Yellow (stripe) and Brown rust (leaf rust):
Yellow rust symptoms include bright yellow-orange spores that form pustules which occur in stripes along the leaves. Pustules of leaf rust are small and circular, producing a mass of orange-brown powdery spores predominantly on the upper leaf surfaces. Later in the season, pustules also develop on leaf sheaths. The pustules easily rub off on a finger. As the crop matures the pustules turn dark and produce black spores embedded in the old plant tissues.

Spot blotch:
The disease spreads as small light brown spindle spots distributed on leaf blade increasing in size along the leaf veins. The spots are irregular and vary from oval to oblong or elliptical. Fully developed lesions become dark brown color and cover entire leaf by merging together.

Control measures:
- The newly released high yielding cultivars coupled with in-built disease resistance are the best option (Table 1).
- Seed treatment with fungicide Vitavax/Thiram @ 2-3 g/kg or Tebuconazole @ 1 g/kg of seed at time of sowing.
- Foliar sprays of Propiconazole (25 EC) @ 0.1% (500 ml in 500 litres of water/ha) at the appearance of rusts and foliar blights and later at 15 days intervals till physiological maturity, if needed.

Pest control
In hills, damage by insect pests to barley crop is not so severe. However, field rats cause heavy loss to barley crop and do considerable damage to the harvested crop lying in stacks in the fields. For rat control fumigate live-burrows with aluminum phosphide @ one tablet of 0.5 g per small burrow, and 3.0 g per large burrow. In case of appearance in the same field, bite with Cuminar (Ratafin) @ 1 kg of prepared bite (1 part Cumin; 19 part wheat or maize flour, 1 part molasses and 1 part mustard oil).

Harvesting, threshing and storage
When moisture content of the grains is about 25-30%, crop should be harvested. After harvesting, it should be sun dried and threshed with a pair of bullock or by using threshers. Harvesting of mature crop should not be delayed, because at that time the occurrence of rain and hailstorms are high. The grain should be dried properly so that moisture content remains between 10-12%. After keeping grains in warehouse, application of EDB @ 3.0 ml/q found to be effective against storage insect pest.

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Barley (Hordeum vulgare L.) is the important cereal crops of northern hills of India comprising the states of Himachal Pradesh and Uttarakhand, particularly in marginal and fragile lands as well as in higher hills. It is the staple food crop in the tribal areas of hills where it is also used in preparation of the local beverages in addition to food and cattle feed. Barley is predominantly grown under rainfed conditions in northern hills using very low inputs by the farmers. During past few years the winters have become warmer in hills and drought is becoming a frequent phenomenon. Therefore, most of the farmers now prefer to grow barley over other crops as it is supposed to be drought tolerant.

Majority of the farmers in this region, popularly use the seeds of own farm saved improved varieties as well as local farmer’s varieties. Their genotypic ability to higher production under low input conditions is very low and they are highly susceptible to many diseases. However, by cultivating improved high yielding disease resistant varieties and adopting recommended package of practices in barley, the productivity level can be increased to 2-3 times from the present level of 11-14 q/ha under rainfed and marginal lands.

Improved package of practices in barley

The recommended improved package of practices and latest high yielding varieties of barley (Table 1) for higher production in northern hills are as follows.

Sowing Time

The time of sowing is an important aspect in successful cultivation of barley. Barley gives best results when sown between 15th October to 10th November. In rainfed areas, sowing should be done in second fortnight of October to utilize the residual soil moisture from monsoon rains.

Seed rate and spacing

Under rainfed conditions 100 kg seed per hectare is required. For normal sown rainfed crop, the spacing of 23 cm between two rows is recommended. Sowing should be done at a depth of 4-5 cm.

Method of Sowing

Barley requires well pulverized clod free soil and it can be achieved by 2-3 rounds of ploughing. To achieve good germination and crop stand, the seed must be sown in moist soil at a suitable depth. Seed drill can be used for sowing the seed at the optimum depth. Deep plough can also be used to open furrows of appropriate depth and seed dropped in the open furrows and covered by planking. The best results are achieved by the use of seed-cum-fertilizer drills.

Manures and fertilizers

Manures and fertilizers both play important roles in the barley cultivation. Combination of organic manures and chemical fertilizers give superior results than the use of chemical fertilizers alone. The application of organic matter to soil improves water holding capacity of the soil besides providing essential nutrients to the plants. Application of farmyard manure (round 10 tonnes/ha) before 15 days of sowing is beneficial.

The quantity of fertilizer to be applied varies according to the fertility status of the soil. In general, the recommended doses are: 40-50-20 kg/ha N-P2O5-K2O (0.8-0.6-0.4 kg/nail N-P2O5-K2O).

Full dose of nitrogen, phosphorous and potash should be placed 8-10 cm deep in furrows at the time of sowing.

Water management

Barley generally is grown as a rainfed crop due its low water requirement. However, there should be enough moisture in the soil for proper germination and good crop stand which ultimately leads to better yield in rainfed areas.

Weed control

It is desirable to control weed through use of good cultural practices. Two manual weeding at 30-35 and 55-60 days after sowing are sufficient to manage the weed population. The chemical methods of weed control are recommended where infestation of weed is very heavy and availability of labors is limited. Post-emergence application of tank mixed herbicides (isoproturon a.i. @ 0.75 kg/ha + 2, 4-D a.i. @ 0.5 kg/ha in 800-1000 liter of water) control both grass and broad leaved weeds are recommended. The post-emergence herbicides should be sprayed 30-35 days after sowing (to ensure sufficient moisture in the soil for better effectiveness of herbicide).

Diseases control

Barley crop suffer from several diseases which reduces its yield. Yellow rust, leaf blight and powdery mildew are the main diseases prevalent in the Northern hills. The symptoms and their suitable control measures are given below.

Table 1. Salient features of improved high yielding and disease resistant/tolerant varieties of barley recommended for northern hill regions

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variety</th>
<th>Year of notification</th>
<th>Recommended area</th>
<th>Nickel</th>
<th>Days to maturity</th>
<th>Potential Yield (q/ha)</th>
<th>Special Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HRL 216</td>
<td>1999</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>170</td>
<td>30.0</td>
<td>Six row hunk less barley with rust resistance, grain uniformity,</td>
</tr>
<tr>
<td>2</td>
<td>HIB 352</td>
<td>2003</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>175</td>
<td>26.0</td>
<td>Mirror, head rust tolerant, grain uniformity</td>
</tr>
<tr>
<td>3</td>
<td>VLB 56</td>
<td>2005</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>153</td>
<td>40.0</td>
<td>Recommended for organic cultivation</td>
</tr>
<tr>
<td>4</td>
<td>VLB 85</td>
<td>2007</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>163</td>
<td>26.3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BHS 300 (Prov. LEBAR)</td>
<td>2010</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>182</td>
<td>29.9 (LOD 79.4 UY)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>UPB 1008</td>
<td>2011</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>161</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VLB 118</td>
<td>2014</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>164</td>
<td>30.0</td>
<td>Six row hunk less barley with resistance to yellow rust</td>
</tr>
<tr>
<td>8</td>
<td>VLB 94</td>
<td>2016</td>
<td>Uttarakhand, HP and J&amp;K</td>
<td>Rainfed Timely sown</td>
<td>164</td>
<td>30.0</td>
<td></td>
</tr>
</tbody>
</table>