Variability of solar, net and photosynthetically active radiations in wheat (*Triticum aestivum* L.) canopy

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Radiation umbrella atop the crop canopy and the spatial and temporal variability of radiation within the canopy constitute a crop’s basic resource environment. Baldocchi et al. (1985) concluded that in soyabean leaf width did not affect the above-canopy radiation balance but the net radiation profile was greatly modified within the canopy. At maximum leaf area index (LAI = 5.83), wheat crop intercepted about 91 to 94 per cent of the photosynthetically active radiation (PAR) (Chahal et al., 1994). At high LAI, the per cent interception was large and independent of quality of incident radiation. (Hipps et al., 1983). Prasad and Sastri (1994) stated that interception of PAR was maximum (78 to 90 per cent) towards the end of the tillering stage of the wheat crop. The objective of this study was to assess the variability of solar, net and photosynthetically active radiations within wheat crop canopy.

A field experiment with wheat (*Triticum aestivum* L.) variety UP 2338 was conducted in partharchhata sandy loam soil at Pantnagar. The crop was sown on 18th November, 1998 in an east-west direction, well fertilized and irrigated. Solar radiation was measured by Kipp and Zonen thermopile pyranometer at 0.175 and 1.25m height from the soil surface in the experiment field from the late jointing stage. The net radiation (Rn) was measured at hourly intervals at canopy level and at 50 per cent of crop height using net radiometer with integrator. The PAR was measured at 0.12m from the soil surface, middle and top of the crop canopy using silicon sensor of the steady state porometer. Measurements were made at hourly intervals throughout the observation day. Interception of PAR (IPAR) was calculated as

\[
IPAR = \frac{(PAR)_{tc} \cdot (PAR)_{h}}{(PAR)_{tc}} \times 100
\]

\[
(PAR)_{tc} = PAR \text{ at top of the canopy.}
\]

\[
(PAR)_{h} = PAR \text{ at desired height of the canopy.}
\]

Leaf area index (LAI) and plant height were measured on all observation days.

Solar radiation receipts beneath the wheat canopy depended on LAI, canopy density, plant height and on the nature of the observation day. The ratios of transmitted radiation (Rt) to radiation incident on canopy showed proportionately low values during 90-119 days after sowing (DAS) (Table 1). This period represented maximum foliage density of the crop (maximum LAI = 6.3). Net radiation (Rn) was higher at post anthesis stage than that during the vegetative phase.

The relationship between the ratio of total net radiation (daily sum of hourly values of net radiation) at mid canopy and at the top of

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PAR VARIATION IN WHEAT

Fig. 1: The ratio of net radiations ($R_o$) at mid canopy level to that at top canopy as a function of leaf area index (LAI).

Fig. 2: PAR interception (%) at different canopy layers in wheat.

Table 1: Ratio of transmitted ($R_t$), net ($R_n$) and PAR with radiation incident ($R_s$) on wheat canopy.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>66</th>
<th>73</th>
<th>80</th>
<th>90</th>
<th>99</th>
<th>108</th>
<th>111</th>
<th>119</th>
<th>126</th>
<th>128</th>
<th>134</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_t/R_s$</td>
<td>-</td>
<td>-</td>
<td>0.35</td>
<td>0.24</td>
<td>0.28</td>
<td>0.21</td>
<td>0.19</td>
<td>0.19</td>
<td>0.23</td>
<td>0.25</td>
<td>0.30</td>
</tr>
<tr>
<td>$R_n/R_s$</td>
<td>0.75</td>
<td>0.73</td>
<td>0.59</td>
<td>0.72</td>
<td>0.71</td>
<td>0.70</td>
<td>0.73</td>
<td>0.80</td>
<td>0.84</td>
<td>0.83</td>
<td>0.81</td>
</tr>
<tr>
<td>PAR/R_s</td>
<td>0.57</td>
<td>0.59</td>
<td>0.56</td>
<td>0.56</td>
<td>0.53</td>
<td>0.53</td>
<td>0.52</td>
<td>0.51</td>
<td>0.50</td>
<td>-</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Canopy level and LAI showed that ratio decreased up to maximum LAI (6.3) and then increased until maturation of the crop (Fig. 1). The proportion of $R_n$ at mid canopy decreased as LAI increased. Thus higher LAI increased greater attenuation of $R_n$ at mid canopy.

The percent interception of PAR calculated over entire canopy column from top of the canopy down to 0.12m above the soil surface was associated with plant height and LAI. At maximum LAI (Figs. 1 & 2), near the milking stage, the interception was 97.5 per cent. As LAI increased from 4.0 at late jointing to 6.3 at milking stage, PAR interception increased at the upper half and top level of the canopy.
REFERENCES


ERRATA

(Volume 2, Number 2, December 2000)

Page No. 107: Fig. 1: Iso-erodent map of Madhya Pradesh on annual basis. The correct figure is given below.

Page No. 113: Read the title as "Use of CERES-Wheat model for predicting wheat yields of Nainital district (U.P.), India" instead of "Use of CERES-Wheat model for predicting wheat yields of Nainital district (U.P.), India"

Page No. 115: Table 1: Read "1 °C" instead of "10 °C" in the description of genetic parameter P5.

Page No. 116: Description in equation 2 and text (line 24), Read "when year ≤ 1987" instead of "when year = 1987".

Page No. 117: In text (line 12), Read "YDSIM" instead of " DSIM"
Page No. 118: Fig. 1: Read the legend as "*Consistent yield series of Nainital district*" instead of "*Consistent yield series of Nainital Districted*".

Fig. 4: Read the legend as "Comparison between observed and predicted yields. Yields from 1980 to 1994 are fitted, while yields from 1995 to 1998 are predicted" instead of "Relationship between observed yield deviations (YDOBS) from trend and simulated yield deviations (YDSIM) from trend".