

## Crops of Dry Temperate Zone

District of Kinnaur, Lahaul and Spiti and sub-tehsils of Pangi and Bharmour of Chamba comprises this zone. During winter (November to April), the areas of this zone are covered with snow. During summer, the season remains mild. Because of such climatic conditions, all *rabi* crops of the plains are cultivated in this zone as *kharif* crops from April-May to October under irrigated conditions. Even grass fails to grow without irrigation due to very scanty rainfall which is less than 25 cm. The main crops cultivated are wheat, barley, buckwheat and pea. Potato and kuth are the cash crops. The other crops of some importance are rye, lentil, beans, sarson, cabbage, cauliflower, turnip, radish, carrot and minor millets. There is a great potential for the production of seeds of temperate vegetables including sugarbeet as well cultivation of zira (black and white). In addition, saffron and hops can also be grown.

### **WHEAT**

#### **Variety**

**Aradhana (HPW-42)** : This variety is recommended for areas above 1500 amsl for timely sown rainfed conditions to replace Sonalika. It is semi-dwarf variety with fully-bearded, dense spikes, white glumes and good tillering ability. It has also shown resistance to flag smut, hill bunt and powdery mildew diseases and early maturing. It has semi-hard, shining amber grains with good *chapati* making qualities. It is resistant to yellow and brown rusts. It gives an average yield of 25 q/ha.

**Saptdhara (Atau Selection)** : This variety is recommended for cultivation in winter season in high hills temperate dry zone. It is resistant to yellow and brown rust. Its average yield is 44 q/ha (without green fodder in May) and 37 q/ha with green fodder i.e. 70 q/ha

#### **Preparatory tillage**

Farm yard manure should be added in October-November and ploughed in, particularly on the slopy lands. The fields should be ploughed twice again in April before sowing to prepare a fine seed bed with optimum moisture.

#### **Sowing and seed rate**

The optimum sowing time is the first fortnight of May in Lahaul and Pangi and first fortnight of April in Kinnaur district. The recommended seed rate is 120 kg per hectare. The row to row spacing should be 25 cm. On slopy fields, the rows should run across the slope to check soil erosion by irrigation water.

#### **Manuring**

Besides the application of farm yard manure which improves the water holding capacity of soils, adequate chemicals fertilizers should be applied to increase the yield. Apply 90 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O per hectare. Apply 1/3 dose of N and full doses of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O at sowing, 1/3 N with first irrigation and the remaining N at the time of ear initiation.

#### **Irrigation**

The Mexican wheats require six irrigations or more depending upon the slope and soil structure. The first irrigation should invariably be given after three to four weeks of planting. At the time of grain formation also, irrigations should be applied to ensure better development of grains. The remaining irrigations should be given at different growth stages.

## Interculture and weeding

One hoeing and two weedings are sufficient to control the weeds. Use improved hoe, if the crop is sown in lines. Alternatively, apply 1 kg 2, 4-D (Soidum salt) per ha in 750-800 L water after about 45 days of sowing or when the weeds have 3-4 leaf stage.

## Harvesting

Wheat crop generally matures around the end of September or first week of October when the plants start drying up. The farmers of this area usually start harvesting the crop at the slightly immature stage and leave it for drying for 4-6 days. The practice might have been good for grain shattering in local varieties. However, Sonalika is non-shattering type and yields more if harvested after complete maturity.

## Plant Protection

Sign of attack/symptom	Control
<b>Insect-pests</b> <b>Armyworm</b> : This insect attacks the wheat and barley crops from the middle of June till the end of July. The leaves are completely eaten and under heavy attack, the ear heads fall-off on the ground. The attack shifts from one field to the other.	<ol style="list-style-type: none"><li>1. Collect the cater-pillars and kill them</li><li>2. Spray 1250 ml chloropyriphos 20 EC (0.05%) per 500 L water per ha on the appearance of pest.</li></ol>
<b>Grasshopper</b> : The grass hopper is a native of sub-alpine zone and is typical in stony localities at higher elevations. The adults emerge in late July and early August and remain active till the middle of September. This insect congregates likelocust and sometimes causes problem. It feeds on all types of vegetation including green.	<ol style="list-style-type: none"><li>1. Spray 1250 ml choropyriphos 20 EC (0.05%) per 500 L water per ha on the appearance of pest.</li><li>2. It is better to spray the on the bunds and grass near the crops before germination of wheat and barleyas the hoppers migrate to the germinating crops from these sources.</li></ol>
<b>Disease:</b> <b>Black rust</b> : Dark brown pustules appear on stems, leaves and leaf sheaths. The teleutosori are most commonly ruptured with fringed epidermis.	Plant resistant variety
<b>Brown rust</b> : Scattered round and coloured pustules appears on leaves	Plant resistant variety
<b>Yellow rust</b> : Small yellow coloured pustules arranged end to end in the form of stripes appear on the leaves and leaf sheaths at 15 day interval from the first appearance of disease.	<ol style="list-style-type: none"><li>1. Plant resistant variety.</li><li>2. Spray the crop with Indofil Z-78 (0.2%)</li></ol>
<b>Loose smut</b> : The affected plants produce black smutted ears containing loosely held spore mass with Vitavbax or Bavistin @ 2.5 g/kg seed.	<ol style="list-style-type: none"><li>1. Rogue out smutted plants and destroy</li><li>2. Treat the seed.</li></ol>

## BARLEY

This crop can be grown very successfully on all soil types in this region. barley is used as a staple food and also for making beverages, for which purpose mostly hulless barley is cultivated.

