

## Grain Crops

### **WHEAT**

Wheat is the most important cereal crop of Himachal Pradesh and is sown throughout the State in the *Rabi* except in Lahaul & Spiti, Kinnaur, Pangi and Bharmour areas of Chamba district, where it is cultivated in summer (April-May to September-October). During 1997-98, the area under wheat in the State was 360 thousand hectares and production was 540 thousand tonnes with an average productivity of 15.0 q/ha as against the national average of 26.0 q/ha.

The main reasons for the low productivity are barani cultivation in about 85% of the total area, less area under good quality seed, low application of fertilizers and other inputs, high incidence of diseases (rusts and loose smut) and high infestation of weeds.

#### **Varieties :**

Table 1 : **Varietal recommendations for different situations**

	<b>Low hills</b>	<b>Mid hills</b>	<b>High hills</b>
Early sown	VL 616 VL 616	-	
	HS 277 HS 277		
	PBW-343	PBW-343	
Timely sown	HPW-89	HPW-89	HPW 42 (Aradhana)
	HS-240 HS-240		
	HPW-147	HPW-147	Atau Selection (Saptdhara)
	HPW-184	HPW-184	
Late sown	HPW-42	HPW-42 (Aradhana)	
	HS-295 HS-295		

#### **Varieties for Foot Hill Areas**

Timely sown (rainfed) PBW-299; PBW-396, PBW-175

Timely sown (irrigated) UP-2338, WH 542; PBW-343, WH-595

Late sown (irrigated) UP 2338, Aradhana, PBW-373, Raj 3765

- 1. HPW-147** : This high yielding variety is recommended for timely sowing under irrigated and unirrigated conditions in low and mid hills of H.P. It is resistant to yellow and brown rust. Its average yield in irrigated and rainfed is about 33 and 25 q/ha, respectively.
- 2. Surbhi (HPW-89)** : This is a high yielding variety suitable for timely sowing under both rainfed and irrigated conditions in low and mid hills of H.P. It is resistant to yellow and brown rusts. It gives an average yield of 28 and 35 q/ha in rainfed and irrigated conditions, respectively.
- 3. 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.
- 4. HPW-184** : It is a new variety suitable under timely sown irrigated as well as rainfed conditions in low and mid hills of the state. It is an alternative to variety HS240 which has become highly susceptible to yellow rust. It has higher degree of resistance to yellow rust, resistance to leaf rust & has shown higher degree of tolerance to loose

smut, hill bunt & Karnal bunt. It has dark green foliage with creamish white spikes of tapering shape. It possesses amber hard, medium bold & lustrous grains. Its average yield is 40 q/ha and 18 q/ha under irrigated & rainfed conditions respectively.

**5. HS-240** This variety is suitable for timely sowing under rainfed as well as irrigated conditions in low and mid-hills of H.P. It is medium tall but slightly late in maturity. However, it is resistant to yellow rust but is susceptible to brown rust and loose smut. This gives an average yield of 28 and 37 q/ha under rainfed and irrigated conditions, respectively.

**6. HS-277** : This variety is recommended for early sowing under rainfed conditions in low and mid-hills. It is medium tall with semi-winter habit and is resistant to yellow rust and its average yield is 30 q/ha.

**7. HS-295** : This variety has been released for low and mid hills under late sown rainfed conditions to replace Sonalika which has become highly susceptible to rusts and loose smut. It is medium tall with profuse tillering, early maturity and easy threshability. Its grains are amber, medium bold and hard with good *chapati* making qualities. It is resistant to yellow rust but slightly susceptible to brown rust. Its average yield is 24-25 q/ha.

**8. VL 616** : This variety is suitable for low and mid hills under rainfed conditions for early sowing. In order to utilize the residual moisture after the harvest of the maize crop, this is the only promising wheat variety for sowing by mid October. It is moderately resistant to yellow, brown rusts and loose smut. The average yield is 25-30 q/ha.

**9. 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

**Soil** : Wheat can be grown on all types of soils except on water-logged soils. Medium loam well drained soils are suitable for its cultivation.

**Preparatory tillage** : The soils should be thoroughly prepared by giving one deep ploughing followed by 1-2 ploughings with desi plough. Clods should be broken to the maximum extent. In areas where wheat follows paddy, one additional ploughing may be required.

