Handbook
on
Fruit Crop Cultivation

Designed for **De-suung National Service: Million Fruit Tree Plantation by the Ministry of Agriculture & Forests**

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Content

Temperate
Fruit Crops

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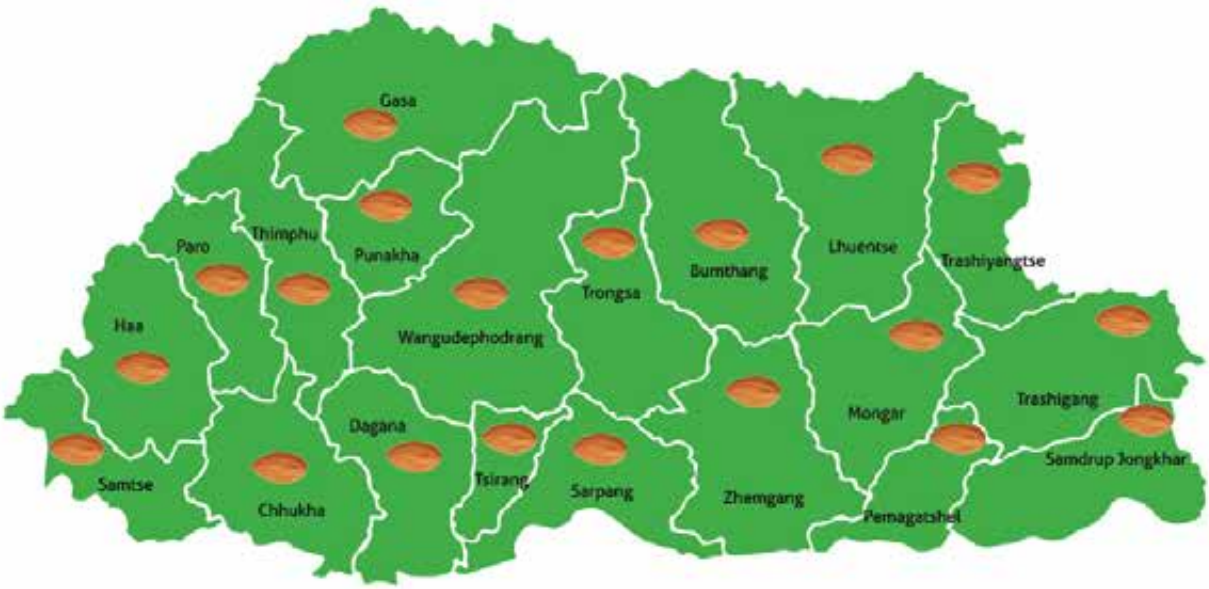
Almond



Common Name: Almond

Botanical Name: *Prunus dulcis*

Yield: 20-25 kgs/tree

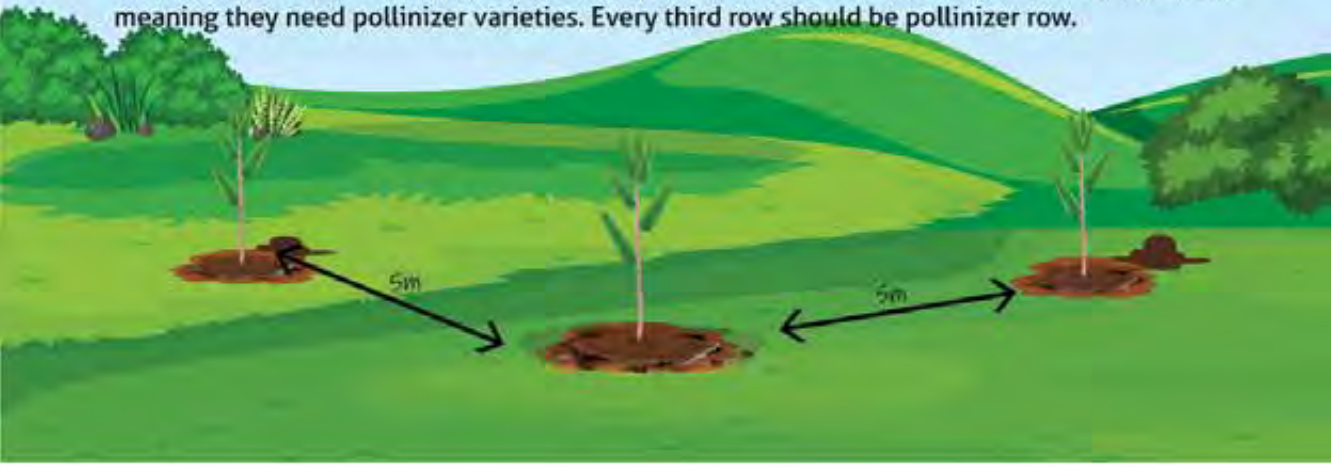
Varieties: *Texas, Drake, Dhebhar Badhan, Kagzi*

Altitude: 1000 to 3200m

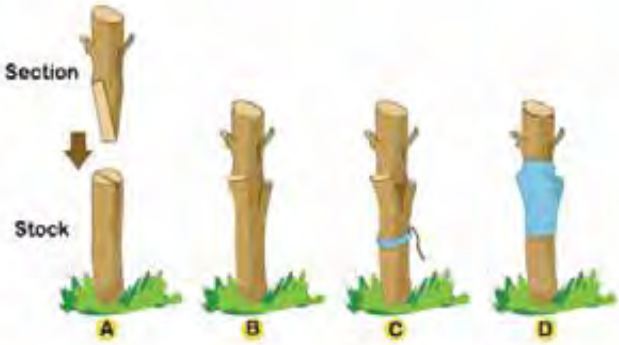
Soil: Almond can be grown best in deep, well drained soils of light to medium texture with pH of 6.5.

Field preparation: Dig pits of $1m^3$ at least a month before planting and refill with top soil and well decomposed manure.

Recommended seedling rate: Plant seedlings at a spacing of 5mX5m An acre of land will accommodate approximately 112 seedlings. The almond flowers are self-incompatible meaning they need pollinizer varieties. Every third row should be pollinizer row.



Nursery raising: Almond can be propagated either through budding or grafting. Budding is done in July and grafting is done in Feburary-March.



Cultivation practices: Pruning is done during dormant season from December to January to maintain desired shape. Modified central leader system is usually recommended for almond.

Nutrient management: Apply fertilizers before bloom around the tree without touching the trunk. Traditionally, application of about 30kgs of Farm Yard Manure is recommended in spring and after harvest.

Water management: The critical stages for the application of irrigation is during flowering (February to March) and fruit development (April, May and June).

Plant protection: Leaf curling aphid, Sanjose scale, Chaffer beetle and stem borer are some of the pests of almond. Spraying with the recommended doses of pesticide can control those pests.

Leaf curling aphid

Harvest: Generally, almonds are ready for harvest when the hull colour changes from green to yellowish with cracks or splitting at suture starting from pedicel end.

Post-harvest management: Fruits may be dried and hulled immediately, or stockpiled for fumigation against Navel Orange worm after harvest. Nuts are dried by forced hot air until their moisture content reaches 5-7%. Nuts are then dehulled and shelled. In-shell nuts can be stored in bins for weeks or months until final processing.

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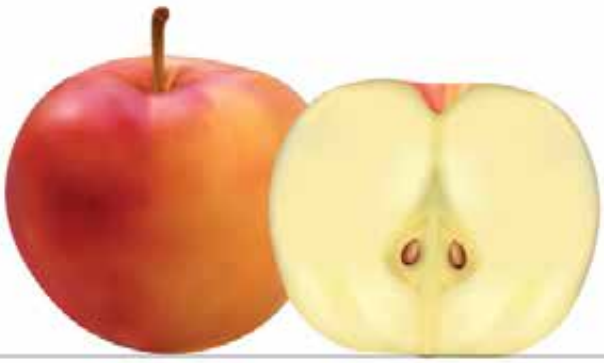
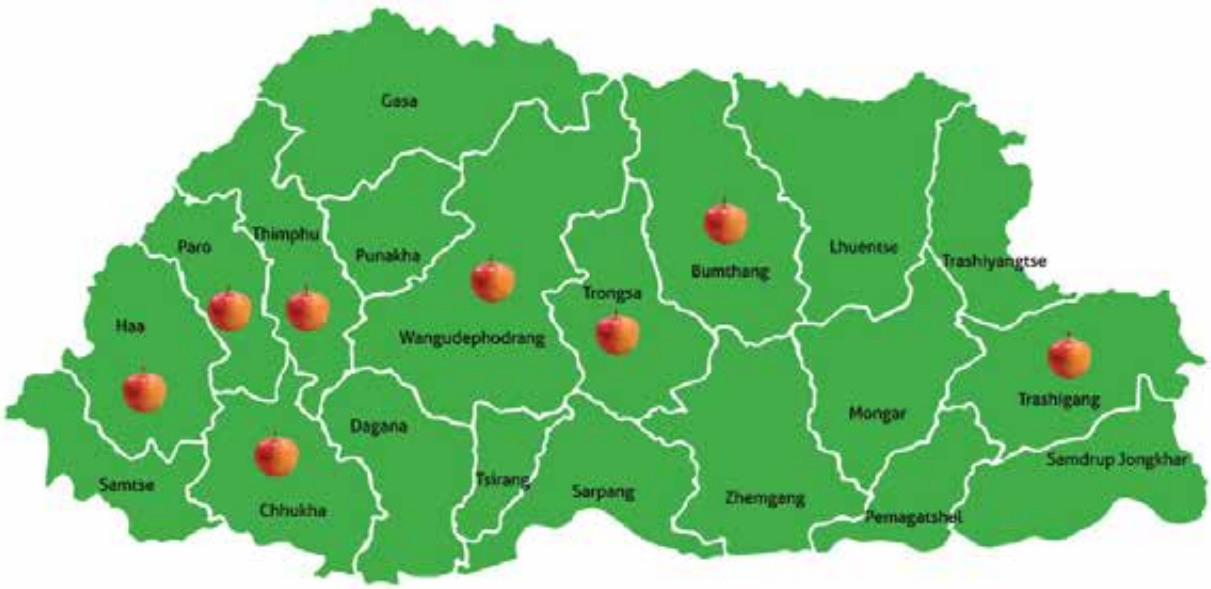
Apple

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Dagana
Samtse
Chhukha
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samdrup Jongkhar

Common Name: Apple

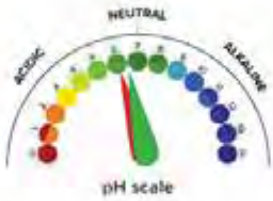
Botanical Name: *Malus domestica*

Yield: 35-60 kgs/tree

Varieties: *Red delicious, Royal delicious, Golden delicious, Red chief, Red free, Lobo, Fuji, Mutsu*

Altitude: 1900-2700 M

Soil: A well-drained, sandy loam or silty loam soil with pH 6 – 6.5



Field preparation: Dig pits of 1m³ a month before planting. Incorporate topsoil with well decomposed manure or compost and refill the pits.

Recommended seedling rate: Maintain a spacing of 6 x 6m for vigorous varieties and 3 x 3m spacing for high density planting.

Nursery management: Apples are propagated through grafting and budding. It is ideal to graft from January to March and budding is usually done from June to August.

Planting: Apple seedling can be planted in the month of February-March while the plants are still dormant. Ensure the graft union is kept 15-20cm above the soil. Plantation of 10% pollinizer varieties like *Golden delicious, Granny smith* and *Jonathan* is recommended for proper fruiting.

Cultivation practices

Train and prune the trees every year to ensure optimum yield and fruit quality. The "Open center system" is usually recommended for deciduous fruit trees.

A 1st year – head back to obtain branching at the desired height of 1m

B 2nd year – prune branched tree to 2 -3 branches in wide angles

C 3rd – 4th year: Continue pruning to attain a desired shape

D Tree pruned into open center system

E Top view of a tree with desired distribution of scaffolds

Nutrient management: Apply fertilizers within the tree canopy about 10 to 15 cm from the tree trunk. Fertilizers especially chemical fertilizers should not come into contact with tree trunk.

Water management: Provide adequate irrigation especially during the time of flowering, fruit set and fruit development stages.

Plant protection: The most important apple diseases in Bhutan are apple scab, apple rust, and powdery mildew. The important apple pests are whooly aphid, trunk borer, and San Jose scale. Visit www.nppc.gov.bt for details on the control measures.

Harvest: Apple fruits will be ready for harvest starting from August to November depending on the variety. Harvest the fruits in early morning hours or towards afternoon when the heat is low.

Post-harvest management: Store the harvested fruits in a cool and dry place away from sunlight and heat.

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Apricot

Common Name: Apricot

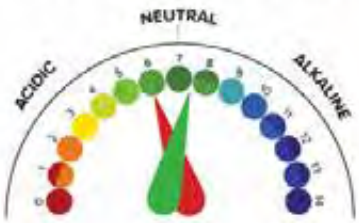
Botanical Name: *Prunus armeniaca*

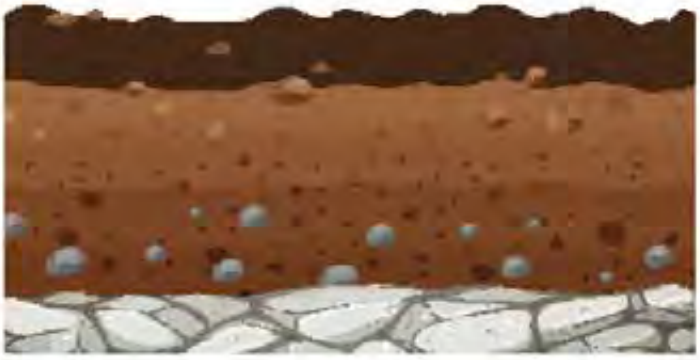
Yield: 21.6kgs/tree

Varieties: *New castle, Shakapara, Bajo Khamchung 1, July elberta*

Altitude: 900-1700m

Soil: Apricot thrive in soil with a pH between 6.5 and 8.0. Well drained loamy soil is preferred.