### Variety

**Dolma** : It is a high yielding, yellow rust resistant, semi-dwarf, profuse tillering and early maturing variety. It has amber lustrous and hard grains with high protein. It is highly resistant to lodging, drought and frost conditions.

### Soil

Barley thrives well under all types of soils and weather conditions in this region.

### Preparatory tillage

Barley requires less tillage than wheat. Generally, one ploughing is sufficient.

### Sowing time

The second fortnight of May is the optimum sowing time of barley.

### Seed rate

Use of 120 kg per hectare and keeping the rows 15 cm apart have been observed best for achieving high yield.

### Manuring

Apply 40 kg N, 25 kg P<sub>2</sub>O<sub>5</sub> and 15 kg K<sub>2</sub>O per hectare. Half the dose of N alongwith full dose of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O should be applied at sowing and the remaining half dose of N with first irrigation.

### Irrigation

3-4 irrigations are sufficient.

### Interculture and weeding

As for wheat crop.

**Harvesting** : As for wheat crop.

### Plant Protection

Symptoms	Control
<b>Diseases</b>	
<b>Yellow rust</b> : Small yellow pustules arranged in stripes are formed the leaves.	1. Sow resistant variety 2. Spray the crop with Indofil Z-78 (0.2%)
<b>Loose smut</b> : The affected plants produce black smutted ears containing loosely held spore mass.	1.Plant resistant variety 2. Rogue out smutted ears and destroy them. 3.Treat the seed before sowing with 25 g Vitavax/kg seed.
<b>Stripe disease</b> : The disease starts by the appearance of small yellow spots on old leaf blades and sheaths. These spots elongate into stripes. Once the leaves starts showing symptoms, all the succeeding leaves of the tiller, sometimes the entire stool shows the stripes.	1. Treat the seed with Indofil @ 2-3 g/kg seed. 2. Plant resistant variety Dolma

## BUCKWHEAT

Buckwheat is a pseudo cereal belonging to the family Polygonaceae. Two species, viz. *Fagopyrum tataricum* and *F. esculentum* are suitable for cultivation. The former is very inferior in quality. The grains are used for preparing pan-cakes locally known as *chilra* which is highly relished. The tender leaves of buckwheat are used for preparing soups and vegetables. Good quality seed of local varieties may be sown. In case of *P. tataricum*, the practice of clipping the plants at knee-high stage prevents plants from lodging and also increases yields. The clipping also provides leaf vegetable for the market.

### Variety

**USDA-1:** It is an early maturing (90-95 days) buckwheat (*F. esculentum*) variety having determinate growth habit and recommended for high hill areas of H.P. It is tolerant to frost and resistant to powdery mildew, lodging and shattering. It has very bold and dark brown conical seeds with good flour recovery and free from bitterness. Its average yield is 25 q/ha.

### Soil

Buckwheat thrives well on all soil types but it is cultivated mostly in poor fields.

### Sowing and seed rate

Seed rate of 25-30 kg/ha is sufficient. Sowing should be done by *kera* in rows 35 cm apart. The general practice of using very high seed rate and sowing by broadcast should not be followed.

### Manuring

Apply 40 kg N and 40 kg P<sub>2</sub>O<sub>5</sub> per hectare for raising a good crop of buckwheat.

### Interculture and weeding

One hoeing and one weeding are sufficient.

### Harvesting

To avoid shattering, the crop should be harvested when 75% of the grains turn brown or dull grey in colour. After harvest, the crop should be allowed to dry for 2-3 days and then threshed.

## KUTH

Kuth (*Saussuria lappa*) is a perennial root crop and belongs to the family Compositae. It is cultivated in Lahaul and Kinnaur only. It is an important cash crop of the valley.

### Soil

Well drained loam soil is the best for the cultivation of this crop. Its cultivation should be avoided on sloppy and stoney field.

**Preparatory tillage :** As recommended for wheat.

### Sowing and seed rate

The sowing of *kuth* should be done before the onset of winter season as the seed of this crop requires chilling for germination. Seed starts germination only after the melting of snow during April-May. Seed rate of 32

kg per ha is recommended. It should be sown by hand dibbling or *kera* in rows 23 cm apart. The seed should be dibbled 3-4 cm deep.