**Time of sowing** : For securing optimum yield, wheat should be sown well in time. Optimum sowing times for different agro-climatic zones of the State are as under :

Zone	Timely sown		Late sown	
	Irrigated	Rainfed	Irrigated	Rainfed
Low hills	Last week of Oct-15 Nov.	Last week of Oct - Mid Nov	Upto end of December	Depends upon the rainfall but should not be delayed beyond end of December
Mid hills	Last week of Oct-15 Nov.	Last week of Oct - Mid Nov	Upto end of December	Depends upon the rainfall but should not be delayed beyond end of December
High hills	1 <sup>st</sup> Oct-15 <sup>th</sup> October	1 <sup>st</sup> Oct-15 <sup>th</sup> October	Upto 15 <sup>th</sup> Oct	Upto 15 <sup>th</sup> Oct

Delayed sowings result in gradual decline in yield.

**Method of sowing** : Farmers generally sow wheat by broadcasting the seed. But it creates difficulty in intercultural operations besides reducing the yield. Hence, wheat should always be sown in lines 22 cm apart by kera. Seed should not be put more than 5 cm deep.

**Seed rate** : 90-100 kg seed/ha is required for timely sown crop and seed rate should be increased to 150 kg/ha for rainfed wheat sown after 20<sup>th</sup> December.

## Manuring:

	Nutrients* (kg/ha)			Fertilizers (kg/ha)			SSP (16%)	MOP (60%)		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Urea or 46%	CAN 25%	DAP ** or 18,46%				
Irrigated	120	60	30	260	480	130	375	50		
Rainfed	80	40	40	175	320	85	250	65		
				(Fertilizer kg/bigha)						
Irrigated				20	38	10	30	4		
Rainfed				14	25	7	20	5		

\* These nutrients can also be supplied from other fertilizers available in the market.

\*\* When 130 kg of DAP is used (under irrigated conditions), reduce the dose of urea by 50 kg and that of CAN by 90 kg, for rainfed crop when 85 kg of DAP is used reduce the dose of urea by 30 kg and that of CAN by 60 kg.

Note : If the wheat crop is sown after 20<sup>th</sup> December in the rainfed areas, FYM @ 15 tonnes/ha should be spread on the soil surface immediately after sowing. Avoid mixing of FYM with the soil.

## Time and Method of Application:

Under irrigated conditions, apply whole of phosphorus and potash and half of the dose of nitrogen at the time of sowing by pora method and the remaining half nitrogen at crown root initiation stage. Urea may be used as a source of nitrogen which should be applied after irrigation or rainfall.

Under rainfed conditions, first half dose of N should be applied at sowing time by pora method and the remaining half dose of N at the first rainfall.

In view of restricted supply of superphosphate, phosphorus requirements of wheat in acid soils (pH below 6) under irrigated conditions may be met through the application of powdered rock phosphate @ 225 kg P<sub>2</sub>O<sub>5</sub>/ha (i.e. 1125 kg rock phosphate containing 20% P<sub>2</sub>O<sub>5</sub>). It should be applied through broadcast and thoroughly mixed into the soil at least 15 days before sowing. When rock phosphate is so used, there is no need to apply phosphorus to the succeeding crop. Nitrophosphate (30 to 50 % water soluble) available are good substitutes of superphosphate in acidic soils.

The doses of fertilizers are for average soil fertility conditions. In order to obtain maximum profit, apply fertilizer on soil test basis. If farm yard manure has been added to the wheat crop, the fertilizer doses should be adjusted accordingly. Liming @ 1 tonne/ha may be applied about 20 days before sowing of wheat to acidic soils but soils may be got tested for lime. Lime once applied can serve the purpose for 2-3 years. Target yield concept for wheat crop should be applied.

Zinc deficiency occurs invariably in coarse textured soils and zinc sulphate at the rate of 25 kg/ha should be applied at least 15 days before sowing by broadcast in soils deficient in zinc.

## Irrigation:

Depending upon the water resources available with the farmers, the following irrigation schedule may be adopted for a better harvest.

Possible no. of irrigations that can be arranged during growing season of wheat	Chronological order of physiological growth stages of wheat when crop must be irrigated				
	Crown root initiation	Late tillering	Late Jointing	Late flowering	Dough stage
One	X				
Two	X			X	
Three	X		X	X	
Four	X	X	X	X	
Five	X	X	X	X	X

In case of available supplementary irrigation, a pre-sowing or post-sowing (30-40 days) after irrigation should be applied.

