



all about
Guava

GUAVA

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Himachal Pradesh Subtropical Horticulture, Irrigation & Value Addition (HPSHIVA) Project, was conceived to harness the potential of horticulture in the subtropical climate area of the state.

The main objective of HPSHIVA project is development of sub-tropical horticulture on commercial lines in cluster approach besides providing sustainable livelihood opportunities to the farmers, who have abandoned their cultivable land because of menace of stray animals, monkeys & wild animals and to the youth population migrating to urban areas to seek wages employment.

The project is being implemented by Department of Horticulture (DoH) and Jal Shakti Vibhag (JSV) as implementing agency with the financial assistance from Asian Development Bank (ADB).

As part of consultancy services under the project, “Package of Practices” for the mandated fruit crops of HPSHIVA Project was developed by a team of experts from Dr. YSP University of Horticulture & Forestry ,COHF- Neri, Hamirpur.

The booklet is an abridged version of PoP developed specifically for **Guava**.

Climate

In Himachal Pradesh, guava is extensively adapted to sub-tropical regions from 410 to 1200 m of altitude amsl. The guava tree grows well in a temperature range of 23-38°C but below 15°C, the plant growth slows down. It can tolerate extended drought, however it is vulnerable to severe frost (lower than – 20 °C) affecting especially the young trees.

Topography and soil

Guava is a hardy tree with deep root system. The best productivity of guava is achieved in loamy soils with good drainage. Heavy clay soils are not suitable for guava planting. The sloppy wastelands characterized with undulated topography of subtropical regions are also considered good for its cultivation. However, on sloppy terrain there is quick depletion of moisture, thus necessitating frequent irrigation. Under such situations contouring and terracing with one-meter wide flat strip should be followed for better productivity.

Recommended cultivars

Cultivars Shweta, Lalit, Sardar, Allahabad Safeda, Hisar Safeda and are best suited for cultivation in the subtropical areas of the state.

1. Shweta :Fruits are round weighing 225 g, white pulp with good keeping quality and round shaped fruit.
2. Lalit :Fruits are round in shape with pink coloured pulp. The TSS is around 11-12° Brix.
3. Sardar: Fruits are spherical and meaty, seeds are soft and in plenty, pulp is white and tasty, contains 130 mg vitamin C/100 g pulp.
4. Allahabad Safeda: Fruits are big in size, round, smooth skin, white pulp, soft, firm, light yellow and on ripening develop very sweet taste, pleasing flavor and have few seeds. It is the most popular variety in India and is the progenitor of many Indian varieties.



Shweta Fruit



Lalit Fruit



Sardar Fruit



Allahabad Safeda Fruit

Propagation

Wedge grafting technique has been standardized and adopted for commercial mass multiplication of guava in nursery with more than 95% success. The polybag raised, grafted plants have better success and growth on farmers' field.

Wedge Grafting

Raising seedling rootstocks

- a) Remove the seeds from ripe guava fruits during August-September. Wash the seeds thoroughly to remove the pulp from the fruit and dry the seeds under shade. Seeds can be stored in a sealed container for planting later.
- b) Guava seeds are placed in hot water for 5 minutes to break seed dormancy.
- c) Place the seed in potassium nitrate solution (2g/l) for three hours for enhancing seed germination rate.
- d) Fill the seedling trays with potting mixture and place two or three seeds in each cell, cover seeds slightly with the medium.
- e) Seeds can also be sown in raised beds under protected structure.
- f) Apply water until medium is wet. Place the seedling trays in warm covered place. Germination takes place in 2-4 weeks depending upon the temperature.
- g) Transplant to polybags when the seedlings have at least two sets of leaves (15 cm high).
- h) Root pruning of main secondary roots should done at the time of transplanting for better establishment.
- i) A light fertigation should be done with NPK 19:19:19 (1.0g/l) as a starter solution immediately after planting.