### **Manuring**

Apply 25 kg N, 25 kg P<sub>2</sub>O<sub>5</sub> and 25 kg K<sub>2</sub>O per hectare each year with first irrigation in May. This dose is to be applied for three consecutive years required for the crop to be matured.

### **Interculture and weeding**

Hoeing in May after each winter is necessary. In addition, 3 weedings are necessary in each year.

### **Irrigation**

The crop requires frequent irrigations from May to September during all the three years.

### **Harvesting**

The crop is ready for harvest at the end of the third year in September-October. Before harvesting the crop, irrigate the field thoroughly for ease in uprooting the roots with pick axes. After harvesting, the roots are cut in 7-10 cm pieces, dried for 2-3 weeks and cleaned thoroughly for storing and marketing.

## **WARE AND SEED POTATO**

High altitude, temperate climate, long-day photoperiod throughout the growing season, absence of insect-vectors spreading virus diseases and high soil fertility, which provide congenial conditions for better tuberization in potato are available in the region.

### **Ware Production in Hills**

#### **Variety**

**Kufri Jyoti** : A medium maturing variety and takes about 130-150 days to mature. It is highly resistant to late blight both on foliage and tubers. It is high yielding variety, also suitable for plains and highly suitable for H.P. The average yield is 150-175 q/ha. This variety should not be allowed to grow beyond its maturity time as tubers will grow large in size and bound to show some cracks which is not desirable quality.

#### **Soil**

A well drained loam soil is the best for this crop which is available throughout the valley. The fields should be thoroughly prepared to prepare a fine seed bed with optimum moisture.

#### **Seed rate**

A seed rate of 25-30 q/ha of medium sized tubers should be used. In case of cut potato, atleast 2-3 buds or eyes in each piece are necessary to ensure good germination and stand. Keep the seeds in baskets or sprouting trays or spread in a room to ensure sprouting. Discard unspouted and rotten tubers. Take sprouted tubers to the field in the basket or in sprouting trays for planting.

#### **Sowing time**

In Himachal Pradesh, potato should be planted in the first half of April. It should be done on ridges 60 cm apart. On sloppy fields, the ridges should be across the slope. The plant distance should be 20-25 cm, depending upon the size of seed.

## **Manuring**

In addition to the application of 20 tonnes of FYM, 100 kg each of nitrogen and phosphorus and 50 kg potash per hectare should be applied. The nitrogen should be applied in two equal doses, half dose of nitrogen alongwith full doses of P and K should be drilled at the time of sowing but taking care to avoid the contact of tubers with fertilizers otherwise germination would be affected adversely. The rest of nitrogen should be top dressed with first irrigation and earthing up.

## **Interculture**

The crop should be weeded when the weeds have germinated preferably when potato plants have emerged. When the plants are about 10 cm high, the final earthing up should be done.

## **Irrigation**

Light irrigations at short intervals should be given after germination. Care should be taken that water does not over-flow the ridges. Four to five irrigations are sufficient to get a good crop.

## **Mulching**

If any plant material, such as pine needles is available, it may be applied on ridges to conserve the moisture.

## **Harvesting**

Potato crop is ready for harvest when the foliage gets almost dried up. The tubers should preferably be uprooted by ploughing the field which causes less injury to the tubers. Tubers then should be spread in shade for about a week, which helps in the roughening of the flesh. With tougher flesh, the tubers are less susceptible to damage during transportation and their quality remains unimpaired. The tubers should be graded properly before marketing.

## **Seed Production in Hills**

1. Obtain disease free seed from a reliable source
2. Plant the crop during middle of April for seed production. Earlier planting results in cracking of tubers of Kufri Joyti.
3. Use healthy large-sized tubers (4-6 cm in dia) with multiple sprouts. Well sprouted, large sized tubers produce a large number of relatively virus free tubers.
4. Spray the crop when it is about 10 cm high with any systemic insecticide like Metasystox, Rogor, etc.
5. Earth up the crop immediately after planting and do the inter-cultural operations as early as possible so that potato plants are less disturbed in later stage of crop growth.
6. During growing season, examine seed plot 2-3 times and remove all off-type and diseased plants showing mottling, mosaic, necrosis, crinkle, rolling of leaves and plants showing symptoms of marginal flavescence or purple top roll. The first inspection should be done when the plants are 15 cm high and the second roguing should be done at the flowering time. During late stages of the crop, grown up plants may show symptoms of purple top roll and these plants should be recovered at that time.
7. In hills, aphids appear during mid-July. To control this vector, spray the crop with Metasytox/Rogor once or twice during July and August.
8. Towards the end of July, cut the haulms of susceptible varieties. Kufri Chandermukhi gets severely affected with late blight at this time. The haulms should be removed from the fields and destroyed but should not be left in the field.
9. Check regrowth of stumps which begin to resprout after removal of the haulms. The resporuting, if left unchecked, will defeat the very purpose of haulm killing.