### Mulching (Only for Palampur situations):

Practice of mulching in late sown wheat @ 8 tonnes/ha pine needles (or some other available mulching material) is beneficial in two ways, as it conserves soil moisture and moderates soil temperature during cold winter nights, and therefore, helps in quick germination. However, practice of mulching can be adopted under Palampur situations, where pine needles and other mulch materials are available

### Weed Control

Manual : If adequate labour is available, one interculture about 1 month after germination helps in weed control and proper moisture conservation in rainfed wheat by creating soil mulch.

Chemical control : To control grassy weeds in wheat, use isoproturon @ 1.250 kg/ha. This chemical is available in different brand names in the market. The following brands are recommended for use at the commercial dose given below.

- I) Masslon (75 WP)/ Himagrolon @ 1.7 kg/ha.

Besides, metoxuron @ 1.250 kg (Dosanax 80 WP) @ 1.6 kg/ha can also be used for weed control in wheat. Reduce the dose by 20 per cent in low hill zone of the state. Apply these herbicides at 2-3 leaf stage of weeds. This stage is reached 30-35 days after sowing in low-hills and 40-45 days in mid hills under timely sown conditions whenever wild oat is a major problem spray this herbicide at 20 days after sowing. *Lolium temulentum* can effectively be controlled by isoproturon based herbicides by adding 0.5% surfactant (Selwet or teepol or sandovit) at 20% lower dose of the herbicide. For the control of broad leaved weeds, apply 2,4-D (Sodium salt) @ 1.0 kg/ha in 800 litres of water at 2-3 leaf stage of weeds. Don't apply 2,4-D, when gram, lentil or mustard is intercropped with wheat. The dose of herbicides should be reduced by 25 per cent in light textured soils.

If oilseed or pulse crop sown mixed with wheat crop, isoproturon herbicide should not be used, but Pendimethalin 1.5 litres/ha (Stomp 30%-5 litres/ha) should be used within 48 hours of sowing.

In case of mixed flora of grasses and broad leaved weeds, apply isoproturon 1.0 kg+2,4-D 0.5 kg (mixture) at 30-35 days after sowing.

**Precaution :** The spray of 2,4-D should not be done at jointing stage of wheat.

Growing wheat in closer rows with 15 cm spacing or cross row sowing at 22 cm with half of the seed and fertilizer distributed in both directions results in decreased number of *Phalaris minor*, wild oat plants, which can be

controlled using half of the above recommended rates of isoproturon but applied 15 days after sowing. Where fields are infested with *Lolium temulentum*, the dose of herbicide to be used will be same as mentioned earlier.

### Plant protection

Sign of Attack / Symptom	Control
<b>(i) Insect-Pests :</b> <b>Termite :</b> Attacks and kills young wheat plants in unirrigated areas in lower hills.	1. Treat the seed with chlorpyriphos 20 EC @ 4ml/kg seed 2. Mix 2 litres chlorpyriphos 20 EC with 25 kg sand and apply in one hectare. 3. Remove stubbles of previous crop before sowing.
<b>Grashopper :</b> Causes damage to germinating crop by cutting the plants. Sometimes serious at lower elevations and in valley areas.	1. Dust Follidol 2% dust @ 20-25 kg/ha 2. It is better to dust the grass on bunds and in waste land near the field before germination of wheat and barley as hopper migrate to germinating crop from these sources.
<b>Armyworm :</b> Feeds on foliage of young crop and attack shifts from one field to other	1. Collect and kill the gregarious forms of caterpillars. 2. Spray 1125 ml Endosulfan 35 EC (Thiodan/ Hildon/ Endocin) or 750 ml Fenitrothion 50 EC (Folithion/Sumithion/Accothion) in 750 litres water.
<b>Wheat bug :</b> Appears in certain localized areas of Kullu and Kinnaur on milky grains and causes chaffyness of grains.	Spray as above
<b>Pod borer :</b> Caterpillars feed on leaves and developing grains.	Spray 1.5 L Endosulfan 35 EC (Thiodan/Hildon/ Endocel) in 750 litres water/ha
<b>Wheat aphid :</b> Aphids may cause severe damage by sucking sap from leaves and ultimately inhibiting grain formation.	Spray 750 ml Methyl demeton 25 EC (Metasystox) or 750 ml Dimethoate 30 EC (Rogar) in 750 L water/ha.
<b>(ii) Diseases :</b> <b>Yellow rust :</b> Small, yellow coloured pustules arranged end to end in the form of stripes appear on the leaves and leaf sheaths. The rust is common in higher and mid hills where it causes much damage.	1. In case of crop meant for seed purpose, spray with 0.2% Dithane M-45/Indofil M-45 (0.2%) at 15-day interval from first appearance of disease symptoms. 2. Plant resistant varieties 3. Spray Bayleton 25 EC, Tilt 25 EC (0.1%) or Contaf 5 EC (0.2%)
<b>Brown rust :</b> Scattered, round and brown coloured pustules appear on the leaves. The rust is common in low lying and valley areas.	1. In case of crop meant for seed purpose, spray with 0.2% Dithane M-45/Indofil M-45 (0.2%) at 15-day interval from first appearance of disease symptoms. 2. Plant resistant varieties 3. Spray Bayleton 25 EC, Tilt 25 EC (0.1%) or Contaf 5 EC (0.2%)
<b>Black rust :</b> Dark brown pustules appear on stems, leaves and leaf sheaths. The teleuto sori are most commonly ruptured with fringed epidermis. The rust is common in areas adjacent to plains.	Plant resistant varieties
<b>Loose smut:</b> The affected plants	1. Rogue out smutted plants as soon as they appear and

