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Short Communication

Effect of showing time on radiation use efficiency of wheat cultivars

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Radiation use efficiency is the dry matter production per unit of photosynthetically active radiation intercepted by the crop. Dhingra *et al.* (1986) observed that higher yields in North-south row wheat crop were associated with greater light interception. Ram Niwas *et al.* (1997) reported maximum radiation use efficiency during different growth stages of three pearlmillet cultivars. Rosenthal and Gerik (1991)studied radiation use efficiency among cotton cultivars. The present investigation was under taken to study the effect of different sowing time on radiation use efficiency of wheat cultivars.

A field experiment was conducted at the Research farm of CCS Haryana Agricultural University, Hisar during the winter season of 1998-99, (29°-10'N, 75°-46'E, 215.2m above msl). Wheat varieties V_1 (WH 542), V_2 (PBW 343), V_3 (UP 2338), V_4 (Raj 3765) and V_5 (Sonak) were raised using three sowing dates i.e. 25th November, 10th and 25th December 1998 in a randomized block design following recommended agronomic practices for wheat crop. Observations on phenological stages viz : tillering, jointing, flag leaf, anthesis, milking, hard dough and maturity were made.

Photosynthetically active radiation (PAR) was measured at 15-day interval with a line quantum sensor (LI-191B) from 30 days after sowing during 1130-1300hrs IST. PAR was measured at the ground level by keeping the sensor along and across the rows and on the top of the crop canopy. The reflected PAR was measured by inverting the sensor over the crop canopy. Plants of one meter row length were uprooted from each plot and leaves were separated for leaf area measurement with a leaf area meter (LICOR). Plant samples were dried in oven and weighed to determine the dry matter produced (g m^2).

Extinction coefficient (k) was calculated using the Bouguer-Lambert-Beer's law.

$$I = Io \exp(-kLAI),$$

$$k = \ln (I/Io)/ LAI$$

Where k = Extinction coefficient; Io=Solar radiation at the top of the canopy; I = Solar radiation at the bottom of the canopy; ln = Log with base e.

Daily solar radiation (Rs) was calculated by using the formula :

$$Rs = RA (1-r) (a+bn/N)$$

Where, RA = Solar constant, r = albedo; a, b = constant (a=0.32, b=0.46);

n,N= actual and maximum possible sunshine hours

Table 1 : Radiation use efficiency (RUE GMJ^{-1}) of wheat genotypes under different sowing dates.

Treatment	Phonological stages							
	Tillering	Jointing	Flag leaf	Anthesis	Milking	Hard dough	Maturity	Mean
D_1	1.32	1.74	2.85	2.42	2.25	2.03	2.33	2.13±0.082
D_2	1.30	1.70	2.75	2.39	2.13	1.97	2.26	2.07±0.078
D_3	1.24	1.59	2.64	2.35	1.99	1.81	2.19	1.97±0.068
V_1	1.26	1.71	2.74	2.40	2.13	1.94	2.30	2.06±0.066
V_2	1.41	1.73	2.80	2.45	2.14	1.98	2.33	2.12±0.069
V_3	1.31	1.69	2.73	2.40	2.13	1.95	2.29	2.07±0.068
V_4	1.24	1.67	2.70	2.39	2.12	1.93	2.28	2.04±0.056
V_5	1.24	1.67	2.69	2.29	2.11	1.92	2.11	2.00±0.050

Table 2 : Growth parameters and yield of wheat cultivars in three sowings.

Treatments	Final Dry matter (q ha^{-1})	Leaf area index (Max.)	Yield (q ha^{-1})
D_1	105.95	4.04	45.34
D_2	103.58	3.86	43.26
D_3	84.33	3.28	34.75
CD at 5%	1.96	0.20	1.28
V_1	97.80	3.83	41.10
V_2	104.58	4.06	43.40
V_3	101.27	3.86	42.50
V_4	97.57	3.70	40.89
V_5	88.55	3.16	37.71
CD at 5%	2.54	0.26	1.65