Grafting

- Easiest method of grafting in guava is wedge grafting. It produces a very strong joint which can with stand under windy conditions. Grafting is easier than air layering.
- Scion should be one year old hard wood i.e. available at the base of guava shoot.
- Two (2-3 cm long) cuts are given on each side of scion to a prepare wedge.
- Head back the rootstock 22-25 cm above the pot medium surface, then cut a slit 2-3 cm down the centre of stem.
- Wedge of scion should be slipped into the slit cut of rootstock. Line up the surface of scion and stock at least on one side so that the union of scion and stock feels smooth, if not possible on both the sides.
- Wrap the graft with grafting/budding tape (12 mm wide). Start from 1cm below the bottom end of joint and move upward, be sure to completely cover upto 1cm above the top of the joint if necessary give a second wrap moving the tape downward along the joint.
- Place the newly grafted seedlings in a 50 % shade net house.
- Put a polythene cap over the grafted plant. Two weeks after grafting the terminal bud will start growing. As leaves start to develop from scion bud, the cap should be removed.

Layout and Planting

Spacing

Guava cultivars should be planted at 3 × 3 m for raising a high density orchard.

Layout

Orchard layout in North-South orientation on square or rectangular system of planting should be adopted for guava plantation.

Preparation of field, bed, planting pit and filling

- Deep ploughing should be done and raised bed (2 meter wide at bottom x 1.5 meter wide at top x 45 cm height) should be prepared one month before transplanting.
- A month prior to planting, pits measuring 60×60×60 cm should be dug and allowed to be disinfected by intense solar radiation. Each pit should be filled with top soil mixed with farmyard manure (20kg), neem cake (1kg), and single super phosphate (500g). After filling the pit, watering is done to allow soil to settle down. Irrigation is provided immediately after planting through drip. The best season for transplanting is rainy season, however, early spring planting can be done if there is assured irrigation.
- Young plants are prone to lodging and breakage due to strong winds, hence, staking should be done to keep plants straight and avoid damage. Wooden sticks (50-80 cm long) treated with chloropyrifos (2ml/litre) can be used for staking.



High density of planting of Guava in slopy undulating topography

Planting

- During planting, care should be taken so as to ensure that the mark of potting mix on plant is a little bit above the ground level, so that some sinking of plant after transplanting can be tolerated.
- Press the soil gently towards roots after filling the pit to half, fill the hole with water until it overflows, then fill it completely with soil.
- No fertilizer should be kept in the hole during planting, as this can harm delicate root system.
- Polybag raised plants can be planted without disturbing their root.

Canopy Management

Training and Pruning

In early years of planting, strong framework of the plant has to be developed by allowing widely angled branches and removal of weak crotch angles.

During training period heavy heading back cuts should be done to maintain vigour of shoots. Productive plants need pruning to maintain the appropriate size and shape. Proper training & pruning practices help to increase yield, quality of produce and reduces the incidences of pests and diseases.



Crop regulation for winter guava production

The primary blooming season for guava in Himachal Pradesh is early spring (March/April) which production crop harvested in rainy season. The rainy season crop is usually infested with fruit fly, produce is poor in quality and insipid in taste. Whereas, the bloom during June-July (mrig bahar) produces winter crop during November-February-March which is considered to be of premium quality. To induce flowering during July, pruning should be done in May (depending upon the microclimatic condition) and second pruning should be done during August-September end to reduce excessive shading and improving fruit size. Both type of pruning i.e. heading back and thinning out should be done so that sunlight must reach interior canopy area throughout the growing and cropping period.



TRAINING AND PRUNING SCHEDULE FOR HIGH DENSITY ORCHARDING OF GUAVA

High Density Planting

Field Planting (3.0×3.0m)

Heading back the trees at a height of 60 cm from the ground level after 3 months of planting

New shoots emerge below the cut point and lowermost shoot should be 30cm above the ground

Retain 3-4 shoots (equally spaced in all directions) 15cm apart and 30 cm above ground level

Prune the shoots after 3-4 months of shoot growth (Cutting back to 50% of their total length (shoot length should be 70-80 cm) i.e. upto 35- 40cm heading back

After winter (1st fortnight of February) Shoot pruning should be done by heading back to 50% of their total length (shoot length should be 70-80 cm)

During 1st fortnight of May Shoot pruning should be done by heading back to 25% of their total length (shoot length should be 70-80 cm)

For winter season fruiting, Shoot pruning during 2nd fortnight of May-June to induce cropping

During end of August-1st fortnight of September pruning of non-bearing shoots to 25% of total shoot length and thinning out of crowding shoots should be done)

Continue shoot pruning (50%) during May-June every year for winter cropping and to maintain the tree shape and size

Pollination

The flowers of guava are bisexual, self-pollinated and do not require any pollinizer. 4-5 bee colonies/ha can be maintained in the orchard for better fruit set and proper cropping.