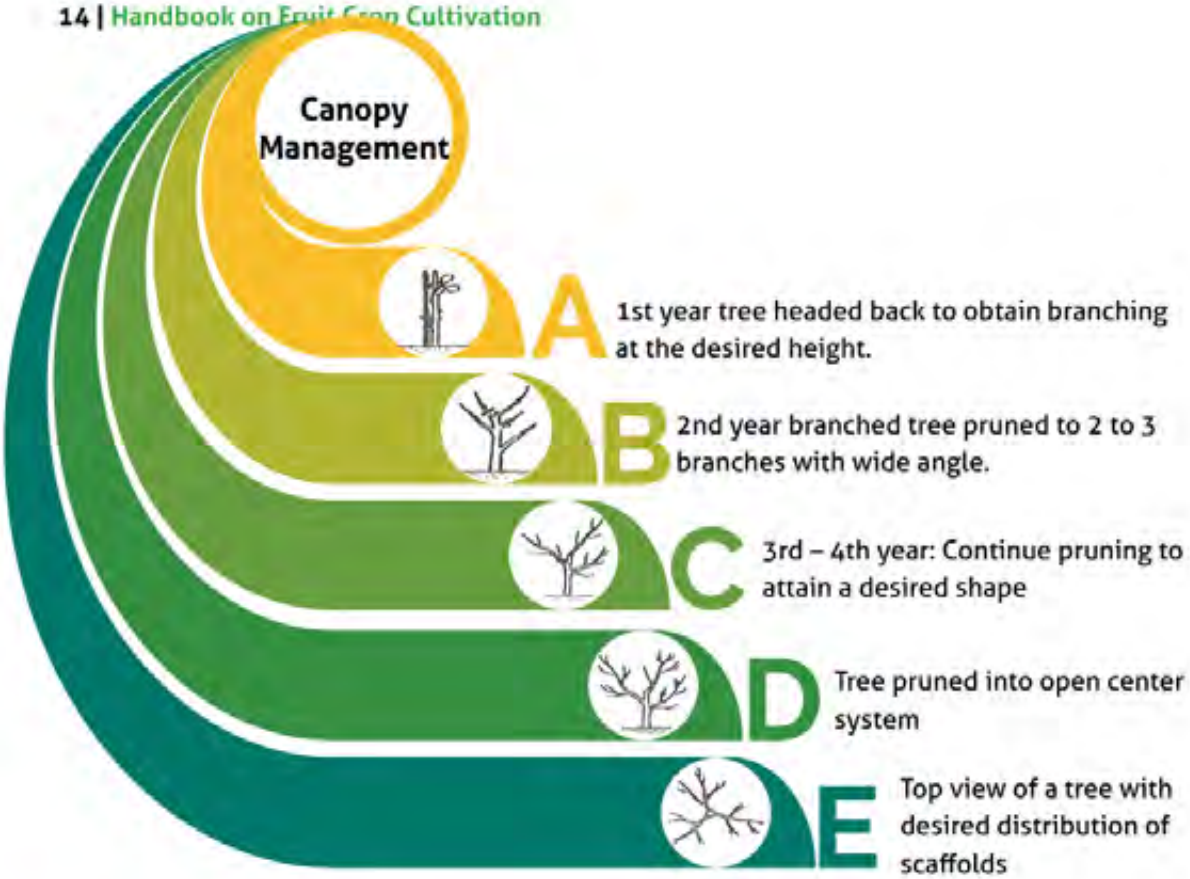
Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manure and top soil. For ideal growth and development, the pit size of 1m³ is recommended.

Recommended seedling rate: Apricot saplings are planted at spacing of 5m x 5m. One acre can accommodate 161 plants.

Nursery management: Apricot are propagated by grafting or budding. Apricot are also grafted on peach or plum root stocks.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Ideally the size of the basin should be equal to the size of the tree canopy

Canopy Management



Nutrient management: Soil nutrient management depends on variety, soil types and age of trees. For trees older than seven years, apply annually 40kgs of Farm Yard Manure.

Water management: Irrigation should be provided during growing, flowering and fruit development stages.

Plant protection:
Major Pest & Management
Major pest in apricot are aphid and twig borer. Spray insecticidal soap and neem oil regularly to control the pest.

Harvesting and storage: Harvest the fruits when color changes from yellow to deep orange with no green remaining in the skin.

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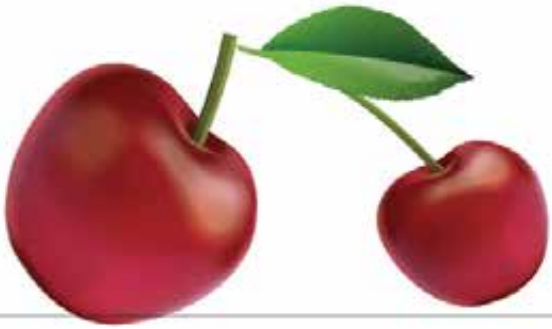
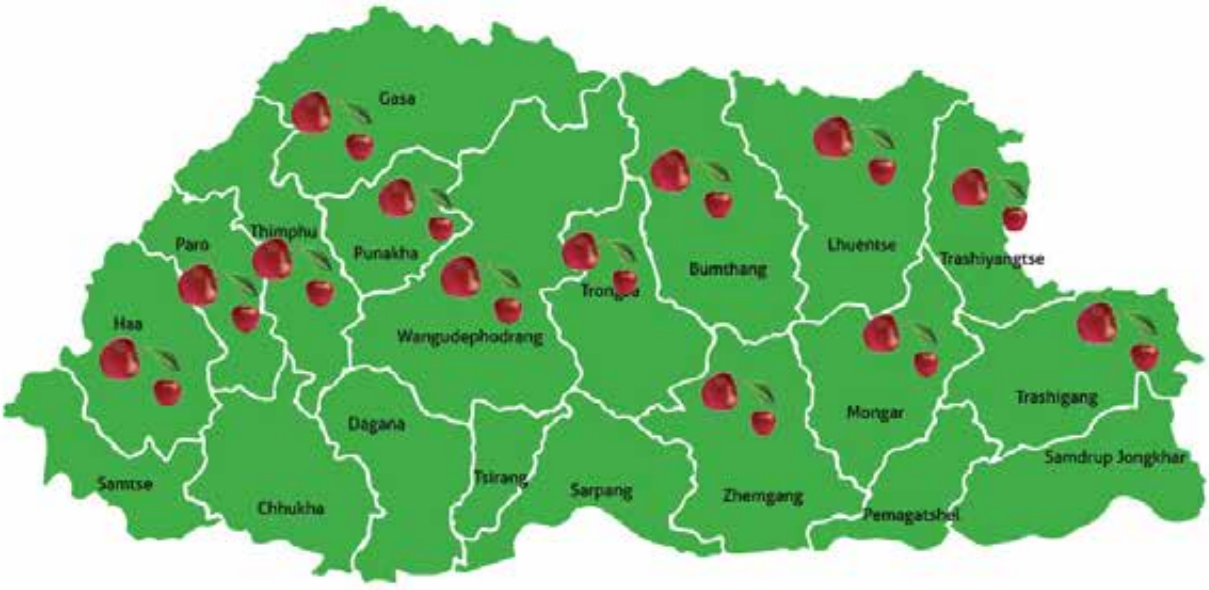
Cherry

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Trashiyangtse
Trashigang
Mongar
Samdrup Jongkhar
Zhemgang
Pemagatshel

Local Name: Cherry

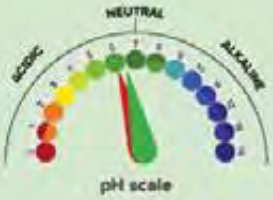
Botanical Name: *Prunus avium*

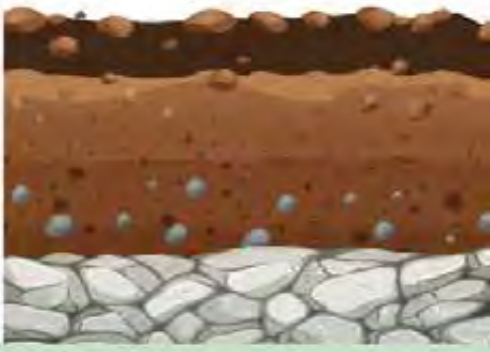
Yield: 1- 2 kgs/tree

Varieties: *Seneca, Royal ann, Jabouney, Seokham drukchu (Stella)*

Altitude: 1600-2600

Soil: A well-drained and fertile soil with pH of 6.2 to 6.8 is preferred for growing cherry.

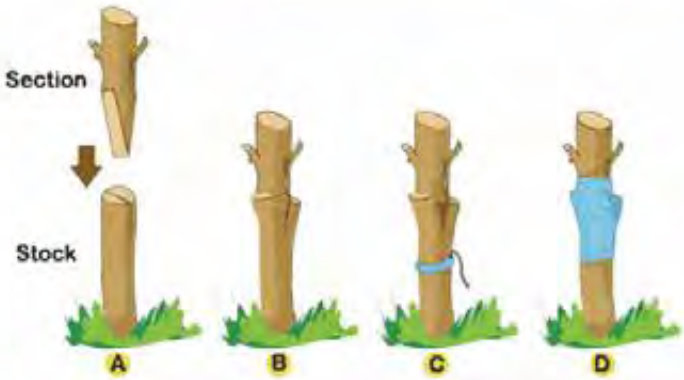




Field preparation: Dig pits of 1m³ at least a month before planting and refill with top soil and well decomposed manure.

Recommended seedling rate: Plant seedlings at a spacing of 5m X 5m. An acre of land will accommodate approximately 112 seedlings.

Nursery raising: Grafting is usually the most preferred method for propagating cherry. The best time to graft is from January to March.



Planting: Plant the seedings in the month of February to March when the seedling is in dormant stage. While planting, ensure that the graft union is about 15cm above the soil level to avoid collar rot.

Cultivation practices: Pruning is done during dormant season from December to January. Open center system is usually recommended in deciduous fruit trees.

In autumn, paint the trunks of young trees with lime to prevent them from low temperature injuries that result in splitting of barks.

Nutrient management: Apply fertilizers before bloom around the tree without touching the trunk. Traditionally, application of about 30kgs of Farm Yard Manure (FYM) is recommended in spring and after harvest.

Water management: Provide irrigation only when required after checking the soil moisture as cherry trees are intolerant to wet growing conditions.

Plant protection: No serious diseases have been observed in the country. Netting is recommended before the fruits turn colors to protect the cherries from birds.

Harvest: Pick the cherries along with the stems for fresh market. Harvest cherries during cool periods to prevent moisture loss and make sure not to damage the spurs.

Post-harvest management: Proper grading and packaging usually in punnets are preferred to fetch good price in the market.

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Chestnut

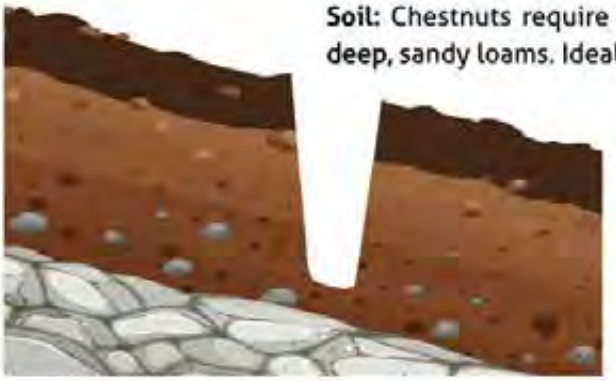
Common Name: Chestnut

Botanical Name: *Castanea crenata*

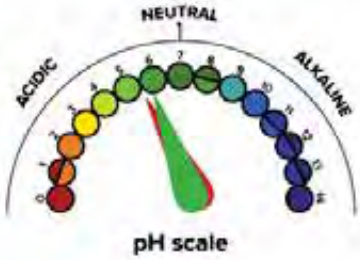
Yield: 7.05 Kg/tree

Varieties: *Wengkhar sokey 1*

Altitude: 1600 to 3000m

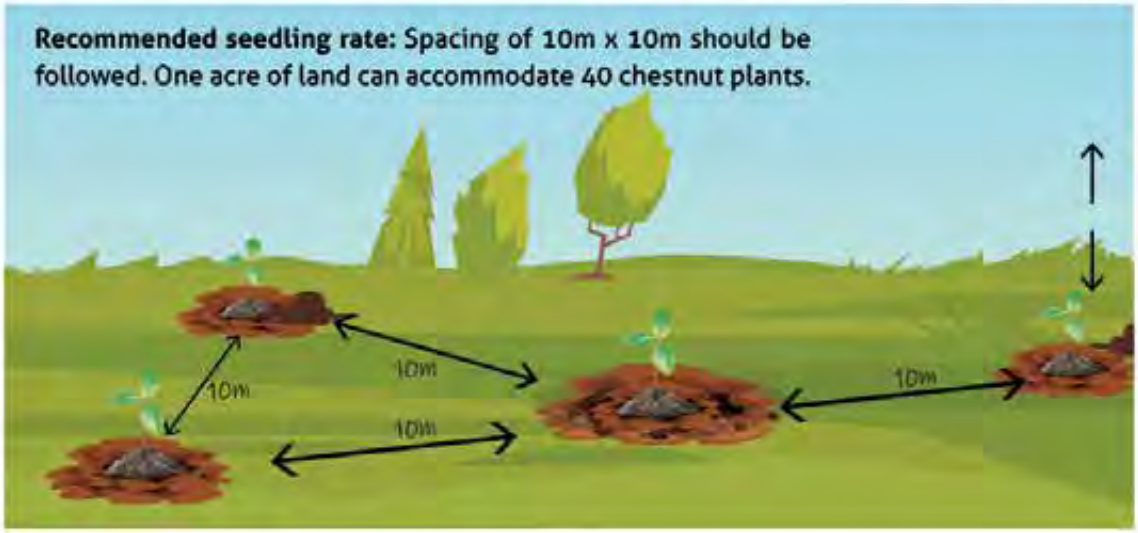


Soil: Chestnuts require sloppy well drained soils and do best on deep, sandy loams. Ideal pH is in between 5.5 to 6.0.



Field preparation: Dig pits of 1m³ in size 1-2 months before planting. Fill the pits with mixture of top soil, Farm Yard Manure or dry organic matter. Planting is done in the month of Jan-Feb when the seedlings are under dormant stage.

Recommended seedling rate: Spacing of 10m x 10m should be followed. One acre of land can accommodate 40 chestnut plants.



Nursery management: Chestnuts can be propagated through seeds or grafting. Grafting can be done between January and March.

Cultivation practices: Open center system of training and pruning should be followed for better nut quality. The pruning is started in the first year and continued throughout the tree's life.

Nutrient management: Application of 40kgs of well decomposed Farm Yard Manure per tree per year is recommended.

Water management: Chestnuts are relatively drought tolerant but young chestnuts plants should be adequately irrigated for the first two seasons of establishment.

Plant protection: Major pest in chestnut is weevils *(Curculio sp.)*. Grubs damage the nuts. The affected nuts should be treated with hot water (52°C) for 30 minutes as it kills the grub without affecting the nut quality.

Harvest: Harvesting of chestnut is done from September to October.

Post-harvest management: Place the nuts on a screen in a shady, cool, well ventilated place for several days to cure, which helps in improving the flavour of the nuts. Nuts should be placed in air tight container and kept in refrigerator for storage.