10. Harvest the crop as soon as the rains stop. Dry the produce thoroughly, sort out damaged and rotten tubers. After proper grading, pack the material for sale. Keep the required quantity of seed for next years' sowing.
11. Treat seed tubers with Emisan-6(0.25%) for half an hour.
12. Follow all over package of practices as given under ware production.

### Plant Protection

Sign of attack/symptoms	Control
<b>Insect-pests</b>	
<b>Cutworms</b> : Larvae cut the stems at ground level and eat the leaves and some times the entire plant. They are voracious eaters and damage more plants than they can consume.	<ol style="list-style-type: none"> <li>1. Apply 2 L chlorop-yrifhos 20 EC mixed with 25 kg of sand per ha at sowing time.</li> <li>2. Use high seed rate.</li> </ol> <p><b>Caution:</b> Do not use BHC dusts as it imparts off-flavour to the tubers.</p>
<b>White grubs</b> : These pests cause damage to the developing tubers in the soil per ha at sowing time.	<ol style="list-style-type: none"> <li>1. Apply 2 L chlorop-yrifhos 20 EC mixed with 25 kg of sand.</li> <li>2. Use well decomposed FYM</li> <li>3. Use high seed rate</li> </ol>
<b>Hadda beetls</b> : Adults cause damage by regular feeding on leaves. They eat areas of leaf tissues, leaving parallel bands of uneaten tissue between presenting a lace-like appearance. Attacked leaves gradually turn brown, dry up and fall on the ground.	Dust 5% Malathion and grubs dust @ 40 kg/ha or spray 1 L at endosulfan (Thioan 35 EC) in 500 L water/ha.
<b>Diseases</b>	
<b>Early blight</b> : Brown spots with concentric rings appear on leaves causing premature defoliation in severe infection.	Spray the crop with Indofil Z-78/Indofil M-45 (0.2%) or Blitox 50 (0.3%) at fortnightly interval with the first appearance of the disease.
<b>Late blight</b> : Lesions appear on leaves as small black areas which extend and kill the whole plant in a few days if moist weather prevails resulting in severe losses in yield.	<ol style="list-style-type: none"> <li>1. Spray twice with Ridmil MZ 70 WP (0.25%) at 15 day interval on first appearance of disease followed by 4 sprays of Indofil M-45 (0.2%) at 7 days interval.</li> <li>2. Use healthy seed for sowing.</li> <li>3. Follow high ridge culture to avoid tuber infection.</li> </ol>
<b>Common scab</b> : The skin of affected tubers becomes rough with deep pits. Raised brown to black corky pustules also appear on tubers.	<ol style="list-style-type: none"> <li>1. Use healthy and disease free seed.</li> <li>2. Treat the seed potato in Emisan-6 (0.25%) 25 g Emisan-6 in 25 L water) at sowing time.</li> <li>3. Use ammonium sulphate instead of CAN fertilizer.</li> </ol>
<b>Black Scurf</b> : Sprouts of germinating tubers killed. Cankers are formed in the underground parts and scurf (brown to black sclerotial bodies) appear on tubers.	Dip the seed tubers in 3% Boric acid (Pharmaceutical grade) solution for 30 minutes or Emisan-6 (0.25%) or acetic acid (1%) + ZnSO <sub>4</sub> (0.05%) for 15 minutes. The same fungicide suspension may be used for 20 dips.
<b>Powdery Scab</b> : Initially raised pimple like pustules appear on tubers. Later cavities are formed filled with spore mass and surrounded by loose skin ring.	<ol style="list-style-type: none"> <li>1. Use healthy seed for sowing.</li> <li>2. Avoid contaminated fields.</li> <li>3. Treat seed tubers with Emisan-6 (0.25%) for 30 minutes.</li> </ol>

<p><b>Bacterial wilt</b> : The characteristics symptoms are dropping of leaves leading to complete wilting and vascular browning and vascular browning of tubers with white slimy bacterial ooze.</p>	<ol style="list-style-type: none"> <li>1. Crop rotation with maize and cereals should be followed.</li> <li>2. Full earthing up at planting should be done.</li> <li>3. Use disease free seed tubers.</li> </ol>
<p><b>Mild and severe mosaic viruses (PVV)</b>: The normal green colour of leaves is interspread with light green patches. Occasionally, necrotic spots appear on leaves. The plants become stunted in growth.</p>	<ol style="list-style-type: none"> <li>1. Use certified seed.</li> <li>2. Spray the crop with methyl demeton (Metasystox 25 EC) @ 750 ml in 750 ml water/ha.</li> <li>3. Wherever possible, dehauling of crop should be completed before mid August.</li> </ol>

## RAJMASH

### Varieties

**K-198 (Triloki Rajmash)** : It has determinate bushy growth, white flowers, broad dark green leaves, bold and creamish yellow coloured seeds with good cooking quality and taste. The height is 45-55 cm and matures in 98-100 days. It is resistant to bacterial blight, angular leaf spot and anthracnose in whole of Zone IV except in Sangla valley where it is moderately susceptible to anthracnose. It is tolerant to shattering. Average yield is 25-27 q/ha.

