens in the male phase and sheds its pollen**.** Inflorescence initiation of the 'Hass' avocado occurred earlier than previously reported for other cultivars in California and other avocado producing regions (Reece, 1942; Schroeder, 1951; Alexander, 1975; Davenport, 1982; Inohue and Takahashi, 1989).

13. Harvesting and yield: Fully mature fruits only harvested. Maturity can be known by change in colour, size of fruit and reduce of glossy shine of the fruit. Average yield 100-500 fruits per tree. High yield during an "on" crop year (average of 66 kg per tree) significantly reduced flowering intensity for the next year's crop (Salazar-García *et al.*, 1998).

14. Ripening & Storage: Mature avocados ripen in about 5-10 days at 20^0C. Ripening can be hastened with ethrel treatments. Mature avocados can be stored in controlled atmosphere with 9% Co_2 & 1% 02 at 10^0C for 60 days.

15. Physiological disorders:

a. **Tip burn: -** It is due to chloride toxicity, the leaf shows necrosis around the edges and fall off. Heavy irrigation at the end of winter, deep ploughing, and addition of organic matter may control this.

b. Grey Pulp: Mainly due to warm temperatures which reduce the moisture content of the fruit below 80%. An evenly distributed grey discolouration which usually spreads from the blossom end. This symptom is generally associated with senescence or ageing and is probably a

slow process. It differs from internal browning in that the actual browning reaction does not necessarily take place here. The grey colour is visible as soon as the fruit is cut, but can subsequently darken further. Fruit analysis (proximal and distal halves) also showed that an increased K concentration resulted in a decreased occurrence of pulp spot. It was concluded that too low soil K values were probably responsible for the high incidence of these two physiological disorders, rather than too high Ca and Mg values (Koen, *et al*., 1990).

16. Conclusion

It is concluded that the above-mentioned novel techniques for avocado is scientifically proven that are highly potential enough to improve the crop productivity. The ultimate aim is to increase the productivity per unit area with the effective utilization of optimum inputs.

Reference:

Alexander, D. McE. 1975. Flowering times of avocados in the Murray Valley. *J. Austral. Inst. Agr. Sci.* 41: 264-267.

Davenport, T. L. 1982. Avocado growth and development. Proc. Fla. State Hort. Soc. 95:92-96.

Inohue, H.; Takahashi, B. 1989. Differentiation and development of avocado flower buds in Japan. *J. Jpn. Soc. Hort. Sci.* 58: 105-111.

Jaganath, I.; Lovatt, C. J. 1998. Efficacy studies on prebloom canopy applications of boron to 'Hass' avocados in California. Proc. World Avocado Congr. III, Tel Aviv, Israel, Oct. 22-27, 1995. pp. 181-184.

Karunakaran Tirupathi, G, Sakthivel, T, Sankar, V, R. Senthilkumar, B. Muralidhara, S. Rajendran, V. Venkattaramanappa, G.S. Mdhu, Nesara Begane. 2022. Avocado cultivation in India. *Technical Bulletin*. **TB-18/2022.**

Koen, T.J., Du Plessis, S.F. And Terblanche, J.H. (1990). Nutritional Factors Involved In Physiological Post-Harvest Fruit Disorders Of Avocados (Cv. Fuerte). Acta Hortic. 275, 543-550. Doi: 10.17660/Actahortic.1990.275.67 Https://Doi.Org/10.17660/Actahortic.1990.275.67

Reece, P. C. 1942. Differentiation of avocado blossom buds in Florida. Bot. Gaz. 104: 458-476.

Salazar-Garcia, S.; Lord, E. M.; Lovatt, C. J. 1998. Inflorescence and flower development of the 'Hass' avocado (*Persea americana Mill.*) during "on" and "off" crop years. *J. Am. Soc. Hort. Sci.* 123: 537-544.

Salazar-Garcia, S.; Lord, E. M.; Lovatt, C. J. 1999. Inflorescence development of the 'Hass' avocado: commitment to flowering. *J. Am. Soc. Hort. Sci*. 24: 478-482.

Schroeder, C. A. 1951. Flower bud development in the avocado. Calif. Avo. Soc. Yrbk. 36:pp 159-163