Orchard soil management

Mulching

The bed should be covered with mulching (plastic or organic mulching) to check the weed population, conserve the soil moisture and regulate soil temperature. Preferably organic mulching having 15-20 cm thick layer of uprooted weeds from the field is considered economic and better for production and quality of the produce. Apply mulch to cover the root zone in accordance to the spacing of plantation around the tree.

Intercropping

During the initial two years, the intercropping of different annual crops can be under taken as secondary crop as mentioned in the table given below to get additional income. Inter- cropping should be avoided during rainy season

Crops for intercropping under high density planting of different fruit crops in sub- tropics of state.

Sr. No.	Name of Crop	Inter Crops	Not be grown as Intercrops
1.	Vegetable	Cabbage, Cauliflower,Pea, Broccoli, Radish	Potato, Tomato, Brinjal, Okra, Cucumber, Pumpkin, Bottleguard, Bittergaurd, Parval, Colocasia ,Chilli, Capsicum
2.	Spices	Turmeric, Ginger, Onion, Garlic, Coriander, Fennel,Fenugreek	
3.	Legumes	Lentil, Chickpea, HorseGram (Kulth)	Beans, Soyabean, Blackgram (Urd), Greengram(Moong),Kideybeen (Rajmash)
4.	Leafy Vegetable	Mustard,Spinach(Palak),Chino podium, Coriander, Fennel, Fenugreek	
5.	Fodder corps	Barley, Oat	Barseem, Jawar, Bajara
6.	Cereals / Oilseeds	Wheat, Barley, Linseed	Maize, Sugarcane, Ragi
7.	Flowers	Marigold, Gladiolus	
8.	Fruit	Strawberry	

Irrigation Management

- Adequate irrigation supply is critical at fruit development stage to get better yield and quality of fruits. In the reproductive phase water stress is beneficial at the time of flower bud differentiation, but during the plant growth water stress should be avoided.



Surface and sub-surface drip irrigation system

- Drip irrigation systems provide the most efficient and economic management to achieve high productive yields in guava orchards. This system is recommended for commercial guava orchards. Drip has a very high efficient water use and provides a good control of fertilizer application. For young trees use one drip line 40cm away from trunk while for trees older than 3 years use one drip line on each side of the tree row 60 cm away from trunk.

Irrigation Scheduling

Proper moisture regime should be maintained during vegetative growth to ensure good flowering and fruit development. In high density planting, in-line drippers are well suited. The drip line should be laid out at the time of planting of orchard with two drip lines having two inline drippers at 50 cm apart in each plant basin with 4.5 lph discharge. There should be a control unit/valve for each land holding. The irrigation schedule is given below for guava orchards and it is applicable for drip irrigation.

Irrigation schedule

Year	Irrigation (litres per tree biweekly*)
1st	04-06
2nd	10-15
3rd	18-22
4 th and above	25-30

*Approx. Amount of irrigation water may vary by 10-15 percent depending upon soil, climate and prevailing weather conditions. During Rainy season from July to Sept sufficient rainfall occurs in the subtropics of the state. Therefore, under such situations there is no need of irrigating the crops except failure of the monsoon. Irrigation should not be given after harvesting until 10 days before pruning i.e. end of May to 1st week of June for winter crop during 3rd year onwards.

Nutrient Management

Manure

Well rotten farmyard manure should be applied along with 50% P through single super phosphate (SSP) in the basin by band placement 15 days before pruning.