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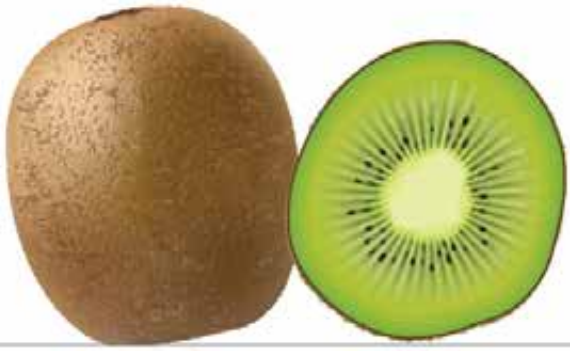
Kiwi

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Mongar
Trashigang
Samtse
Chhukha
Pemagatshel
Samdrup Jongkhar

Common Name: Kiwi

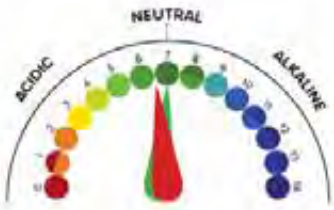
Botanical Name: *Actinidia deliciosa*

Yield: 10kgs/tree

Varieties: *Wengkhar yellow, Wengkhar Green, Hayward and Enza red*

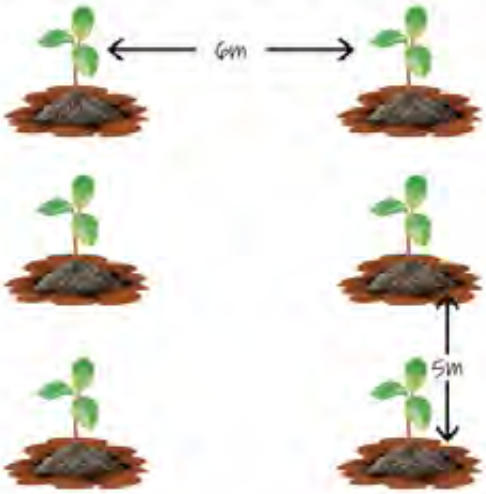
Altitude: 1200-2300M

Soil: Deep, rich, well-drained sandy soil are ideal for kiwi. Soil pH ranges from of 6.9 to 7.3



Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manures. For ideal growth and development, pit size of 60cm^3 is recommended.

Recommended seedling rate: Kiwi plants are planted at recommended spacing of row to row 6m and plant to plant 5m. Male and female planting ratio has to be maintained. For every 7-9 female plants, one male has to be planted.



Sample layout

M	F	F	F	F	F	F	F
F	F	F	M	F	F	F	F
F	F	F	F	F	F	F	M

Nursery management: The rootstock are raised through seeds and grafted after 2-3 years. The grafting usually done in the month of December to March.

Cultivation practices: Basin should be made around the tree trunk. Basin making keeps the floor clean and enable proper irrigation and manuring.

Canopy management: Training and pruning is done in winter before sap flow. Maintain 1 -1.5m length of main branches in 2 opposite directions. Keep 30-50cm long lateral branches with spacing of 50cm.

Nutrient management: Apply 50kgs of farmyard manure or compost mixed with 200g of suphala per tree in a year.

Water management: Irrigation should be applied during growing, flowering and fruit development stages.

Plant protection: Phytopthora root rot is the major issue in kiwi. Avoid water logging condition in the field.

Harvesting and storage: Harvest the fruits after leaves are all fallen. Keep the harvested fruits in a cool room using paddy straw to prevent from shrinking. For ripening, store the fruits with high ethylene emitting fruits such as apples and bananas.

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Peach


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Samdrup Jongkhar
Dagana
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samtse
Chhukha

Common Name: Peach

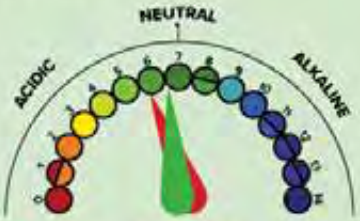
Botanical Name: *Prunus persica L.*

Yield: 20 to 30 kg/tree

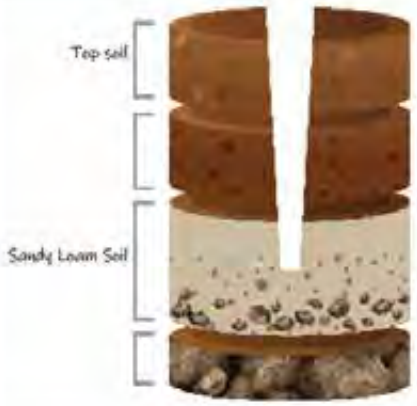
Varieties: *Flordasun, July elberta, Bathpala super, Nonomiwase*

Altitude: 1000-2500m

Soil: Deep sandy loam soil rich in organic matter is considered best for peach growing. The pH of the soil should be 5.8–6.8.

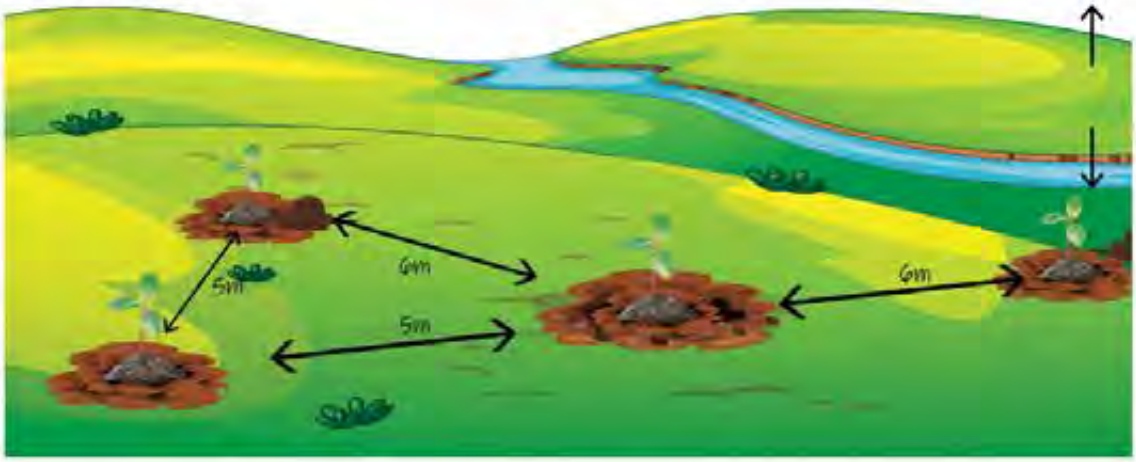


pH scale



Field preparation: Dig pits of 1m³. Fill the pits first with mixture of top soil, FYM or dry organic matter. Planting is done between January and March.

Recommended seedling rate: Peach seedlings are planted at a spacing of 4.5 x 5m to 5 x 6m depending upon the varieties and nature of the terrain. An acre of land can accommodate more than 161 plants.



Nursery management: Peach stones take at least one year to germinate. Once the seedlings reach pencil size thickness, they are grafted from January end to February.

Cultivation practices: Open centre system of training is recommended for peaches. At the time of planting, stem is cut to a height of 40-70cm above the ground level and only 2-3 well spaced branches are allowed to develop on it. Fruit thining should be carried out in the month of April and May depending on the varieties

Nutrient management: Apply compost or Farmyard Manure in December and January.

Water management: There should be sufficient moisture in the soil before the emergence of leaves and flowers. Frequent irrigation is needed during the fruit development.

Plant protection: The most common pest in peach is peach leaf curl aphid (Brachycaudus helichrysi). Visit www.nppc.gov.bt for pest management in peach.

Harvest: Harvesting is done in the last week of May to 2nd week of July depending on the variety.

Post-harvest management: Peaches can be stored for 6-7 days under normal conditions.

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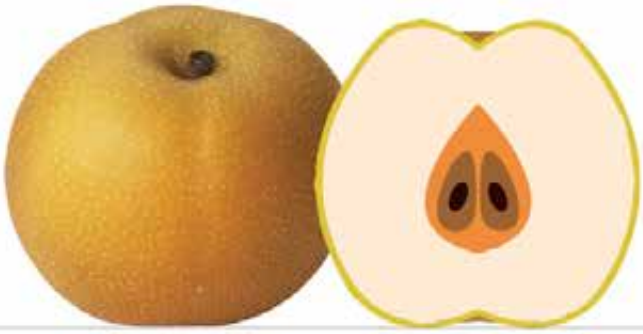
Pear

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Samdrup Jongkhar
Dagana
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samtse
Chhukha

Common Name: Pear

Botanical Name: *Pyrus pyrifolia*

Yield:50 to 80 KgAZ

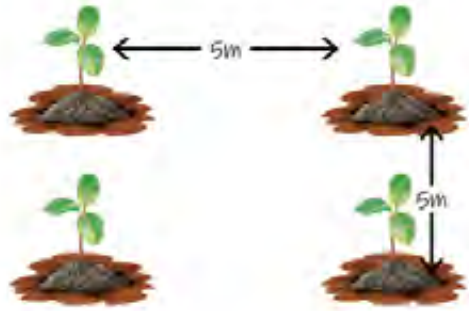
Varieties: *Kosui, Hosui, Chojuro, Nitaka, Shinko, Atago*

Altitude: 1600-2500 m asl

Soil: Soil rich in organic matter, slightly acidic (pH range of 6-7.5), well drained and deep soil is preferred.

Field preparation: Dig pits of 1m³ in size. Fill the pits first with mixture of top soil, Farm Yard Manure or dry organic matter.

Recommended seedling rate: Pear seedlings are planted at a spacing of 5 x 4.5m or 5 x 5m. An acre of land can accommodate more than 161 plants.

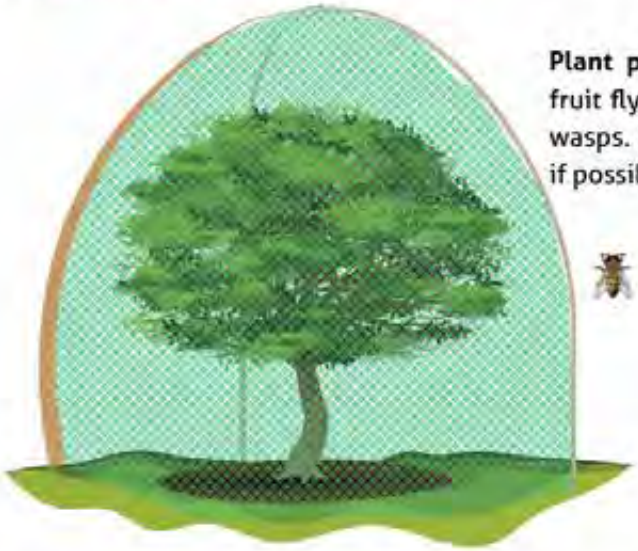


Nursery management: Pear is easily propagated through grafting from end of January to early March. Local pears can be used as rootstock.

Cultivation practices: Pear is usually trained to open centre type of framework so that plant can receive more sunshine. First fruit thinning is done after natural fruit drop from April to 3rd week of May and second fruit thinning is done when fruits attain the size of walnut or at the end of June depending upon the variety.

Nutrient management: Apply compost or Farm Yard Manure in December-January.

Water management: Water is critical during flowering and fruit development.



Plant protection: Pear fruits are affected by fruit fly and depredation by birds, rodents and wasps. Bagging of fruits with newspapers and if possible netting of orchards is recommended.

Harvest: Pear can be harvested in the first week of August to 2nd week of November depending on the variety.

Post-harvest management: Fruits should be graded based on size and colour. Wooden, plastic or cardboard boxes should be used for packaging.

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Pecan Nut

Common name: Pecan nut

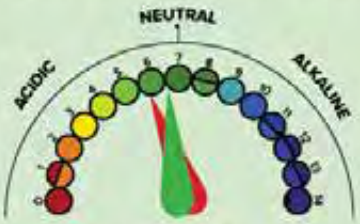
Botanical Name: *Carya illioensis*

Yield: 23 kgs/tree

Varieties: *Bajo Thasa Targo-1 and Bajo Thasa Targo-2*

Altitude: 900-1700m

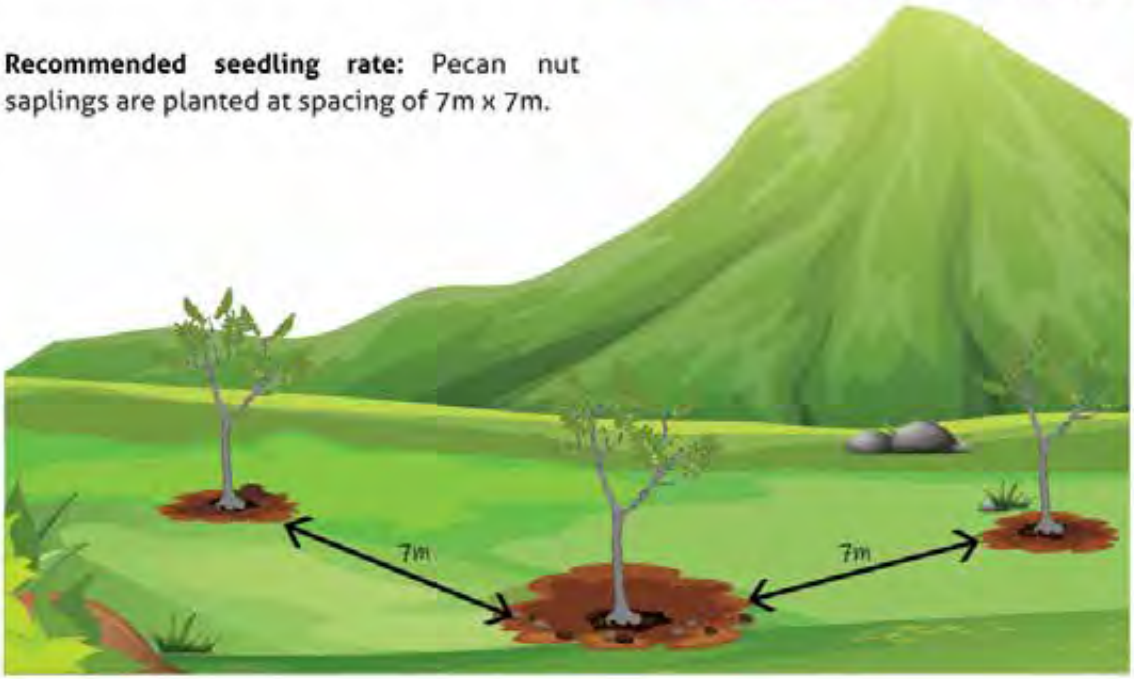
Soil: **Pecan can be grown in varied soil that are deep, well drained and well aerated with pH of 6.5 to 7.**



pH scale

Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manures. For ideal growth and development, a pit size of $1m^3$ is recommended.

Recommended seedling rate: Pecan nut saplings are planted at spacing of 7m x 7m.



Nursery management: For faster germination, seed need to be stratified for 3 to 3.5 months. The rootstock are raised and grafted after 2 to 3 years when they attain pencil size.

Cultivation practices: Ideally the size of the basin should be equal to the size of the tree canopy.

Canopy Management: Pecan trees are trained to modified central leader system. The training and pruning of the trees is carried out for the first four to five years.

Nutrient management: Depending on the soil test results, pecan orchards may need fertilizers to correct soil pH and other micro and macro nutrients deficiencies. The two most important nutrient required are nitrogen and potassium.

Water management: Water is critical especially during flowering and fruit development.

Plant protection: Scab is the main disease. It is caused by fungus *(Cladosporium caryigenum).* Symptoms are appearance of small, brown to black spots in underside of leaves and nuts.

Control: Proper canopy management and spray fungicide before flowering and after fruit set.

Harvesting and storage: Pecans must be harvested as soon as when the shuck begins to open. When about 60 to 70 percent of the nut clusters have open shucks, harvesting can begin.