produce black smutted ears containing loosely held spore mass.	destroy 2. Treat seed with Vitavax/ Benlate/Bavistin @ 2.5 g/kg seed. 3. Grow resistant varieties in areas where the incidence of disease is quite high. Note : Seed treatment should preferably be done at sowing time, however, there is no harm if it is done earlier also.
<b>Bunt</b> : The grains in the affected ears at full ripeness are filled with a greasy spore mass smelling strongly of rotten fish. The grain coat, however, remains intact.	Treat seed with Vitavax or Agrosan GN (2.5g/kg seed).
<b>Flag smut</b> : The disease is characterised by the appearance of long narrow stripes running parallel to the veins on the leaves. These stripes later on rupture exposing black sooty mass of spores.	1.Avoid late sowing. 2.Apply irrigation immediately after sowing in fields where disease is serious. 3.Treat seed with Bavistin/ Venlate @ 2.5 g/kg seed. 4.Rogue out diseased plants and destroy them by burning.
<b>Powdery mildew</b> : The disease is characterized by appearance of white to ashy coloured loose cottony mass of fungus on aerial parts of the plants especially stems, leaves and leaf sheaths.	Spray the crop at fortnightly interval with Karathane (0.05%) or Bavistin (0.05%).
<b>Karnal but</b> : Only few ears in a stool and only few grains in an ear are affected and transformed into black bunt sori.	1. Treat the seed with Bavistin/Agrosan GN @ 2.5 g/kg seed. 2. Plant resistant varieties
<b>Ear cockle and yellow ear rot:</b> The affected ears become abortive with twisted stalk bearing yellow slime. At later stage, the ears carry dark green galls known as cockles filled with nematode larvae.	1. Rogue out affected plants and destroy 2. Separate out the nematode galls from seed by floatation method in 5% ordinary salt solution.

## BARLEY

Next to wheat, barley is the most important *rabi* cereal with respect to area and production in Himachal Pradesh. during 1998-99, it was grown on an area of 26.7 thousand hectares and gave a grain production of 27.8 thousand tones with an average yield of 10.41 q/ha as against the national average of 18.5 q/ha. Barley is the crop of marginal lands and those areas where late maturity of wheat does not permit the feasibility of double cropping. That is why it is a main crop in higher elevations under rainfed conditions and in high-hill dry temperate zone. Also, barley has several uses for the hill people, i.e. for food, feed, fodder and local beverages.

Hulless barley is grown in Lahaul and Spiti and Kinnaur districts and Pangni and Bharmour areas of Chamba district, whereas in other districts hulled barley is mostly cultivated.