**KRC-8 (Baspa)** : It is a semi-dwarf variety and matures in 110-120 days. It is recommended for high hill areas of H.P. It is resistant to bean anthracnose. It has attractive spotted magenta coloured bold grains with good cooking quality. Its average yield is 18-20 q/ha.

**HPR-35 (Kanchan)** : It is semi-dwarf, determinate and early maturing variety and recommended for mid and high hill areas. It is better suited both under monoculture and intercropping with maize. It has mottled deep pink bold grains with good cooking quality. Its yield is 12-15 q/ha.

## HOP

Hop (*Humulus lupulus L.*) is one of the cash crops of dry temperate zone particularly Lahaul & Spiti. The mature female cones are used in flavouring and preservation of beverages. The price of female cones depends upon the alpha acid content present in them. In past, female hop cones worth about two crore rupees were used to be imported from European countries annually.

### Varieties

The varieties recommended for commercial cultivation in Himachal Pradesh are Late Cluster, Harmukh and Hybrid-2. Late Cluster has maximum alpha acid content (8 per cent) and is comparable with best varieties of Europe. This variety flowers very profusely.

### Climate

Although hop plants can tolerate quite a wide range of climate but the produce of commercial importance is produced in areas having mean temperature range of 15-19°C only during summer season. If adequate water supply is available during summer then even high temperature does not effect growth. However, high rainfall during cone production is harmful. So dry temperature zone is the best suited for this crop.

## Soil

Hop can be grown on soils varying from sandy loam to clay loam. However, fertile and well drained soils are the best for this crop.

## Propagation

Hop plants are propagated both from seed as well as through vegetative methods (layering, strap cutting, soft wood cutting, under runners and lateral branches). Vegetative method of propagation is the general practice and seed is used only while breeding new varieties. Planting is preferably done in autumn before the soil becomes cool. This way, plants develop new roots giving the plants a good start in spring. The plants can also be planted during first fortnight of February.

Spacing	Plant to plant	1 m
	Row to row	2 m

Thus, 4000-4500 plants are accommodated per hectare. If seeded hops are grown then care is taken to plant sets of male hops on the outer rows of the garden in such a way that female flowers are in the burr.

## Training

The hop plants are trained in a number of ways but Worcester system of training is recommended. In this method of training, the hop plants are trained on wire net with the help of poles. The poles are erected in row in front of rows of hop plants. At the top of poles, hooks and screws are fixed. Parallel to each row, two wires are fixed with poles and hop vines are allowed to spread on it.

## Manuring

FYM	25-30 tonnes/ha
Nitrogen	100 kg/ha
Phosphorus	40 kg
Potash	120 kg/ha

Add full quantity of farm yard manure, phosphorus and potash in the soil at the time of land preparation. Apply half quantity of nitrogen in March-April and the rest half in June in circle of 3 ft diameter around plants.

## Flowering

Flower initiation starts in June and by middle of July, the female inflorescence, commonly called burr, is formed. After pollination stigmas die and quick development of burr and elongation and thickening of axis takes place. The bracts and bractioles quickly enlarge giving inflorescence a characteristic cone shape. The plant is then said to be in a hop. The lupulin (small multicellular glandular pairs) present in burr quickly develops and accelerates their resin secretions and essential oils, the quality constituents of cones. Lupulin can be lost by rough handling while picking and drying.

## Stage of harvesting cones

The cones mature from end of August to end of September. At this stage, following changes take place in the cones :

1. The colour of bractioles and to some extent colour of bracts becomes yellow.
2. The lupulin glands are completely filled with resin.
3. The aroma of hops is fully developed.

## Yield

On an average, 3-year old plants yield 12-15 quintals green cones or 3-4 quintals dry cones.

## Drying of hops

The cones after harvesting are dried in kilns at a temperature of 32°C. Drying is complete at a temperature of 60-65°C. After drying, the cones are packed in cloth bags for transportation.