Age of Plant (year)	1 st	2 nd	3 rd	4 th year onwards
FYM (kg plant ⁻¹)	10	10	15	20

Nutrient recommendation

The amount of nutrient to be applied through fertilizers in high density orchard of guava depends on the age of tree, condition of plant and type of soil. The fertilizer dose (g/ tree) should be divided equally among the number of splits and applied at weekly intervals. For proper growth and higher yield, following nutrient doses should be applied:

Age of theTree (year)	Nutrient (g tree ⁻¹)		
	N	P	K
1	120	60	60
2	240	120	120
3	360	180	180
4 year onwards	480	240	240

*Application of N, P and K should be based on soil/leaf test values.

Stages of nutrient application

Stage of application	N (%)	P (%)	K (%)
After fruit harvest	40	60	20
During fruit set	40	40	20
Fruit growth	20	-	60
Total	100	100	100

Cropping

- Soil application of chelated micronutrients of 20g borax, 20g copper sulphate, 20g manganese sulphate, 20g iron sulphate, 20g zinc sulphate and 40g magnesium sulphate per tree per year in the month of January-February along with FYM application should be given.
- For better fruit set and cropping, micronutrients should be applied as foliar spray of 0.2% solution of the needed nutrient (fruit set and pea stage).

Harvesting / Post Harvest Management

Maturity indices

The maturity of guava fruits is determined by its TSS : acid ratio, specific gravity and skin colour. TSS: acid ratio ranging from 26.0-36.0 with specific gravity <1.0 and light green to yellow colour depending upon variety and distance of transport should be considered for determining proper stage of harvesting. Harvesting should be done through hand picking with staggered harvest as per maturity of fruits.

Grading

The fruits are mostly graded as per the size and colour.

Packaging

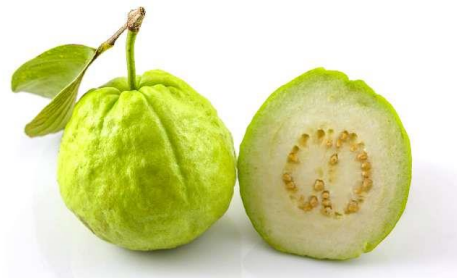
For local markets fruits are packed in baskets/crates, whereas for distant transportation fruit are packed in corrugated fibre boxes with proper cushioning using paddy straw/dried grass/guava leaves/rough paper etc. Being a delicate fruit, it requires careful handling during harvesting and transportation with proper ventilation.

Storage

The shelf life of guava is short, therefore, proper storage for long distant market is required. Mature green and partially ripe guavas are stored at 8-10°C for 2-3 weeks while fully ripe guavas can be stored at 5-8°C for 1 week at 90-95% RH.

Yield

The sweet orange tree starts bearing fruits at 3rd year onwards after planting with 8-10 kg yield per plant. The plants can bear 20-25 kg fruit in 4th year which will stabilize in 5-6th year onwards at 50-55 kg per plant yield under good management practices.



Diseases

Important diseases of guava prevalent in sub tropical zone of Himachal Pradesh are listed below:

Fruit Canker

Causal organism: *Pestalotiopsis psidii*

Symptoms

- Canker develop on young green and mature fruits.
- Infection generally occurs on green fruits.
- Symptoms also appear on buds, calyx and leaves as small, circular spots.
- Scabby, minute, brown or rust- coloured lesions of 2 to 4 mm diameter appear on the fruit, which are unbroken and circular and later tear open the epidermis in a circinate manner.
- These scabby lesions later develop raised margins and cankerous spots develop in great numbers.
- The fruit breaks open in severe cases and the seeds are exposed.
- Market value of fruits is reduced as fruits become hard, malformed and mummified.



Guava Fruit Canker

Disease cycle and Epidemiology

- Dormant mycelia serve as primary source of inoculum while, air borne conidia serve as secondary source of inoculum.
- A bug *Helopeltis antonii*, which punctures the young fruit for sucking juice, damages and exposes the fruit to infection by the pathogen.
- Optimum disease development requires a humid atmosphere (80-100%) and higher temperature (25-30°C)
- Disease does not occur below 15°C and RH 50%.

Disease Management

Cultural Methods

- Summer irrigation + Nutritional management reduces the disease.

Chemical Methods

- Since the wound by insect predisposes the fruit to infection, spray the young fruits after pollination with a suitable systemic insecticide.
- Three or four sprays with Bordeaux mixture (10g copper sulphate + 10 g lime per litre of water) or copper oxy chloride (3g per litre) or Pyroclostrobin + metiram (Cabrio Top) @ 1g/litre of water is effective to check the disease.