ཨན་འབྲས།

Persimmon

Common Name: Persimmon

Botanical Name: *Diospyros kaki*

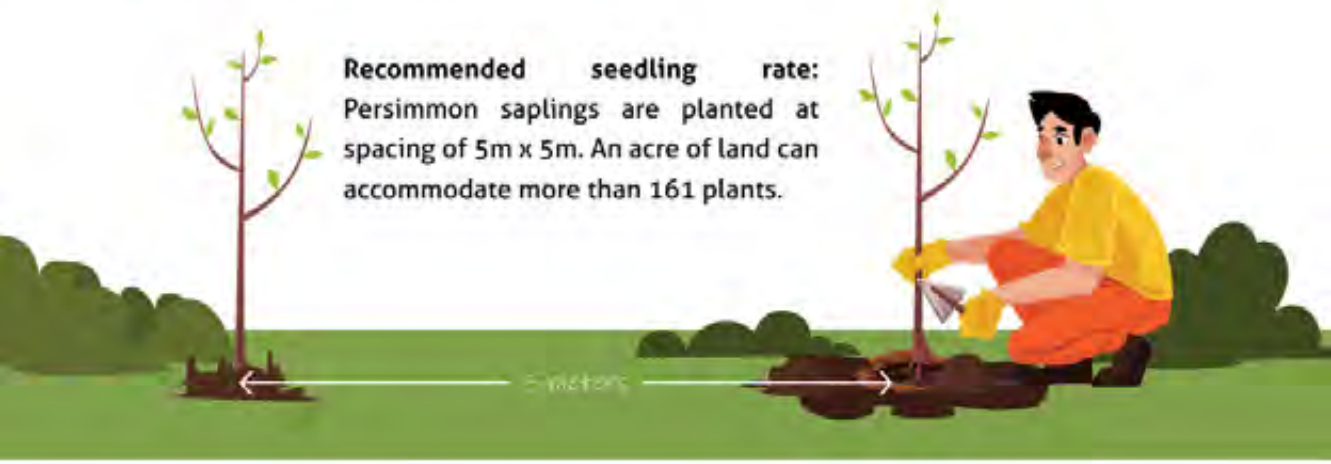
Yield: 35 kgs/tree

Varieties: *Fuyu, Jiro and Wengkhar Anday 1.*

Altitude: 1500-2200 M

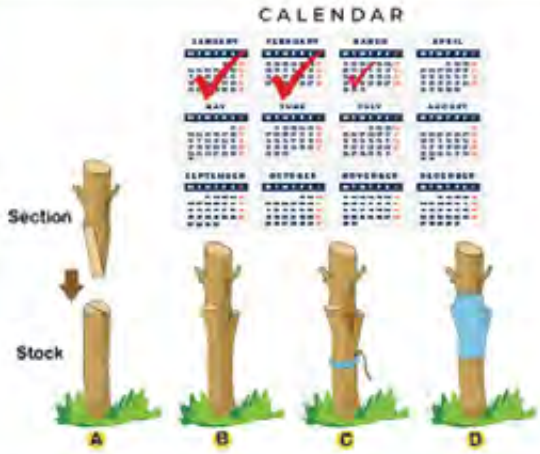
Soil: Well drained, lighter soils which have good subsoil containing some clay is preferred. Soil pH of 6.0 – 6.8 is optimum for persimmon cultivation

Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manures. For ideal growth and development, a pit size of $1m^3$ is recommended.



Recommended seedling rate: Persimmon saplings are planted at spacing of 5m x 5m. An acre of land can accommodate more than 161 plants.

Nursery management: Persimmon is propagated through grafting. Local astringent persimmon seeds can be used as rootstock. Scion woods should contain 2 to 3 buds. Grafting is done in between January to early March.



Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Basin making keeps the floor clean and enable proper and irrigation and manuring. Ideally the size of the basin should be equal to the size of the tree canopy.

A One year old plant is headed back to obtain branching at desired height.

B In 2nd year, the branched tree is pruned to maintain 2 to 3 branches with wide angles.

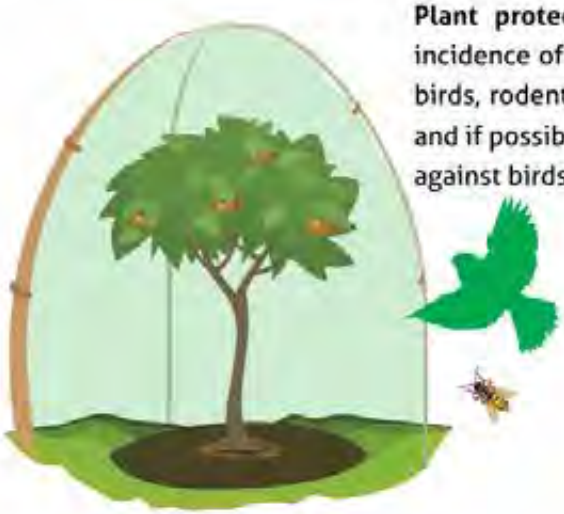
C The fruit tree start fruiting from 3rd – 4th year onwards

D The shape of the fruit tree should be 'Open Centre' system as shown in year 4 figure.

E A tree with desired distribution of scaffolds (Top view)

Nutrient management: Apply compost or Farm Yard Manure (FYM) sometime in December/ January followed by split application of a mixture of chemical fertilizers (100 gram per tree) 2-3 weeks before flowering and the second dose after the fruit thinning or at fruit growing stage.

Water management: Water is critical especially for flowering and fruit development. Watering should be done during growing season, flowering and fruit development stages.



Plant protection: In our conditions, there is no serious incidence of pests and diseases except fruits depredation by birds, rodents and wasps. Bagging of fruits with newspapers and if possible netting of orchards is recommended to protect against birds

Harvesting and storage: Harvested from early October to late November when fruits turn yellow to reddish. Persimmons can be stored for about two weeks. Proper packaging should be done to avoid damage during transport. Boxes or trays with proper protective materials can be used.

ཤུ་སྦྲི།

Plum


Gasa
Thimphu
Paro
Punakha
Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Trashigang
Mongar
Samdrup Jongkhar
Pemagatshel
Zhemgang
Dagana
Tsirang
Sarpang
Samtse
Chhukha

Common Name: Plum

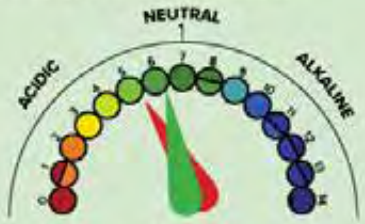
Botanical Name: *Prunus salicina L.*

Yield: 45 kg/tree

Varieties: *Oishiwase, Soldum, Santa rosa, Jambay Lhakhang chuli*

Altitude: 1500-2500m

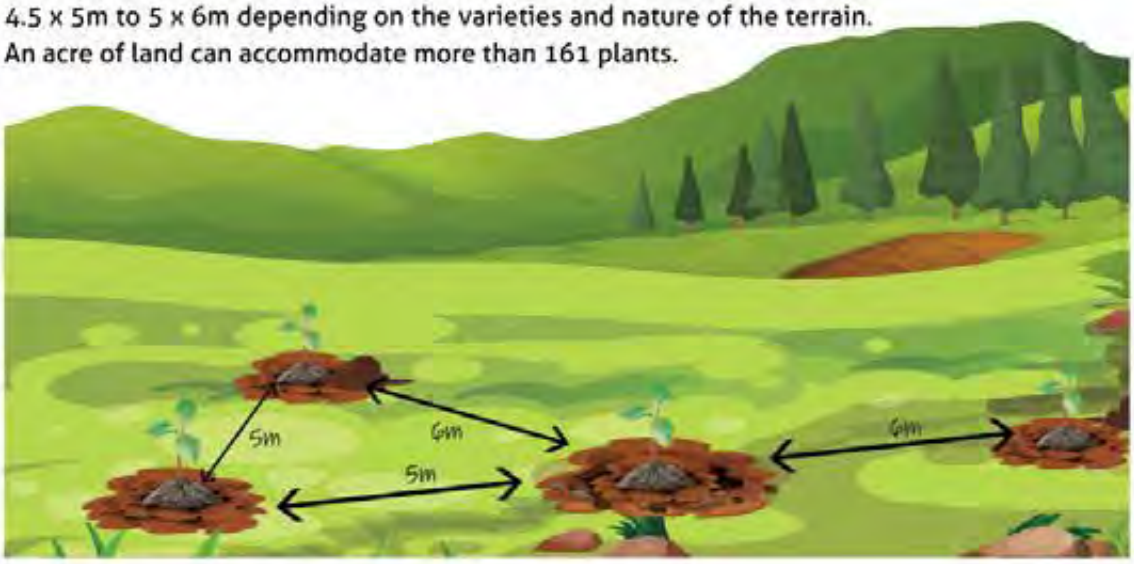
Soil: Deep, fertile and well drained loamy soil with pH range of 5.5 to 6.5 is most suitable.



pH scale

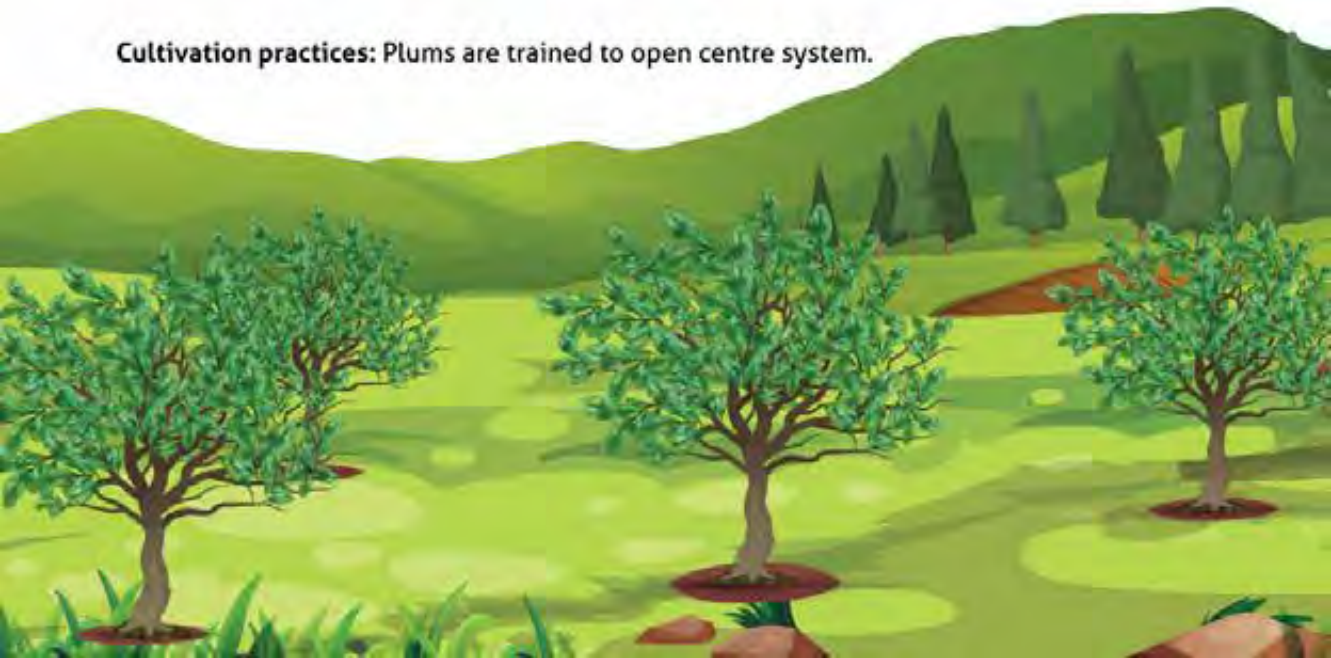
Field preparation: Dig pit size of 1m³. Fill the pits with mixture of top soil, FYM or dry organic matter.

Recommended seedling rate: Plum seedlings are planted at a spacing of 4.5 x 5m to 5 x 6m depending on the varieties and nature of the terrain. An acre of land can accommodate more than 161 plants.



Nursery management: Plums are propagated by grafting. Cuttings can be often used for raising rootstock. Grafting can be done in between February to March.

Cultivation practices: Plums are trained to open centre system.



Nutrient management: Apply compost or Farmyard Manure in December-January

Water management: There should be sufficient moisture in the soil before the emergence of leaves and flowers. Frequent irrigation is needed during the fruit development.

Plant protection: Plum is affected by leaf curl aphid *(Brachycaudus helichrysi)*. Detailed Control measures for pest and diseases can be found in www.nppc.gov.bt

Harvest: Plums can be harvested from first week of June to second week of July depending on the variety.

Post-harvest management: Plum fruits have short shelf life therefore, fruit should be marketed immediately after harvest.

ཤུར་གོ།

Walnut


Gasa
Punakha
Thimphu
Paro
Haa
Wangdephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Trashigang
Mongar
Samdrup Jongkhar
Pemagatshel
Zhemgang
Sarpang
Tsirang
Dagana
Chhukha
Samtse

Common Name: Walnut

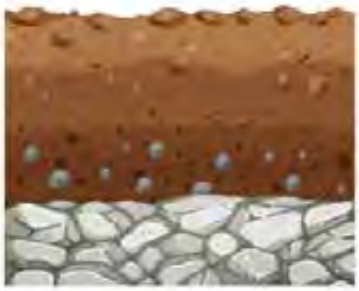
Botanical Name: *Juglans regia*

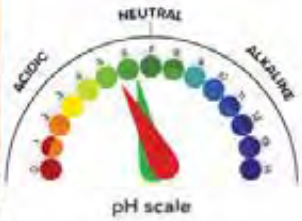
Yield: 40-60 kgs/tree

Varieties: *Kanthel selection, Yusipang 2 and Kagzi*

Altitude: 1,400-2,500m

Soil: Deep, friable loamy soil with pH slightly acidic between 5.5-6.5.





Field preparation : Dig pit size of 1m³. Mix the top soil with well decomposed manure to fill the pit.

Recommend seedling rate: For walnut, 7m x 7m spacing is recommended. For high density planting, 6m x 6m can also be planted. One acre of land can accommodate 82 to 112 plants depending on the variety and spacing adopted.

Nursery management: Walnut is propagated through grafting and budding. In walnut, the bleeding (sap flow) occurs which leads to failure of graft union. Therefore grafting can be done before occurrence of sap flow.

Planting: The best time of plant walnut is in February to March. Graft/bud union should not be buried under the soil at the time of planting.

Cultural practices : Weeding, mulching and basin preparation around the plants are essential practices to keep the orchard clean. Training and pruning is also important parts of cultural practices. It is very important to train the trees at the initial stages. Tree training is done to obtain a desired shape or good tree frame.

Nutrient management: Generally, walnut is not applied with fertilizers. However in order to obtain higher yields of quality nuts, it is important to apply Farm Yard Manures.

Water management: Watering is required during flowering and fruit set. In the water scarce area, drip irrigation system is recommended for efficient use of limited water.

Plant protection: Incidences of pests and diseases on walnuts are quite common in Bhutan. You can visit www.nppc.gov.bt for detailed management of walnut diseases and pests.

Harvest : Grafted or budded walnut plants will come into fruiting in about 3 to 4 years and full economic bearing in 6 to 7 years' time. Depending on the location, walnut is harvested from August to October in Bhutan.

6-7 years

3-4 years

Post-harvest management: Collect the nuts from the ground. Clean, wash, and dry the nuts on a sheet or dry floor to dry them up to 8% moisture level. Nuts are graded according to size, colour, and variety.