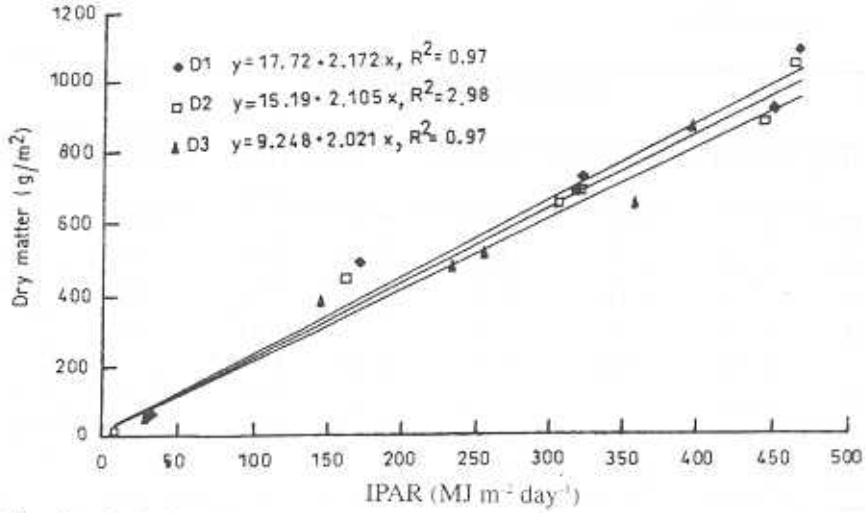

Fig. 1: Relationship between dry matter of wheat and intercepted photosynthetically active radiation (IPAR) under different sowing dates

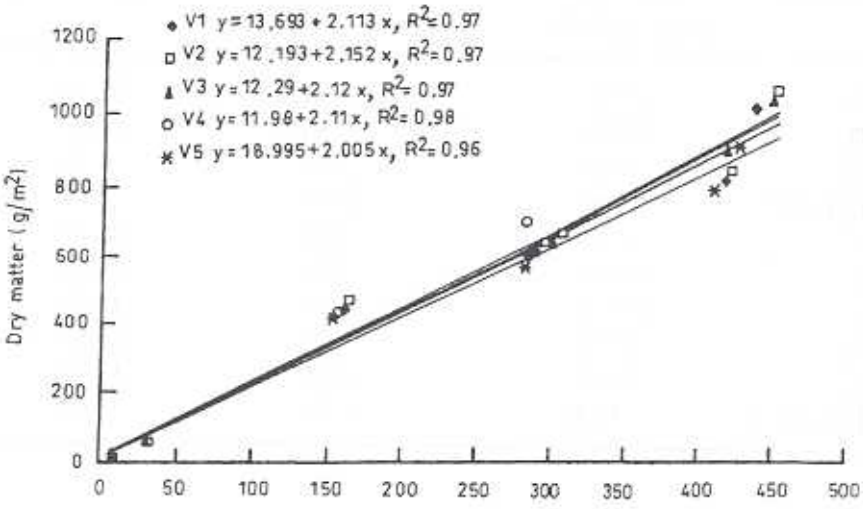

Fig. 2 : Relationship between dry matter of wheat cultivars and intercepted photosynthetically active radiation (IPAR) under different wheat cultivars

The incoming PAR was then calculated by multiplying Rs with 0.45 (Rosenthal and Gerik, 1991). Daily radiation intercepted by the canopy was determined from the computed extinction coefficient, incoming and reflected PAR and interpolated leaf area index estimated between radiation measurements :

$$IPAR = (1-e^{-KLAI}) PAR$$

Where,

IPAR = cumulative intercepted photosynethtically active radiation(MJm^{-2})

Radiation use efficiency (RUE) was computed at various phenophases using the formula :

$$RUE = \frac{DM\ (gm^{-2})}{IPAR\ (MJm^{-2})}$$

where DM = Total dry matter (gm^{-2});

Radiation use efficiency varied significantly among dates of sowing, increased with crop growth and attained maximum(Table 1) at flag leaf stage in all the treatments. It decreased upto hard dough stage and increased at maturity. This decline in RUE might be due to less PAR interception by the crop because of less LAI during this period. The seasonal mean RUE was maximum in D_1 ($2.13 gMJ^{-1}$) and decreased with delay in sowing. Among the cultivars, RUE was the highest in cv.PBW 343, followed by cultivars UP 2338, WH 542, Raj 3765 and Sonak. Dry matter production, leaf area index and yield (Table 2) were found to be maximum in (D_1) the 25 November sown crop and minimum in (D_3). Among the cultivars, dry matter, leaf area index and yield were the highest in V_2 (PBW 343) i.e. 104.58 (q ha^{-1}), 4.06, 43.40 (q ha^{-1}) respectively followed by V_3, V_1, V_4 and V_5.

A linear relationship was observed between dry matter and IPAR (Fig.1&2) in all the treatments. R^2 values varied from 0.96 to 0.98 which are significant at $P \leq 0.01$. Slope value of the regression line shows that wheat crop sown on 25th November is highly efficient is radiation utilization. Slope values also show that PBW 343 was more efficient in radiation utilization in comparison with other cultivars.

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