Styler End Rot

Causal organism: *Phomopsis psidii*

Symptoms

- Initial symptoms of the disease appear as circular, water soaked lesions at styler end.
- The lesions turn dark brown and increase up to 2 cm in diameter.
- Softening of the tissue occurs and entire fruit rots in a week to 10 days time.
- Numerous closely aggregated small, white or light grey pycnidia develop on infected area
- The infection reduces the nutritional value of fruits



Styler end rot affected fruits

Disease cycle and Epidemiology

- The disease appears in December and spreads fast during February- March
- Conidia are the sources of infection.
- Normally, alpha conidia are the infectious conidia and are produced above 20°C while beta conidia are produced at lower temperatures
- Both types of conidia are inter convertible and change into one another depending upon the prevailing temperature conditions

Disease Management

Cultural Methods

- Collect and destroy the infected fruits from the planting area.
- Application of calcium chloride @ 400g per 100 litre of water in December (2nd and 4th week) should be done.
- Light Interception and distribution should be maintained in canopy through pruning and training.

Chemical Methods

- Spray copper oxychloride (3g per litre of water)

Red Rust

Causal organism: *Cephaleuros virescens*, *C. parasiticus*

Symptoms

- Symptoms of leaf and fruit spots are more pronounced than rust symptoms
- Spots on leaves may be scattered or crowded, numerous or few and vary from mere specks to big patches
- The fruit lesions are dark green to brown or black in colour and smaller than leaves.

Disease cycle and Epidemiology

- Humid weather is conducive for disease development
- The alga first spreads between cuticle and epidermis followed by penetration of the epidermal cells.
- Necrosis occur in the affected cells.

Disease Management

Chemical methods

- Spraying the leaves in every 3 to 4 weeks with a mixture containing 340 g copper oxide, 340 g hydrated lime and 680 g ZnSO₄ in 227 litres of water.



Insect Pest Management

There are number of insect-pests infesting guava. Important insect-pests prevalent in sub tropical zone of Himachal Pradesh are listed below:

Guava fruit fly

Bactrocera dorsalis

Tephritidae : Diptera

Host

It is one of the major pests of guava in India. It also infests guava, peach, citrus, ber, banana, papaya and so on.

Symptoms and Damage

- Semi ripe fruits with decayed spots.
- Dropping of fruits. Damage to semi ripe fruits is caused by both maggot and the adult.
- The oviposition punctures made by the female serve as entry for fermenting organisms.
- Maggots feed on the pulp and convert the pulp into bad smelling discoloured semi liquid mass, unfit for use.
- The fruits develop brown rotten patches on them and fall to the ground eventually.

Life Cycle

- Adult fly is a brown or dark brown with hyaline wings and yellow legs.
- Eggs are laid in small clusters of 2-15 just beneath the skin of the fruit. About 200 eggs are laid by a single female during a period of 1 month.
- Egg period is 2-3 days in March and April and prolonged up to 10 days in winter.
- Maggots become full grown in 6-29 days depending on the season.
- Maggots come out of the fruits and pupate in the soil. Entire life cycle takes about 25 days in the tropics.

Management

- Collection and destruction of fallen, rotten fruits. Collect and destroy infested fruits. For destruction infested fruits, dig a pit of 2-3 feet depth, collect all the dropped fruits and put them into pit and cover the pit with soil.
- Raking under the trees to expose the pupae of the pest to natural enemies.
- Mixing of carbaryl 10D in soils @ 50-100 g/tree.
- Install pheromone traps in the orchard at mid of canopy height @ 15 trap per ha.
- Foliar spray with malathion 2 ml/l + gur 20 g a month before harvesting the fruit crop, repeated after 15 days.
- Spray Spinosad @ 0.25 ml/l or Chlorantraniliprole (0.25ml/l) before ripening (walnut stage) and 15 days after first spray.
- Spray flubendimide/cypermethrin @ 0.25ml/l per month before harvest of crop.
- Post-Harvest Control (Heat treatment techniques):
- Hot water treatment: Submerging fruits in hot water at 43 to 46.7oC for 35- 90 min.
- Double dip method: Immersion of guava fruits in water at 40oC for 20 minutes, followed by 10 minutes at 46oC to get 100 per cent mortality of *Bactrocera dorsalis* eggs.