Subtropical Fruit Crops

ག་ཡོ།

Avocado


Gasa
Paro
Thimphu
Punakha
Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Mongar
Trashigang
Dagana
Samtse
Chhukha
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samdrup Jongkhar

Common Name: Avocado

Botanical Name: *Persea americana*

Yield: 19.7 kgs/tree

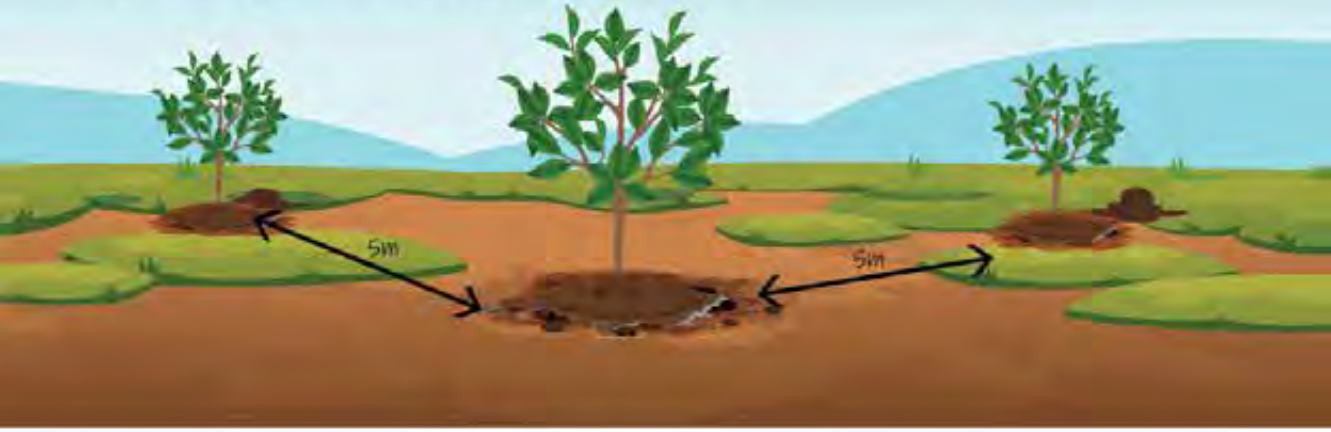
Varieties: *Hass, Bacon, Brogdon, Zutano, Pinkerton, Reed*

Altitude: 300-1500m

Soil: It prefers coarse and well drained soils. Avocado is prone to root rot disease, avoid cultivating in clay soil.

Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manure and top soil. For ideal growth and development, pit size of 1 m^3 is recommended.

Recommended seedling rate: Avocado saplings are planted in Feb-March. The recommended spacing is 7m x 7m for non-grafted and 5m x 5m for grafted.



Nursery management: For true to type seedlings, avocado must be either budded or grafted.

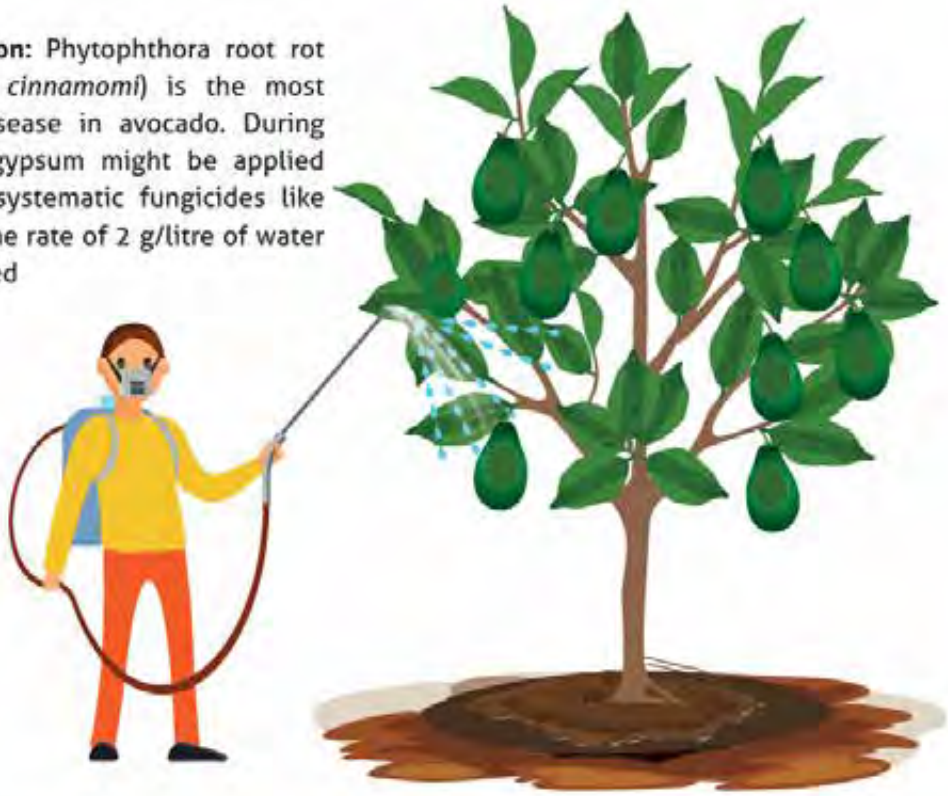
Cultivation practices: For proper growth and development, a basin should be made around the tree trunk. The size of the basin should be equal to the size of the tree canopy.

Canopy Management: Avocado require less pruning and good branching system are developed even without pruning.

Nutrient management: Application of 10-20 kg Farm Yard Manure per tree/year is recommended.

Water management: Irrigate the plants before the trees become water stressed and during the key phenological times like flowering and fruit set.

Plant protection: Phytophthora root rot (*Phytophthora cinnamomi*) is the most destructive disease in avocado. During initial stage, gypsum might be applied or otherwise systematic fungicides like Mancozeb at the rate of 2 g/litre of water is recommended



Harvesting and storage: Avocado is harvested in Mid-December to January. Unlike many other fruits, avocado do not ripe on the tree. Avocado is climacteric and ripens after harvest.

ངའ་ལག།

Banana


Gasa
Paro
Thimphu
Punakha
Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Monger
Trashigang
Samtse
Chhukha
Dagana
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samdrup Jongkhar

Common Name: Banana

Botanical Name: *Musa spp.*

Yield: 15 kg/tree.

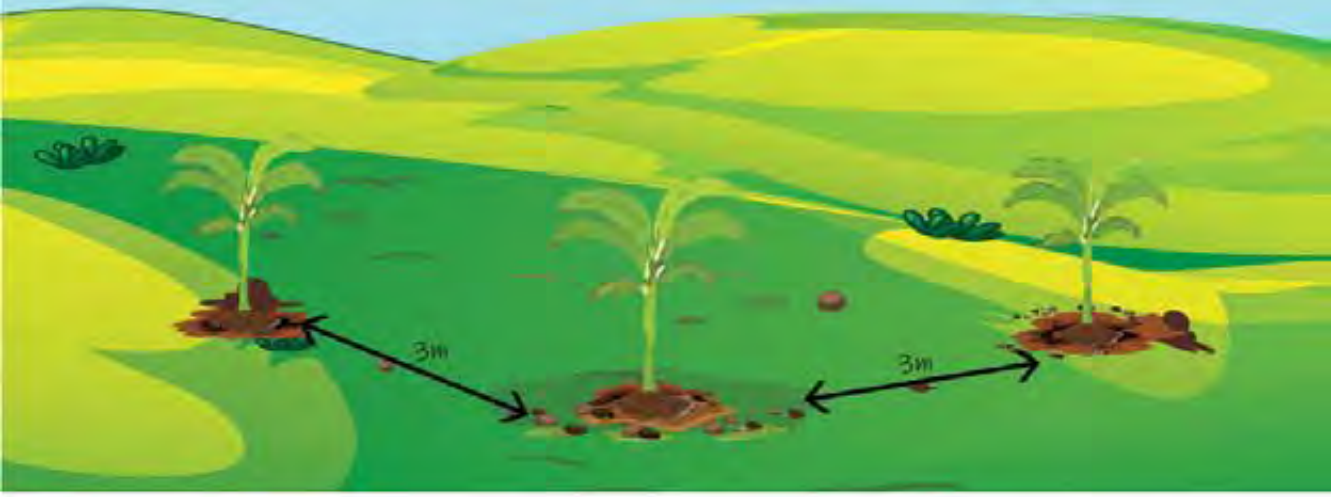
Varieties: *Jaji, Gheukola, Chinichampa, G-9*

Altitude: Up to 1,800 m

Soil: Deep friable loam soils rich in organic matter with pH range of 6.0 – 7.5 is recommended.

Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manure. For ideal growth and development, a pit size of 90 x 90 x 90 cm is recommended.

Recommended seedling rate: Banana saplings are planted at spacing of 3 x 3 m. An acre of land can accommodate more than 450 plants. Rainy season is the best time for planting.



Nursery management: 4 months old Sword sucker of 1-2 kg weight and 80-120 cm heights having a piece of underground stem with a few roots attached to it is suitable for planting.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Basin making keeps the floor clean and enable proper irrigation and manuring. I

Nutrient management: An application of 10 kg FYM/plant is given at planting time.

Sucker management: Excessive emergence of suckers from the main plant reduces yield. The suckers should be periodically removed till 70-80 % plants come into flowering. One healthy sword sucker (sucker with sharp leaves and broad base) is retained per plant opposite to the side of inflorescence.

Spathe and dry leaves removal: Spathe (the reddish terminal portion) should be removed after emergence of 8 hands per bunch. Dry leaves and debris touching the developing fruits should also be removed for producing quality fruits.

Water management: Irrigation should be provided during growing season and during fruit development.

Propping and earthing up: Heavy bunches may result in lodging; therefore, all the plants should be provided with a support under the bunches. Banana is a surface feeder and its roots do not go deeper in the soil, so earthing up is recommended.

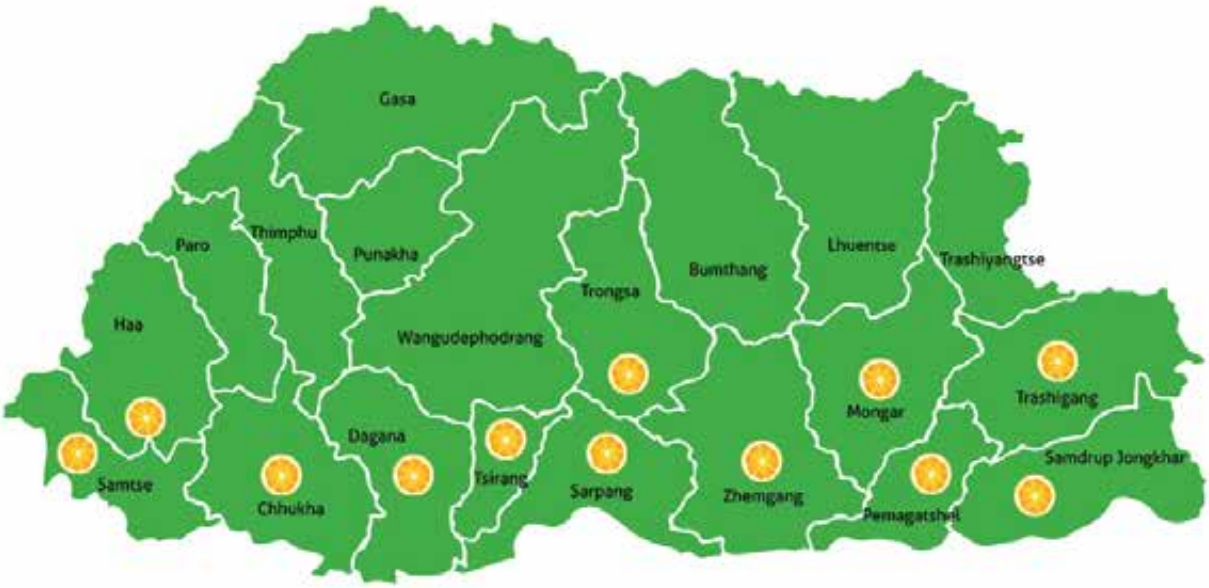
Plant protection: Tobacco caterpillar, thrips, Pseudostem weevil, Rhizome weevil, Banana scarring beetles and aphids are main insect pests of banana. Panama wilt, Sigatoka leaf spot, Anthracnose and Bunchy top virus are major diseases of banana. Recommended dose of chemical application is advised.

Harvest: Harvesting starts from 9–18 months after planting. As the fruit matures, the finger shape changes to round from angular. During maturation, the colour of the peel changes from deep green to light green or yellow.

Post-harvest management: The banana fruits harvested at green mature stage can be successfully ripened in four days by exposing to ethylene gas (100 ppm) for 24 hours in a ripening chamber maintained at 16-18°C and 90-95% RH.

ཀཡ་ས།

Citrus


Gasa
Thimphu
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Wangdephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Trashigang
Mongar
Dagana
Samtse
Chhukha
Tsirang
Sarpang
Zhemgang
Pemagatshel
Samdrup Jongkhar

Common name: Orange/mandarin

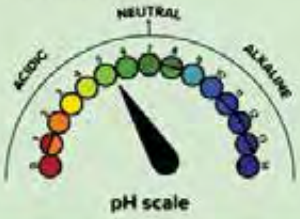
Botanical Name: *Citrus reticulata 'Blanco'*

Yield: 35 kg/ tree

Varieties: *Dorokha selection, Wengkhar tshelu 1, Wengkhar tshelu 2, Clemintina nules, Tarku*

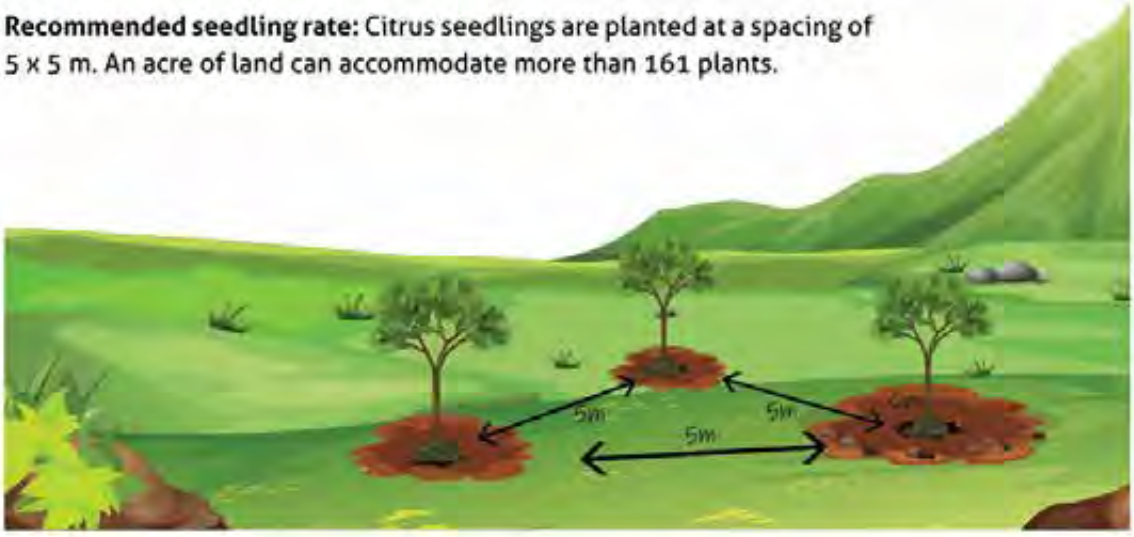
Altitude: 700-1700m

Soil: Deep, well-drained, loamy and fertile soil is considered to be best for optimum citrus fruits production. Soil pH ranging from 5.0 to 6.5 is recommended.



