STUDIES OF SOIL MOISTURE STRESS IN BARLEY (HORDEUM VULGARE L.)

by N. C. SINHA*, O. N. MEHROTRA and R. K. MATHUR**

Key words
Barley Photosynthesis Protein Respiration Soil moisture stress Water use efficiency

Summary
The objective was to find the optimum range of water contents for inducing better growth, physiological efficiency and yield potential of barley plants (Hordeum vulgare L. var. K18). A pot culture experiment was conducted in the Division of Crop Physiology and Biochemistry Kanpur-2. The plants were subjected to various soil moisture stresses, i.e., 0.15, 0.30, 0.45, 0.60 and 0.75 atm tension throughout the crop growth period measured by irrometers.

Plants maintained at 0.45 soil moisture tension required 19.07 litre of water and had the best water use efficiency (1765 mg dm/litre of water) which favourably influenced the leaf water balance (85.9%), plant growth as measured by plant height (85.4 cm) and tiller production (35.6) per hill, photosynthetic efficiency (2.185 mg CO₂/g dm/h), grain number (722) and grain yield (33.7 g) per hill while plants irrigated at a tension greater than 0.45 SMT did not develop as well. However, protein and gluten percentage increased gradually with the subsequent increase in soil moisture tension. On the other hand respiration rate (2.090 mg CO₂/g dm/hr) and leaf area (4375 cm²) were recorded to be the highest at 0.60 and 0.30 atm SMT respectively.

Thus it is suggested that for reaping high harvest of barley crop, the physiological need of water (19.07 litre) in total of plant life should be made available through scheduled irrigation based on maintenance of plant at 0.45 SMT from seeding to maturity.

Introduction
Barley is mostly grown under unirrigated conditions where other important crops can not be taken. Opinions differ with regard to soil moisture stresses which crops can tolerate without reduction of yields. Thus Adams et al. found that cotton yields were not affected by irrigation treatments even though in one of them the water content was at the permanent wilting percentage in part of the soil. On the other hand, Aspinall et al. reported that grain yield of barley was reduced considerably by moisture stress. Likewise green weight and seed production of clovers was reduced by water deficiency. Excess soil moisture at any stage of crop growth reduced the grain yield. Excessive irrigation also reduced the growth of plants.

* Indian Grassland and Fodder Research Institute, Jhansi-284003, U.P. India.
** C.S. Azad Agricultural University, Kanpur-2, U.P. India.
Experimental methods

The experiment was conducted with barley (*Hordeum vulgare* L. var. K18) during main growing season in cemented pots (28 x 24 cm, depth or height = 35 cm) holding 7.5 kg of farm soil. Fertilizer application at the rate of 1.0 g ammonium sulphate, 0.55 g superphosphate and 0.16 g muriate of potash was given to each pot just before sowing to supply N, P <sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O at 50, 25 and 25 kg/ha respectively. The field capacity, moisture holding capacity and permanent wilting percentage of soils were 20.8, 41.15 and 5.11 respectively. Watering of plants were controlled by irrometers after emergence. The pots were irrigated to bring them back to field capacity (0.1 atm) whenever moisture dropped to 0.15, 0.30, 0.45, 0.60 and 0.75 atm soil moisture tension. The tensiometers were installed at active root zone depth (18.0 cm).

The respiration and photosynthetic rate in leaf, gluten content in barley flour, permanent wilting percentage, field capacity and moisture holding capacity were determined by the respective methods as described by authors. Protein content in grain is determined by multiplying 5.95 with estimated nitrogen.

Results and discussion

The results indicate that soil moisture influences profoundly not only the growth, yield and physiological behaviour of plants, but also the quality of grains. Plant height decreased both under low and high soil moisture. Likewise the leaf area suffered as the soil moisture tension increases (Table 1). Almost similar findings were reported on wheat crops. Although the leaf area was maximum at 0.30 soil moisture tension, the tiller production as well as plant height was maximum at 0.45 SMT showing thereby that even though the high soil moisture was conducive to increased leaf area, it did not result in large tillers or taller plants. It was only so when the moisture balance (85.9%) was optimum under 0.45 SMT but it was reduced when soil moisture was increased or decreased although apparently the reduction was normal.

Table 1. Effect of soil moisture stress on growth and physiological behaviour of barley (*Hordeum vulgare* L. var. K18); 5 replications

<table>
<thead>
<tr>
<th>Treatment (Soil moisture tension)</th>
<th>Growth</th>
<th>Physiological behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant height (cm)</td>
<td>Leaf area per plant (cm²)</td>
</tr>
<tr>
<td>0.15</td>
<td>77.6</td>
<td>4361</td>
</tr>
<tr>
<td>0.30</td>
<td>81.7</td>
<td>4375</td>
</tr>
<tr>
<td>0.45</td>
<td>85.4</td>
<td>4215</td>
</tr>
<tr>
<td>0.60</td>
<td>57.0</td>
<td>2728</td>
</tr>
<tr>
<td>0.75</td>
<td>37.5</td>
<td>2026</td>
</tr>
</tbody>
</table>

C. D. at 5% *P* 11.6 29.3 15.1 – – –

– = Not analyzed.