Guava mealy bug

Ferrisia virgata

Pseudococcidae: Hemiptera

Host

It is otherwise called white tailed mealy bug /striped mealy bug . It is a widely distributed species in tropical and subtropical countries. It also infests bhindi, amaranthus, coccinia, colocasia, lab lab, tomato, brinjal, cashew, anona, guava, amla, grape, tobacco, pepper, cotton, betelvine.

Symptoms and Nature of Damage

Nymphs and adults remain clustering upon the terminal shoots, leaves and fruits and suck the sap which results in:

- Yellowing, withering and drying of plants or shedding of fruits etc.
- Formation of sooty mould due to honey dew excretion.
- In dry weather they may move down below ground and inhabit the roots.

Life Cycle

- Female bug is apterous with two long prominent waxy filaments at the posterior end and a number of waxy hairs over the body covered with waxy powder.
- In the posterior end of the body, the dorsum has a prominent blackish patch.
- It has the habit of encircling itself by secreting thin glassy threads of wax specially when its population is less.
- Reproduction takes place both sexually and parthenogenitically, the latter being more common.



Mealy Bug on fruit



Nymphs clustering upon the terminal



- Mating takes place only once and lasts for about 12-23 minutes.
- The female lays the eggs in groups which lie under its body.
- Fecundity ranges from 109 to 185 during an oviposition period of 20-29 days.
- Incubation period is about 3-4 hours.

Management

- Deep summer ploughing up to base of the tree trunks, after harvesting to expose eggs of mealy bugs.
- Dusting chlorpyrifos 5D or Malathion 5D around tree and incorporating in to the soil.
- Spraying with acetamiprid 0.5 ml/l or imidachloprid 0.5 ml/l or chlorantraniliprole 0.3 ml/l, when severe mealybug infestation noticed on the twigs.
- Wrapping 25 cm wide, 400 gauge polythene sheets on the tree trunk 30 cm above ground level and pasting grease over it to prevent migration of freshly hatched first instar nymphs during winter (Nov-Dec) from soil to trees, one week before their emergence.
- Crawlers collected beneath the polythene sheet may be scraped with a knife.

Bark eating caterpillar

Indarbela tetraonis, *Indarbela quadrionotata*

Metabelidae : Lepidoptera

Host

Guava, Mango, Litchi, Orange, Pomegranate, Loquat, Mulberry, Moringa, Rose and Eugenia.

Symptoms of Damage

- Young trees succumb to the attack. Caterpillars bore into the trunk or junction of branches make zig zag galleries.
- Presence of gallery made out of silk and frass is the key symptom.
- They remain hidden in the tunnel during day time, come out at night and feed on the bark.
- Under severe infestation, flow of sap is hindered, plant growth arrested and fruit formation is drastically reduced.

Life Cycle

- Adult emerge in summer and lays 15-25 eggs in clusters under loose bark of the trees.
- Eggs hatch in 8-10 days.
- Larvae make webs and feed by making zig zag galleries on the wood filled with frass and excreta and later bore inside the wood.
- Larval period is 9-11 months and pupates inside the stem.
- Pupal stage is 3-4 months.

Management

- Kill the caterpillars by inserting an iron spike into the tunnels.
- Injecting Spinosad 1.6 ml or kerosene oil in the ratio of 1:3 into the tunnel by means of a syringe and then the opening of the tunnel is plastered with mud.
- Dip a small piece of cotton in any of the fumigants, like chloroform or petrol or kerosene. Introduce into the tunnel and seal the opening with clay or mud.
- Spray spinosad 0.2ml/l or cypermethrin (1ml/l) or cyantraniliprole (0.3ml/l) or chlorantraniliprole (0.3ml/l).

Physiological Disorder

Cracking of guava takes place during winter months. Calcium chloride and Boric acid @ 400g and 100 g, respectively in 100 litre water should be sprayed. Two sprays should be done in November month at fortnight interval.

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