Field preparation: Dig pit size of 1 m^3. Fill the pits first with mixture of top soil and Farmyard manure/dry organic matter.

Recommended seedling rate: Citrus seedlings are planted at a spacing of 5 x 5 m. An acre of land can accommodate more than 161 plants.



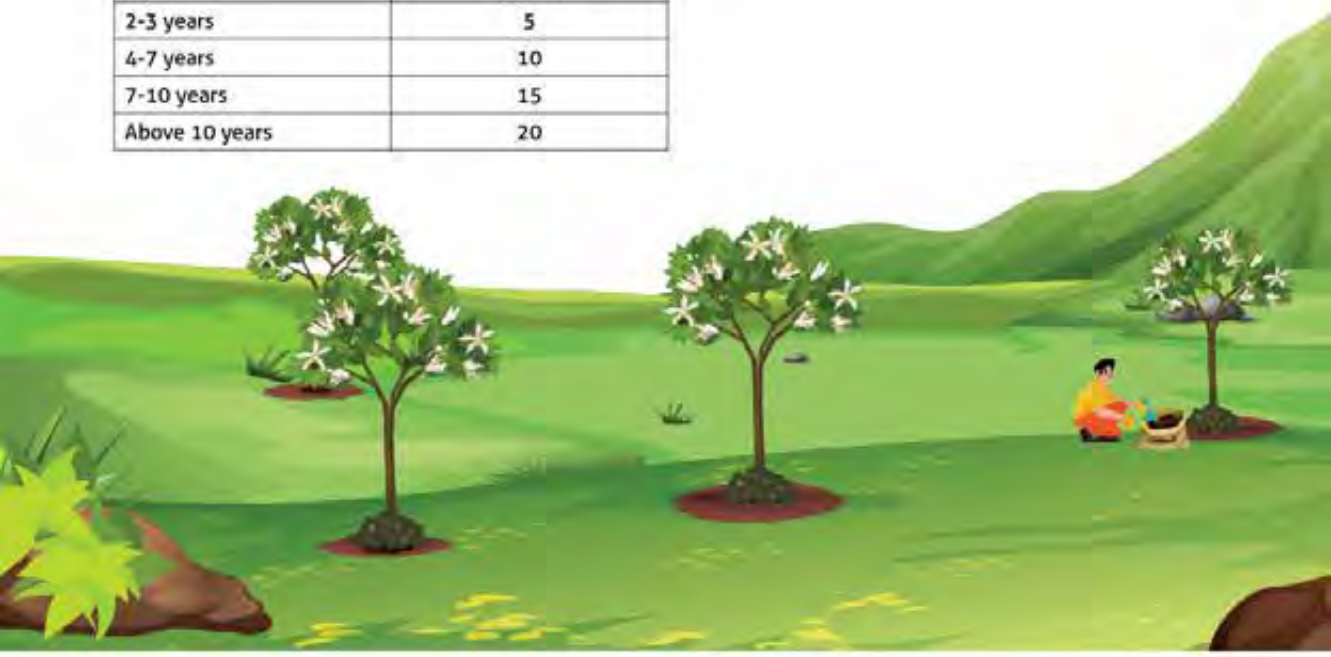
Nursery management: Citrus is propagated through seeds but side veneer grafting is recommended to reduce gestation period.

Cultivation practices: Grafted plants are transplanted during rainy season without burying the graft union in the soil. Citrus tree whether old or young should be first trained to "Modified central leader system" and then pruned during January-February.

Fruit thinning: First fruit thinning is carried out in the first week of July and the second fruit thinning is carried out in the first week of August.

Nutrient management: Apply the following amount of composts or well-decomposed farmyard manure based on age and per tree basis:

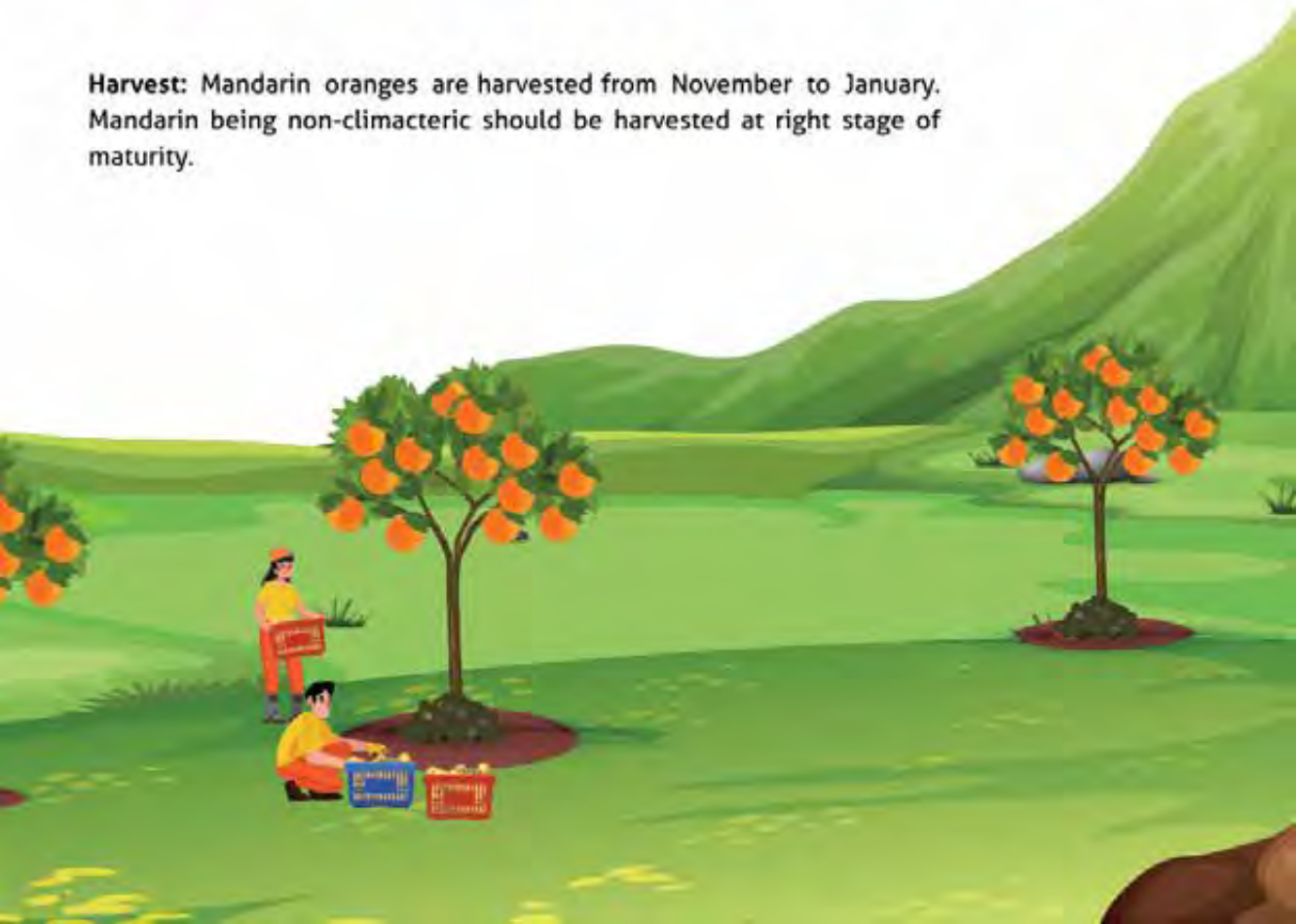
Age	Kg/tree
2-3 years	5
4-7 years	10
7-10 years	15
Above 10 years	20



Water management: Mandarin trees need a reliable supply of good quality water all round the year for good tree growth and production of high quality fruit.

Plant protection: Huanglongbing (citrus greening diseases) is one of the most devastating diseases of citrus. Maintaining proper health of the plant through application of balanced nutrient is recommended.

Harvest: Mandarin oranges are harvested from November to January. Mandarin being non-climacteric should be harvested at right stage of maturity.



ཀྲུལ་བ་རིགས་ལྷ།

Dragon Fruit

Common Name: Dragon Fruit

Botanical Name: *Hylocereus undatus (Haw.)*

Yield: 20 kg/tree

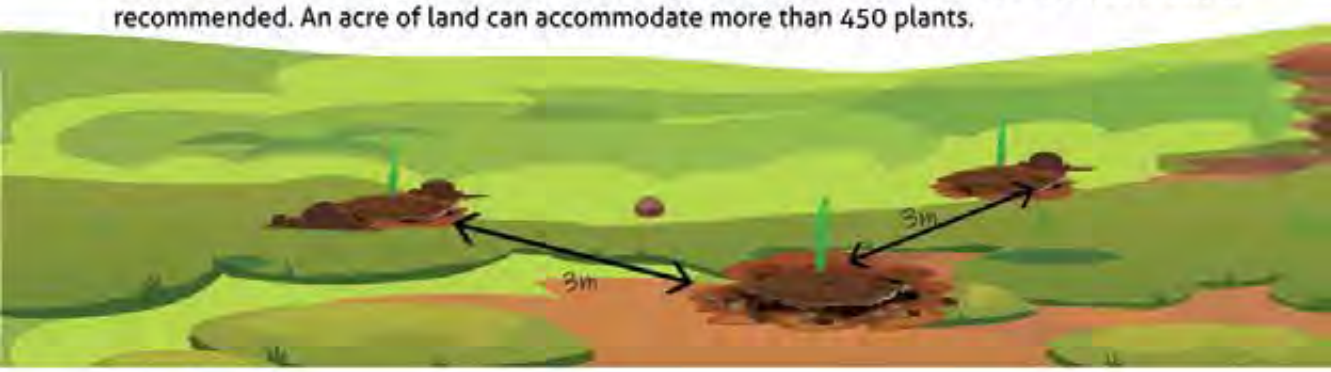
Varieties: *Gyelwa Ring Nga*

Altitude: 300 m to 1500 m

Soil: Dragon fruit can grow on a wide range of soils from sandy loam to clay loam. It is sensitive to water logging and saline conditions.

Field preparation: Dragon fruit seedling or cutting should be planted in a well-prepared pit. The dimension of the pit should be 2 feet deep and 2 feet wide.

Recommended seedling rate: A spacing of 3 m from plant to plant and 3 m between rows is recommended. An acre of land can accommodate more than 450 plants.



Nursery management: Dragon fruit is propagated through cuttings, 6-12 inches long cuttings obtained from one year old stem should be used.

Cultivation practices: Plant at least 2 to 3 cuttings on different sides of the post. Tie each cutting to the post if possible and remove lateral branches to encourage upright growth till it reaches its desired height. Single post trellis system of about 2.45 m height with a square frame fixed on top and tyre attached to square frame is recommended.

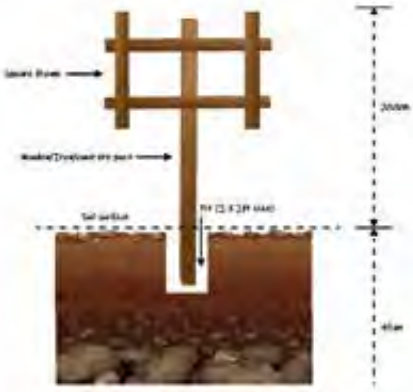


Figure 1 Single post trellis with a square frame fixed on top

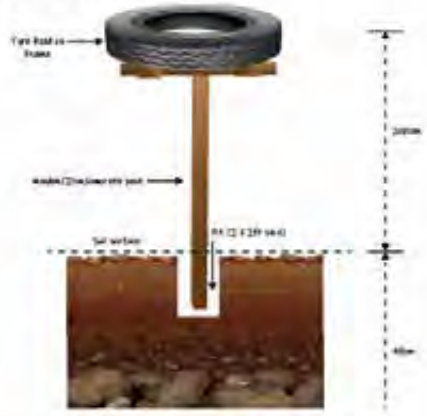


Figure 2Single post trellis with a tyre fixed on top of square frame

Nutrient management: Incorporation of about 20 Kg of well decomposed farmyard manure or compost at the time of planting and regular top-dressing with well decomposed manure annually is recommended.

Water management: Dragon fruit requires plenty of water for their growth because they have originated from tropical and subtropical rainforests.

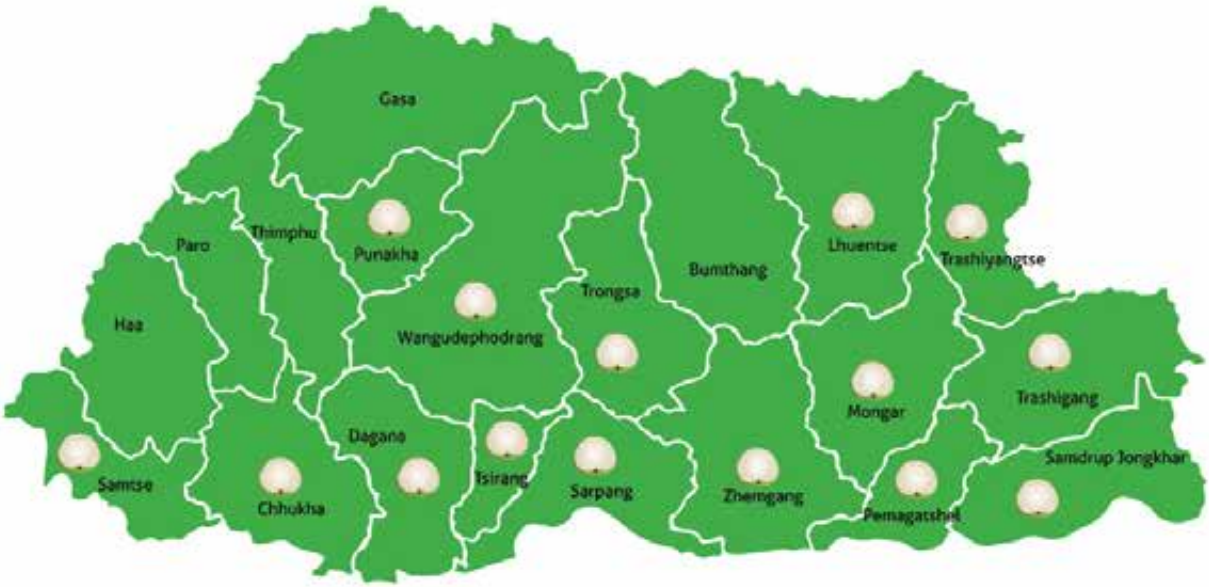
Plant protection: Insect-pest is currently not a major concern in dragon fruit.

Harvest: Unlike other fruits, it has long harvest period. Thus, fruits can be harvested from August till October.