## Varieties

- (1) **Vimal (HBL-113)** : This is a high yielding variety recommended for low and mid hills of H.P. It is resistant to yellow rust. Its average yield is about 25-30 q/ha
- (2) **Dolma** : It is a 6-rowed hulless, high yielding, semi-dwarf, profuse tillering variety. It has bold, amber, lustrous and semi-hard grains with high protein content. It is moderately resistant to yellow rust, loose smut, drought and frost and is meant for timely sowing. It is recommended both for summer and winter cultivations in mid and high altitude areas. Its average grain yield is 18-20 q/ha and is also recommended for fodder purpose.
- (3) **Sonu (HBL-87)** : This variety is released for sowing in low and mid hill areas (upto 1500 m amsl) under timely or late sown, unirrigated or restricted irrigated conditions. It is about a week early in maturity and possesses bold, light yellow attractive grains. It is moderately resistant to yellow rust and *Helminthosporium* leaf stripe, highly resistant to shattering and lodging.
- (4) **Gopi (HBL-316)** : It is a 6 rowed hulled barley recommended for low and mid hill areas under timely sown rainfed conditions. It has high tillering ability and resistance to yellow and brown rusts under field conditions. It is also fairly resistant to aphids and other insect-pests and to lodging. Its spikes are medium long and awned and grains are medium bold, shining and yellow in colour. It is semi dwarf and medium in maturity with average grain yield of 25-30 q/ha.
- (5) **Harit (HBL-276)** : It is a new 6 rowed hulless, high yielding, profuse tillering, semi-dwarf, superior to Dolma in grain yield & disease resistant variety. Like Dolma, it has bold & amber grains. It is resistant to yellow rust, loose smut, drought & recommended for rainfed conditions in mid & high altitude areas, besides summer cultivation in Zone IV. It has dense spike & more grains per spike than Dolma. Its average grain yield is about 25-30 q/ha.

## Soil

Barley thrives best on well drained loam soil but can be successfully raised even on poor sandy soils. Satisfactory crop of barley can be had under rainfed conditions with meager amount of rainfall. It should not be grown in acidic soils. In acidic soils, lime should be applied one month before sowing as per requirement.

## Preparatory tillage :

Two to three ploughings with desi plough are sufficient for preparing ideal seed bed for barley.

## Time of sowing

Optimum sowing time of barley is from last week of October to first week of November. Though yield declines with delay in sowing but in the event of drought/lack of rains, crop can be sown upto end of December.

## Method of sowing

The crop should be sown by kera in lines 22 cm apart.

## Seed rate

100 kg seed per hectare is optimum. Additional 20 to 25 kg seed should be used under rainfed and late sown conditions.

## Manuring

Nutrients (kg/ha)			Fertilizers					
N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Kg/ha			Kg/bigha		
			Urea or	CAN	Super phosphate	Urea or	CAN	Superphosphate
40	20	-	85	160	125	7	13	10

### Method of application

Apply whole of the phosphorus and half of nitrogen at the time of sowing by pora method and the remaining half nitrogen after 4-5 weeks.

### Water management

This crop suits very well to rainfed conditions of Himachal, hence no specific recommendations for water management practices are there. But it is advisable that there must be enough soil moisture at the time of sowing for seed germination. In the absence of winter rains, one irrigation after 3 to 4 weeks of sowing should be given.

### Weed control

To control grassy weed in barley, spray isoproturon @ 0.75kg/ha and for broad leaved weeds 2,4-D Sodium @ 0.75 kg/ha (Fernoxone or Bathua Powder) at 2-3 leaf stage of weeds should be used in 700-800 litre of water per hectare.

### Harvesting

When the crop attains maturity, it should soon be harvested to avoid shattering. After threshing, the produce should be stored in a well protected place.

### Plant protection

- (i) **Insect-pests:** As for wheat
- (ii) **Diseases:**

Symptom	Control
<b>Yellow rust</b> : Small yellow pustules arranged in stripes are formed on the leaves.	Sow resistant varieties.
<b>Brown rust</b> : Small brown pustules are formed on leaves.	Sow resistant varieties.
<b>Loose smut</b> : The affected plants produce black smutted ears containing loosely held spore mass.	1. Rogue out smutted ears as and when they appear and destroy them. 2. Treat seed with vitavax/ Bavistin @ 2.5 g/kg seed.
<b>Stripe disease</b> : The symptoms are manifested on leaf blades and leaf sheaths in the form of yellow stripes, soon turning brown and resulting in drying up of the leaves.	1. Treat seed with Agrosan GN @ 2.5 g/kg seed. 2. Use disease free seed.
<b>Covered smut</b> : The grains are replaced by black spore masses which do not fall a part as in loose smut but are held together by the ovary wall and the glumes.	Treat seed with Agrosan GN @ 2.5g/kg seed.