## Plant Protection:

Sign of attack/symptoms	Control
<b>Insect-pests</b>	
<b>Aphids</b> : They cause damage by sucking growing shoots.	Spray the crop with methyl demeton (Metasystox 25 EC) or dimethoate (Rogor 30 EC) @ 750 ml/750 L water/ha.
<b>Caterpillars</b> : They feed on plant foliage and soft stem.	Spray the crop with methyl parathion (Metacid 50 EC) @ 750 ml/750 L water/ha.
<b>Diseases</b>	
<b>Powdery mildew</b> : Powdery mass on leaves and stems but does not harm cones.	Dust the crop with sulphur 5% dust.
<b>Downy mildew</b> : It affects leaves, growing tips as well as mature cones.	1. Use healthy stock and remove diseased parts. 2. Spray the crop with Bordeaux mixture (5:5:50) from April onwards or Indofil Z-78 (0.3%) as soon as the disease appears.
<b>Verticillium wilt</b> : From the soil, the fungus enters plant roots and affects leaves and stalks.	1. Remove the diseased plants. 2. Adopt 4 year rotation with potato. 3. Three drenches with Bavistin 50 WP (0.2%) should be done in October, April and June.

## KALAZIRA

Kala Zira (*Bunium pencicum*) has been found growing wild in the district of Kinnaur, Lahaul and Spiti and tehsil Pangi and Bharmour of Chamba. Realizing its importance as a spice and more valuable seed in Ayurvedic medicines, farmers can have a gross income of fifteen to twenty thousand rupees per hectare by growing kala zira. It, being a perennial crop, does not require planting year after year. Through experimental trials, it has been possible to domesticate kala zira in higher elevations (arid zone) ranging from 1,850 to 3,100 m above seal level. The natural habitats of the plant are low rainfall areas during summer (150-450 mm), accompanied with heavy snowfall in winter (2-5 m). After over-wintering, the bulbs start sprouting with the onset of spring after the snow melts. Low rainfall during the vegetative, flowering and maturity stages help in developing flavour and quality seeds. The flower initiation occurs only after the bulbs attain three years of age. At present, only the local material is being multiplied. Collections from different zones are being made and the germplasm is under study to know if there is any genetic variability.

## Soil and seed bed preparation

Sandy loam soils are best suited for the proper development and growth of bulbs. Two to three ploughings are necessary. Mulching in November/December encourages early sprouting of bulbs.

### Time of sowing

The optimum time for sowing of seed as also for transplanting of bulbs is from mid-October to mid-November.

### Method of sowing and seed rate

(a) **With seed** : The seed @ 1-1.5 kg per ha should be sown in lines 20 cm apart and 2 to 2.5 cm deep.

(b) **With bulbs** : The bulbs @ 75-100 kg per ha are planted 10 cm deep and 20 cm apart. The space between the rows should be 30 cm.

### Manuring

Apply 60 kg nitrogen, 30 kg each of phosphorus and potash per hectare to obtain good crop. Also apply 20 tonnes FYM per hectare before last ploughing.

### Interculture and Weeding

Three to four hoeings and weedings are sufficient to control the weeds. Care should be taken to avoid injury to the bulbs.

### Irrigation

It requires 3-5 irrigations depending upon the soil type. The first irrigation should invariably be given when sprouting starts. At the time of flowering and seed formation, irrigations should be applied to ensure better development of seeds.

### Harvesting and threshing

The crop flowers in the first week of June and matures by first fortnight of July. As the crop is susceptible to shattering, timely harvesting is more important to avoid losses. It should be harvested when the seeds turn light brown for commercial purpose and dark brown for using as seed. Threshing is done with sticks. Average yield is 8-10 q/ha.

### Plant Protection

Sign of attack/symptoms	Control
<b>Insect-pest :</b>	
<b>White grub</b> : The insect remains hidden in soil and cause heavy damage to seedlings immediately after germination.	Apply 2 L Chloro-pyriphos 20 EC mixed with 25 kg of sand per ha at sowing time.
<b>Disease</b>	
<b>Blight</b> : The foliage and branches of the plants become dark brown to black. The foliage drops down and the plants dry.	Spray the plants with Indofil Z-78 or Indofil M-45 (0.2%) at fortnightly interval with the first appearance of the disease.

## SAFFRON

Saffron (*Crocus sativus*) prefers cool, dry and sunny site between elevations ranging from 1,500 to 2,500 m above sea level. Cool and wet climate inhibits flowering but increases the potentialities of mother corms to produce a large number of daughter corms. Its cultivation can be well practised in areas where average rainfall is about 100 cm also some snow is received during winter.

## Soil

Saffron can grow on different types of soils ranging from sandy loam to clay loam. However, proper drainage should be ensured to avoid rotting of corms.

## Preparation of land

Three to four ploughings are sufficient for preparing a fine bed. Farm yard manure and other organic materials should be properly mixed in the soil before the final ploughing to get good seed bed. Small manageable raised beds (2m x 1m x 15cm) always give good results. The beds should have channels on all the four sides to drain-off any excess moisture in sandy soils of dry temperate zone of Himachal Pradesh. Making of raised beds is not necessary but it is desirable to have beds where the soils are loam and there is a good rainfall.

## Time of planting

The optimum time of planting ranges from July to first week of August. Mid July is the best time to sowing.