Post-harvest management: The fruits have good shelf life. As such, the fruits can be stored up to 1 week under room temperature condition and 3 weeks under refrigerated condition without losing freshness and quality.

བལཡོ་སེན།

Guava


Gasa
Paro
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Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Mongar
Trashigang
Samdrup Jongkhar
Dagana
Samtse
Chhukha
Tsirang
Sarpang
Zhemgang
Pemagatshel

Common Name: Guava

Botanical Name: *Psidium guajava*

Yield: 40 kg/tree/year

Varieties: *Bebsew shakha, Bajo bebsew*

Altitude: 1000-1500m

Soil: Guava can be grown well in any type of soil conditions, but prefer soils with high organic matter with pH range from 5 to 7.

Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manure and top soil. For ideal growth and development, a pit size of $1m^3$ is recommended.

Recommended seedling rate: Spacing of 5 x 5m apart is recommended and plantation is done in May to June. Application of 20kgs of Farmyard Manure is recommended per tree at the time of planting.

Nursery management: Guava is propagated both by seeds and vegetative methods. But vegetative propagations like air-layering, wedge grafting and patch budding is recommended for commercial guava seedling production.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Ideally the size of the basin should be equal to the size of the tree canopy.

Nutrient management: 10kgs of FYM is applied during February to March and another 10kgs of FYM is applied in September. The nutrients are applied away from the tree trunk.

Water management: The Guava trees require irrigation during March to May at 15 days interval to get good yield.

Training and pruning: Open centre system is recommended for good yield.

Intercropping: The land between the trees can be used to grow intercrops such as ginger, turmeric, chilli and other vegetable crops in guava orchard during pre-bearing stage.

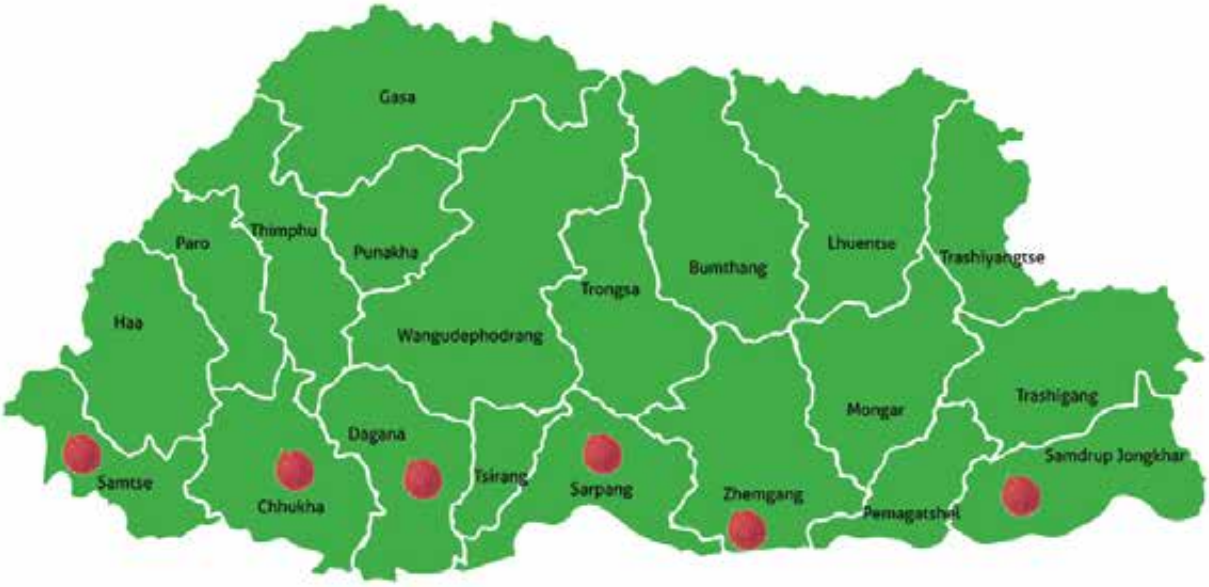
Plant protection: Fruit fly, scale insect, bark eating caterpillar, stem-borer and mealybug are the some of the pests affecting the growth and yield of guava. Major diseases are wilt of guava, fruit canker, scab, Anthracnose and Cercospora leaf spot.

Harvest: The fruits are ready for harvest after 4-5 months of flowering and are usually harvested during the month of September to November. At maturity, fruits change colour from dark green to greenish yellow.

Post-harvest management: Guava fruit is highly perishable in nature and should be marketed immediately after harvest. However, it can also be stored up to 4 weeks in the cold store with temperature of 5°C and 75-85% relative humidity.

ལི་ཆི།

Litchi


Gasa
Thimphu
Paro
Punakha
Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Dagana
Tsirang
Sarpang
Zhemgang
Mongar
Trashigang
Samdrup Jongkhar
Samtse
Chhukha
Pemagatshel

Common Name: Litchi

Botanical Name: *Litchi chinensis*

Yield: 70kg/tree

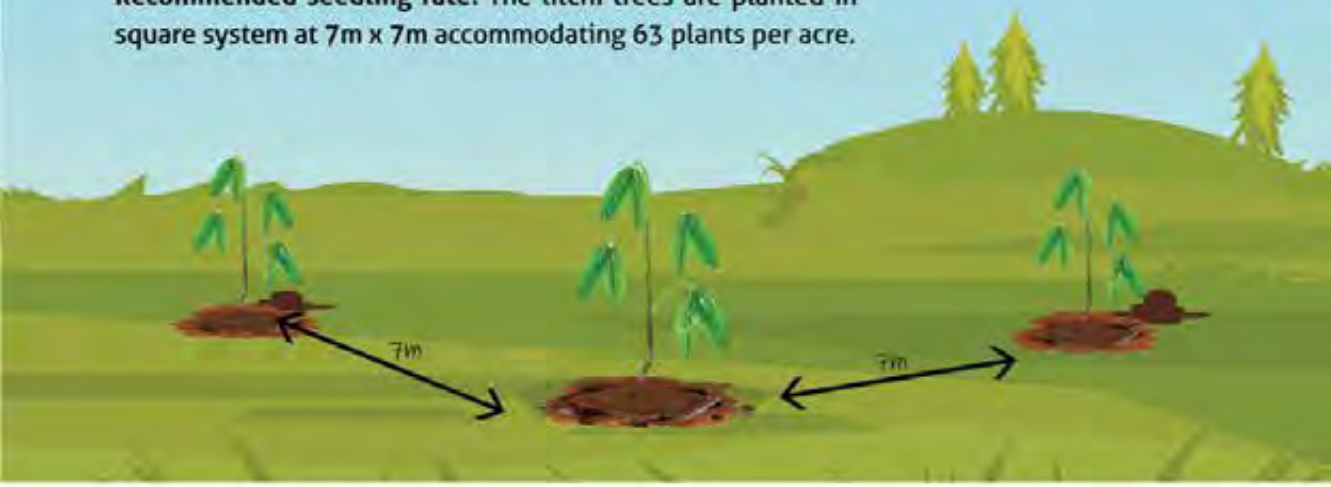
Varieties: *Bhur Selection 1, Shahi, Early bedana, Bhur litchi 1, Bhur litchi 2*

Altitude: Up to an altitude of 800m

Soil: The ideal soil for litchi cultivation should be well- drained, deep loamy soil rich in organic matter and having slightly acidic to neutral pH (7).

Field preparation: Before planting, pits of 1m³ should be dug. The pit should be filled with top soil mixed with 20kgs of well rotten Farm Yard Manure. Planting should be done during monsoon season.

Recommended seedling rate: The litchi trees are planted in square system at 7m x 7m accommodating 63 plants per acre.



Nursery management: Air layering is the most common method of propagation. About 6 months old air-layered plants should be planted in permanent field in monsoon.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Basin making keeps the floor clean and enable proper and irrigation and manuring. Ideally the size of the basin should be equal to the size of the tree canopy.

Training and pruning (canopy management): During initial years of orchard establishment, training of the plant is necessary to provide a definite shape. Pruning of centrally growing upright branches should be done periodically (once in 2-3 years) to facilitate proper aeration and light penetration. Pruning of the dried twigs and branches should be carried out in the month of June-July.

Nutrient management: 40kgs of Farmyard Manure per year per tree is recommended. The manure should be applied just after harvesting and pruning of the trees.

Water management: Established orchards need frequent irrigation during flowering and fruit development stages. Mulching around tree basin with litchi leaf, crop residues and other farm waste are useful to conserve soil moisture.

Plant protection: Erinose mite and shoot borer are the two serious pests that causes immense damage to the crop. The infestation of the latter is common in September-October flush. Litchi shoot borer can effectively be controlled by spraying Cypermethrin (0.01%) twice at 7 days interval during flushing.

Erinose mite

Fruit rot of litchi

Harvest: Harvesting is usually done in May and June. The fruit colour changes from green to pink on maturity. The fruits are harvested in bunches along with a portion of the branch and few leaves.

Post-harvest management: The fruits cannot be stored at room temperature for long duration. It loses its bright red colour and turns brown within 2 – 3 days after harvest.

ཨམ་ཧུ་ཀུ་ཡེ།

Mango


Gasa
Paro
Thimphu
Punakha
Haa
Wangudephodrang
Trongsa
Bumthang
Lhuentse
Trashiyangtse
Trashigang
Mongar
Samdrup Jongkhar
Pemagatshel
Zhemgang
Sarpang
Tsirang
Dagana
Chhukha
Samtse

Common Name: Mango

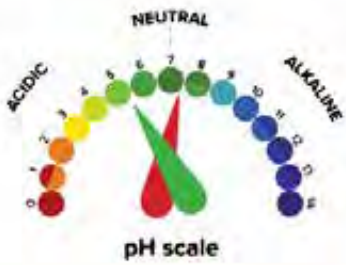
Botanical Name: *Mangifera indica*

Yield: 27 kg/tree.

Varieties: *Bajo Amchukuli 1, Bajo amchukuli 2, Bajo amchukuli-3, Samtenling amchukuli-1, Samtenling amchukuli-2, Samtenling amchukuli-3, Samtenling amchukuli-4*

Altitude: 150-1200m

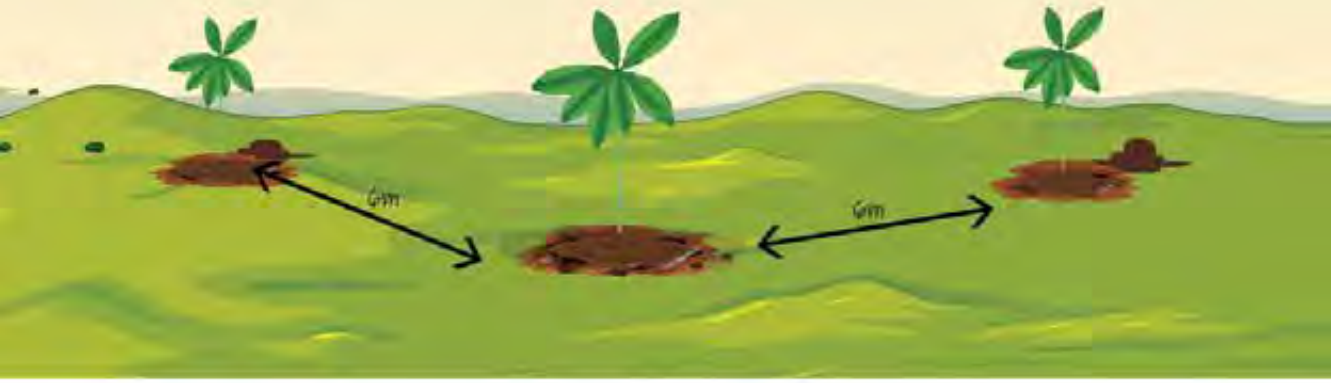
Soil: Well drained loamy soil with pH ranging from 5.5 to 7.5 is suitable.



pH scale

Field preparation: The recommended size of the pit is 1m³. The pits are filled with well decomposed manure, basic doses of fertilizer and top soil before planting. The graft union must be 15 cm above the ground level while planting grafted plants. Planting of mango tree can be done from May to June.

Recommended seedling rate: Row to Row and Plant to Plant spacing is 6 x 6m.



Nursery management: Mango is commercially propagated through soft wood grafting. It can also be grafted in the early month of March before the commencement of monsoon rain.

Cultivation practices: Training of young mango trees is necessary to establish a good frame structure. Usually modified centre leader system of training is adopted in mango. Pruning is done after the harvest in the month of August to September.

Nutrient management: 5kgs of well decomposed mannure should be applied at the time of planting and thereafter application of 10kgs of manure per tree is recommended.

Water management: Watering is done once in a week during early establishment of plants. Frequency of irrigation can be reduced when the plant is well established. Critical stage for watering is during flowering and fruit development.

Plant protection: Following pest and diseases are common in mango: Leaf hopper, mango fruit borer, Mango stem borer and Mango anthracnose. Recommended doses of chemical spray is advised.

Fruit	Index	Colour
	Index 1	Dull Green
	Index 2	Light green
	Index 3	Greenish Yellow
	Index 4	Yellowish Green
	Index 5	Light Yellow
	Index 6	Yellow-orange

Harvest: Mango usually takes 120-130 days for maturing. Mango is climacteric fruit and it is harvested when it is fully matured.

Post-harvest management:

- Sorting is done to discard the infested, diseased and malformed fruits
- Mango is then graded according to size
- Proper packaging is done
- For low temperature storage, temperature between 5-16°c is ideal for mango storage.

མ་དུ་ཕ་ལ།

Papaya


Gasa
Paro
Thimphu
Punakha
Lhuentse
Trashiyangtse
Bumthang
Trongsa
Haa
Wangudephodrang
Mongar
Trashigang
Dagana
Samdrup Jongkhar
Samtse
Tsirang
Sarpang
Chhukha
Zhemgang
Pemagatshel

Common Name: Papaya

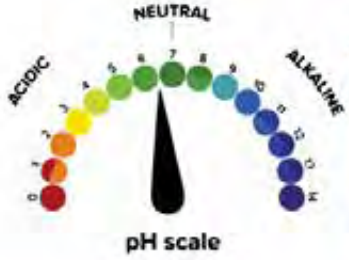
Botanical Name: *Carica papaya*

Yield: 25 kg/tree.

Varieties: *Local*

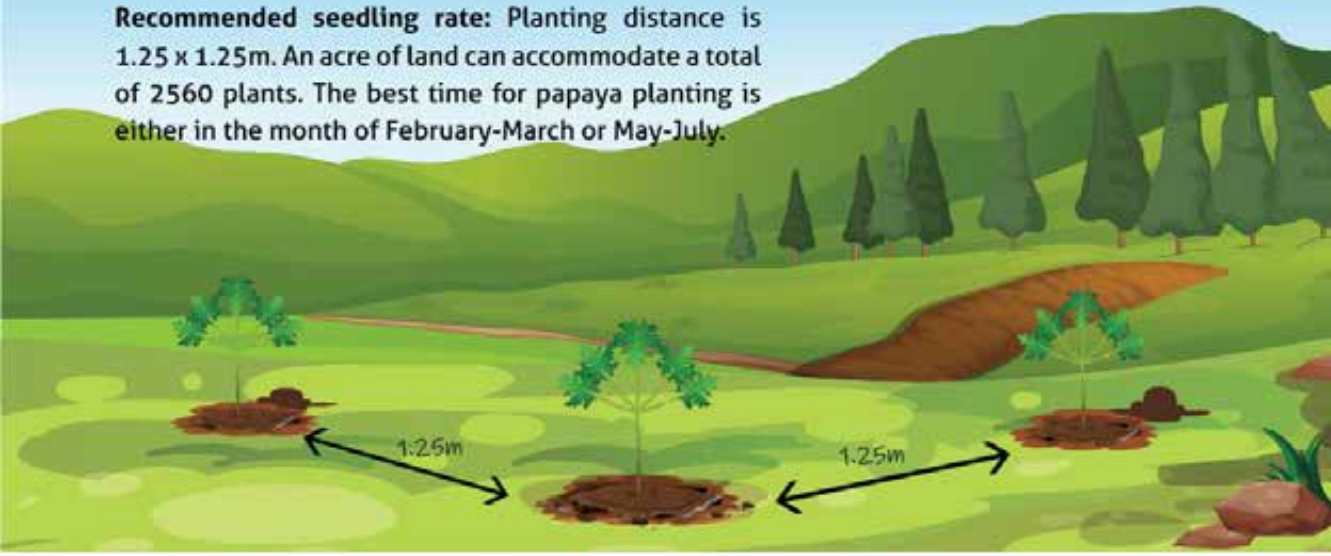
Altitude: 1000m

Soil: It is a shallow rooted plant, highly sensitive to water logging. A well-drained soil rich in organic matter is desirable. The pH of the soil should be within 6-7.



Field preparation: Field should be prepared at least one month ahead of planting with incorporation of well decomposed manure. Dig pits of size 60cm × 60cm × 60cm at spacing of 1.25 × 1.25meters. Fill the pits with 5kgs of well decomposed FYM (farmyard manure) per pit and an equal quantity of top soil.

Recommended seedling rate: Planting distance is 1.25 x 1.25m. An acre of land can accommodate a total of 2560 plants. The best time for papaya planting is either in the month of February-March or May-July.



Nursery management: Papaya is commercially propagated through seeds. Generally 250-300 g of seeds is sufficient to raise the seedling for one acre.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Basin making keeps the floor clean and enable proper and irrigation and manuring.

Nutrient management: Papaya is a heavy feeder. 20 to 30kgs of well decomposed Farmard Manure per tree per year is recommended.

Water management: Adequate watering is necessary. Water logging in any case should not be allowed, in fact the plants must not come in contact with water by placing 20-30cm of earth all around the young plants.

Pollination management: For adequate pollination, there should be 10 percent male plants in an orchard and the male plants should be well scattered throughout the field.

Female

Male

Plant protection: Aphids act as vector of papaya ring spot virus and mosaic. Spray the systemic insecticides for control.

Ring spot virus

Harvest: Papaya trees set fruits within 8-10 months after planting. Papaya fruit may be harvested green for use as a vegetable and ripened fruits for table purpose. The economic life of papaya is only for 3-4 years.

Post-harvest management: After picking, fruit should be placed at room temperature 2-4 days to fully ripen before being stored in the refrigerator. Ripened fruit can be stored up to 4 to 7 days at 20°C.

རྒྱ་གར་སྐྱུར་པོ།

Passion Fruit

Common Name: Passion fruit

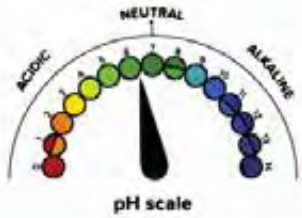
Botanical Name: *Passiflora edulis*

Yield: 3 kg per vine

Varieties: Local, Summer queen

Altitude: Purple type can be usually grown from 900 to 2000 m above mean sea level and Yellow type below 1000 m.

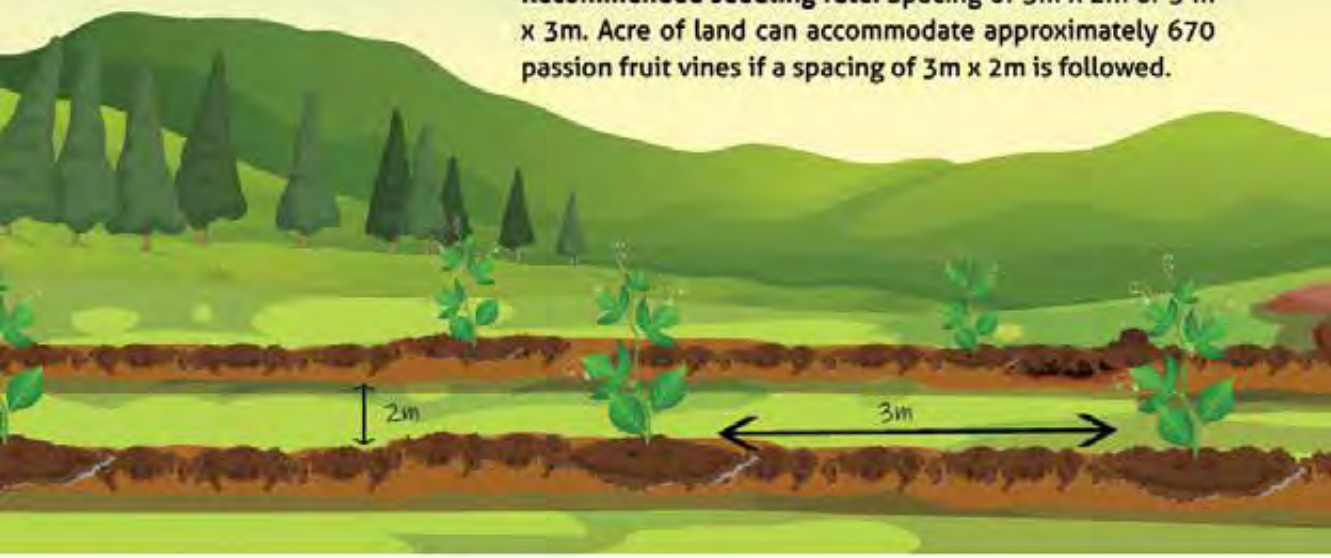
Soil: Passion fruit is best grown on light to heavy sandy loams of medium texture. Soil with a pH of 6.5 to 7.5 is the most suitable.



pH scale

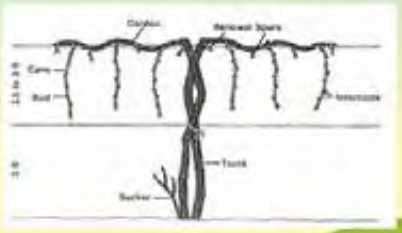
Field preparation: Pits of 45cm x 45cm x 45cm are dug. Areas with high winds should be avoided to prevent from damages.

Recommended seedling rate: Spacing of 3m x 2m or 3 m x 3m. Acre of land can accommodate approximately 670 passion fruit vines if a spacing of 3m x 2m is followed.



Nursery management: All types of Passiflora species can be propagated from seeds, cuttings, air layering or by grafting.

Cultivation practices: Passion fruit is a woody vine that requires support and trellising for good growth and fruiting. Kniffin system is most economical.



Nutrient management: In the first year of plantation, 10kgs of Farmyard Manure per vine and from second year onwards 15kgs of FYM per vine is recommended. The manure should be applied in February-March.

Water management: On an average, passion fruit requires irrigation of 12-15 litres/vine/day in summer and 6-8 litres/vine/day) in winter.

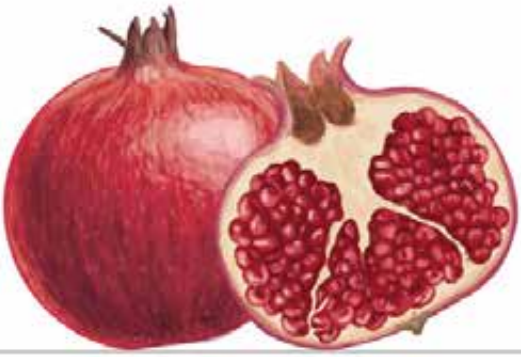
Plant protection: The most common disease in passion fruit is Brown spot disease caused by *Alternaria macrospora Simes.* The affected branches should be pruned and burnt.

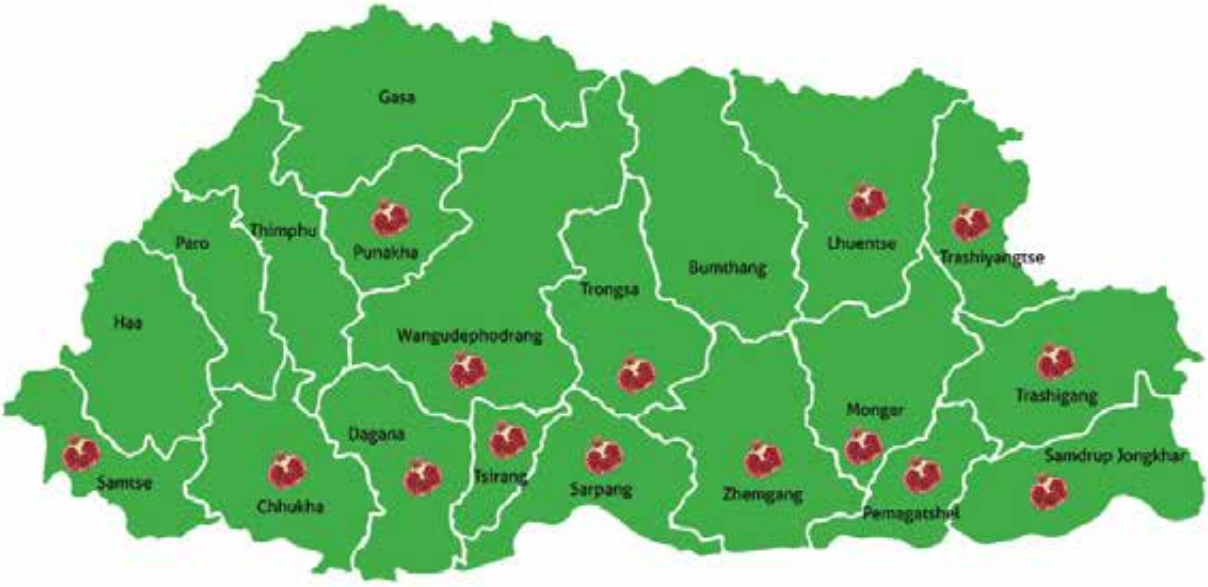
Harvest: The vine will start yielding fruits after 10 months of planting and bearing reaches optimum by 16-18 months. Fruit takes about 80-85 days to reach maturity after flowering.

Post-harvest management: The purple passion-fruit can be stored up to 5 weeks with little loss of mass at 5°C maintaining humidity of 80-90 %. The yellow passion-fruit can however be stored for about a week at 5-7.5°C.

ཕོ་ན་འབྲུ།

Pomegranate





Common Name: Pomegranate

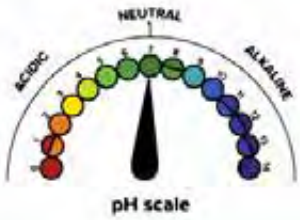
Botanical Name: *Punia granatum*

Yield: 14.27 kgs/tree

Varieties: *Bedana, Bajo seindu-1*

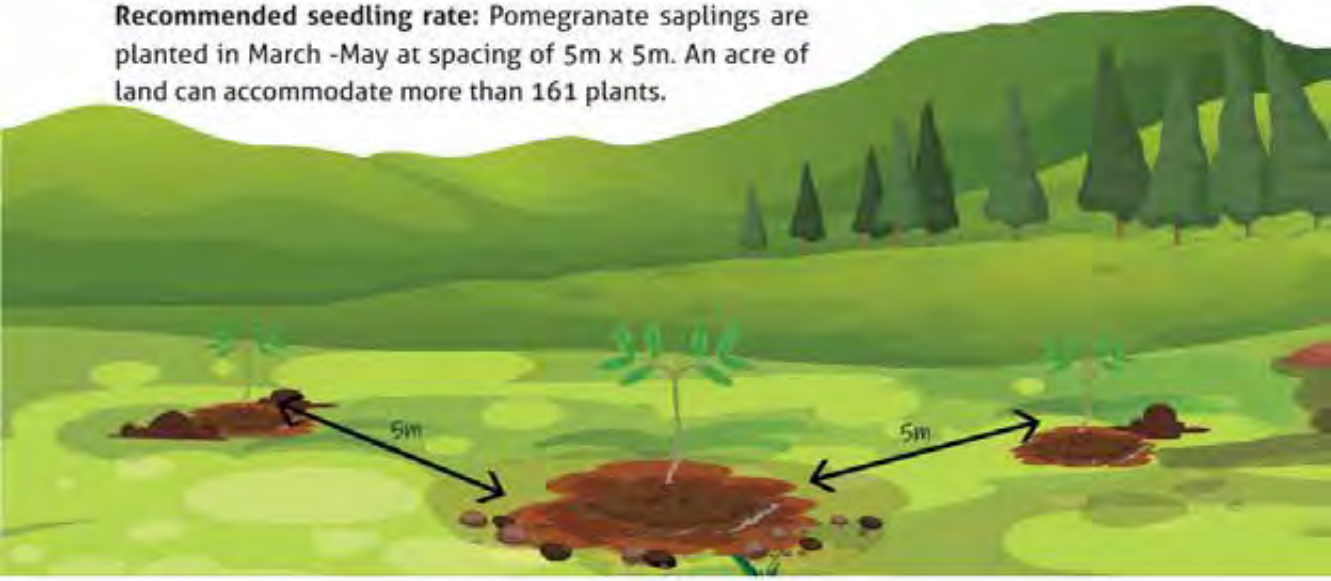
Altitude: 400-1500m

Soil: Deep loamy Soil having a pH range between 6.5–7.5 is ideal for Pomegranate farming.



Field preparation: Field should be prepared at least one month aheadof planting with incorporation of well decomposed manure. For idealgrowth and development, a pit size 1m³ is recommended.

Recommended seedling rate: Pomegranate saplings are planted in March -May at spacing of 5m x 5m. An acre of land can accommodate more than 161 plants.



Nursery management: Pomegranate plants can be propagated through hardwood cutting or air layering. Whip and tongue grafting is recommended for propagation. Grafting is done in the month of February-March.

Cultivation practices: For proper growth and development of the plant, a basin should be made around the tree trunk. Ideally the size of the basin should be equal to the size of the tree canopy.

Canopy Management: Pomegranate require less pruning and good branching system are developed even without pruning. However, branches going sideways and unruly top should be pruned.

Nutrient management: Apply 10-20kgs Farmyard Manure per tree/year.

Water management: Water is critical especially for flowering and fruit development. Watering should be done during growing, flowering and fruit development stages.

Plant protection:

Fruit cracking or splitting is one of the most severe disorders due to irregular irrigation, boron deficiency, and sudden fluctuation in nocturnal and diurnal temperatures. It can be corrected through providing irrigation at proper stages.

Harvesting and storage: Fruits should be harvested when dark rose pink colour is developed on the surface. Pomegranate fruit can be stored for one to two weeks at room temperature.