## Propagation

Saffron is propagated by means of corms. The plant is perennial and only large sized corms with diameter of 2.5 cm or above may be used for planting.

## Manuring

Add 20 tonnes FYM per hectare in the soil before last ploughing. Apply 90 kg nitrogen and 60 kg each of phosphorus and potash per hectare.

## Method of planting

Corms should be planted 6-7 cm deep with line to line and plant to plant spacing of 10 cm.

**Seed rate :** The seed rate varies with the method of sowing :

- (i) **By dibbling :** Fifteen quintals of corms per ha are required.
- (ii) **By broadcasting :** About 40 quintals of corms per ha are necessary. For proper management, only the dibbling method is recommended.

## Interculture and weeding

Two to three hoeings and weedings are sufficient to control the weeds.

## Irrigation

It requires 2-3 irrigations depending upon the rainfall during the growing season.

## Time of flowering and harvesting

Flowering starts in the first week of October and continues upto the first week of November. The plucking of flowers is usually done by hand in the morning. The plucking flowers are fully dried in the sun for 3-4 days. After the flowers have fully dried, the three long stigmas are picked up by hand. The upper portion of the stigma which is red-orange in colour is the *shahi* saffron. The lower portion of the style is also taken out and it is the saffron of inferior quality and is called *mogra*.

## Yield

An average yield of about 2.5 kg/ha of dried saffron is obtained.

## Diseases

Symptom	Control
<b>Corm rot:</b> It causes varying degree of stunting, yellowing with reduced number of daughter corms thus affecting the yield.	1. Grow healthy corms. 2. Corm-dip in 0.2% suspension of Bavistin in water for 30 minutes at the time of planting followed by drenching of soil with the same suspension during October and in April in subsequent years.

## VEGETABLE CROPS

Vegetables grown in *kharif* season in higher altitude are of economic importance as off-season cash crops.

## CABBAGE

### Varieties

Pride of India, Golden Acre and Large Late Drum Head

<b>Time of sowing</b>	High hills	April-May
<b>Seed rate</b>	750-900 g/ha	
<b>Spacing</b>	Early varieties	30 x 45 cm
	Mid varieties	45 x 45 cm
	Late varieties	60 x 45 cm

### Manuring

20 tonnes of FYM, 125 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O per ha. All FYM, P, K and 1/2 N should be applied before transplanting and the rest N as top dressing.

## CAULIFLOWER

**Varieties :** K-1, Pusa Snowball-1

<b>Time of sowing</b>	High hills	April
<b>Seed rate</b>	750 g/ha	
<b>Spacing</b>	Late varieties	45 x 60 cm

## Manuring

20 tonnes of FYM, 125 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O per ha. All FYM, P, K and 1/2 N should be applied before transplanting and the rest N as top dressing.

## Insect-pests

Sign of attack	Control
<b>Leaf eating caterpillar</b> : This caterpillar causes serious damage by feeding on the foliage. Whole of the leaf is eaten up except the veins. The attack starts from the last week of July and continues till August end.	1. Destroy the yellow egg masses and caterpillars feeding gregariously. 2. Spray 750 ml malathion (Cythion 50 EC) in 750 L water/ha. The spray can be repeated after an interval of 10-15 days. <b>Caution</b> : The harvesting should be done only after an interval of seven days.
<b>Flea beetle</b> : The adults cut regular holes on the leaf surface. The attack starts in the middle of July and continues till the middle of August.	Spray 750 ml malthion (Cythion 50 EC) in 750 L water/ha. If the pest again appears, the second spray be done after an interval of 15 days. The harvesting should be done only after an interval of 7-10 days.

## KNOLKHOL

**Varieties** : White Vienna, Large Green

**Time of sowing** High hills March-July

**Seed rate** 1000-1250 g/ha

**Spacing** 30 x 22.5 cm

## Manuring

20 tonnes of FYM, 125 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O per ha. All FYM, P, K and 1/2 N should be applied before transplanting and the rest N as top dressing.

## PEA

This is very important cash crop in mid and high hills where it is grown during summer.

**Varieties** : Bonneville, Kinnauri and Lincoln

**Time of sowing** High hills March-June

**Seed rate** 40 kg/ha

**Spacing** 60 x 7.5 cm

## Manuring

20 tonnes of FYM, 20 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 30 kg K<sub>2</sub>O per ha.

## Diseases

Symptom	Control
<b>Powdery mildew</b> : White floury patches covering large areas appear on stems, branches, leaves and pods.	Spray the crop with first appearance of disease with Bayleton (0.025%) and after 20 days with Karathana (0.05%) or Sulfex (0.3%) at 7 day interval.
<b>White rot</b> : Infected plants are covered with white mycelium and black sclerotia are formed in them. Quality of pods is affected. Later on, whole plant dries up. Plants start rotting and lodge.	<ol style="list-style-type: none"><li>1. Burn all plant debris after harvest.</li><li>2. Follow crop rotation with wheat/barley and never with.</li><li>3. Follow proper spacing between row to row and plant to plant.</li><li>4. Avoid excessive irrigation from pre-flowering stage onwards.</li><li>5. Stake medium to tall varieties.</li><li>6. Avoid injury to the stem during picking.</li><li>7. Treat seed with Bavistin @ 25 g/kg seed.</li><li>8. Spray Bavistin (0.05%) from pre-flowering stage onwards.</li></ol>

## BEANS

**Varieties** : Premier, Contender and Kentucky Wonder

**Seed rate** : Dwarf variety : Premier, Contender-75 kg/ha

**Climbing variety** : Kentucky Wonder-35 kg/ha

<b>Time of sowing</b>	High hills	April-May
	60x15 cm	(Dwarf variety)
	90x15 cm	(Climbing variety)

<b>Manuring</b>	FYM	20 tonnes/ha
	Nitrogen	40 kg/ha
	Phosphorus	60 kg/ha
	Potash	30 kg/ha

Apply FYM, P, K and 1/2 N at the time of preparation of land for sowing. The rest N to be applied as top dressing.

## Insect-pest

Sign of attack	Control
<b>Bean beetle:</b> It attacks beans at seedling stage. The first formed leaves are eaten away leaving the young seedling devoid of leaves which later on dry up.	Dust 2% Folidol @ 20-25 kg/ha or spray 500 ml Metasystox 25 EX/Metacid 50 EC in 500 L water/ha.

## SARDA MELON

Sarda melon or Afghan melon is being grown in district Kinnaur which is the only locality in India where it can be successfully grown because of its similar climatic requirements. Sarda melon is more sweet, very crisp, more juicy, bigger and has a longer shelf life as compared to ordinary musk melon. It offers a promise as a cash crop in dry temperate zone as the marketing can be done in autumn when no melons are available.

### Varieties

**Selection-1 :** Early maturing, fruit 12-15 cm long and 8-9 cm broad, spindle shaped, average fruit weight 1 kg, smooth rind, flesh colour white, very sweet (14.5% T.S.S.), moderate in crispness, average yield 250-300 q/ha.

**Selection-9 :** Medium maturing, fruits 20-22 cm long and 10-12 cm broad and oblong. Average fruit weight 1.250-1.500 kg; rind slightly netted on maturity, flesh colour white with pinkish tinge towards placenta, very sweet (14.5% T.S.S.), very crisp, average yield 275-325 q/ha.

### Sowing time

Since it is very exacting in climatic requirements, it can only be grown in dry temperate zone of H.P. (5000-7500 m asl). Depending upon weather, sowing should be done in the month of May.

**Seed rate :** 3-4 kg/ha

**Spacing :** Row to row - 1.5 m

Plant to plant - 1.0 m

3-4 seeds are sown per hill and finally one or two vines are allowed to trail per hill, flat on the ground.

<b>Manuring</b>	FYM	20 tonnes/ha
	Nitrogen	50 kg/ha
	Phosphorus	60 kg/ha
	Potash	50 kg/ha

Mix FYM well in the soil at the time of land preparation. Drill P, K and 1/2 N at the time of sowing and remaining half N about 50 days after sowing.

## Seed production

Keep an isolation distance of 800 m for foundation and 400 m for certified seed production between the two varieties of sarda melon. Ripe, true to type fruits should be selected for seed extraction. Seeds along with placenta are scooped out with knife and placed in a container for fermenting for 24-30 hours. Seeds are then washed with running water and dried to a moisture content below 8%.

## Disease

Symptoms	Control
<b>Powdery mildew</b> : This disease breaks out from June-August. White floury patches appear on all plant parts and in severe cases, leaves become brown and shrivelled. Fruits of affected plants do not develop fully and remain stunted.	Spray Bavistin (0.05%) at 15-20 day interval in the very initial stages of disease appearance.

## ONION

Onion has become an important crop of dry temperate zone because crop of summer onion can be transported to other areas in October when it sells at much higher rate.

### Varieties

**Agri. Found Dark Red** : A deep red colour, self toppling variety, good storage and transportation.

**N.53** : Red coloured variety, has thicker neck than Agri-Found Dark Red, less suitable for storage.

**Sowing time** : Seed sowing March-April

**Transplanting** : May-June

**Seed rate** : 10-12 kg/ha

**Spacing** : 20 x 10 cm

**Manuring** : FYM 20 tonnes/ha

Nitrogen 125 kg/ha

Phosphorus 75 kg/ha

Potash 60 kg/ha

Apply all FYM, P&K and half nitrogen before transplanting at the time of field preparation. Other half nitrogen be top-dressed after 60 days of transplanting the crop.

**Harvesting** : October

**Yield** : 200-250 q/ha