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Short Communication

Radiation use efficiency of mustard as influenced by sowing dates, plant spacing and cultivars

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Radiation use efficiency (RUE) can be expressed in terms of above ground dry matter production per unit of photosynthetically active radiation absorbed by the crop. Practices, such as cultivar and row spacing affect RUE (Foale et al, 1984; Rosenthal Gerik, 1991). Crops sown on different dates are exposed to different solar elevation during the season and this may influence RUE through its effects on radiation transmission coefficients. In the present research study RUE for three mustard cultivars sown on three sowing dates is reported.

The study was carried out at Agrometeorology Research Farm area of CCS Haryana Agricultural University Hisar (Lat. 20° 10'N, Long. 75° 46'E) during *rabi* season 1992-93 on slightly alkaline soil. The experiment was planned in split plot design with six combinations of three dates of sowing (20th October, 10th November and 30th November) and two plant spacings (30 cm x 15 cm and 40 cm x 20 cm) in main plot and three varieties (RH 30, Luxmi and Varuna) in sub plots and replicated thrice. All recommended partices for the crop were adopted. Photosynthetically active radiation (PAR) was measured with the help of line quantum senor at 5, 50, and 150 cm in the canopy and at the top of the crop in all the treatments. Reflected PAR was measured by inverting the sensor over the canopy. Observations were taken at 15 days interval after 25 days of sowing during 1200 to 1300 hrs IST. The plants were uprooted from 1 m^2 area and leaves were separated for leaf area index (LAI) measurement. The uprooted plants were dried in oven till constant weight for determination of dry matter m^{-2}.

Extinction coefficient (K) for each cultivar was calculated from transmitted (T) and incomming PAR (I) data by using the equation

$$K = -\ln(T/I)/LAI$$

Daily solar radiation data were collected at agromet observatory 200m away from the experimental field. The interpolated leaf area data were used with the daily solar radiation data (SR, MJ m^{-2}) to estimate daily-absorbed photosynthetically active radiation (APAR) by the formula

APAR=0.45 Rs (1-R-T+RT) (Rosenthal *et al*, 1993)

Where
Rs is radiation at top of the crop
R is reflected solar radiation
I is incoming solar radiation
T is transmitted solar radiation

Absorbed PAR was accumulated daily from 25 days period and regressed against the total above ground dry matter (DM) to

calculate radiation use efficiency (RUE) for each cultivar, sowing date and plant spacing.

$$RUE = \frac{\text{Cumulative dry matter (g) between two intervals}}{\text{Cumulative absorbed photo-synthetically active radiation}}$$

RUE was the highest from sowing to harvesting in the 20th October sowing (Table 1) and decreased with successive sowings viz. 10th November and 30th November. However, dates of sowing did not seem to have influenced RUE significantly from

Table 1: Radiation use efficiency (g MJ^{-1}) of mustard cultivars under three sowing dates and two plant densities.

Treatment	25 DAS	40 DAS	55 DAS	70 DAS	85 DAS	100 DAS	115 DAS	Harvest
Oct.20	0.04	0.30	0.61	0.93	1.19	1.44	1.83	1.64
Nov. 10	0.03	0.26	0.61	0.82	1.05	1.37	1.56	1.49
Nov. 30	0.03	0.22	0.43	0.62	1.03	1.17	1.30	1.09
CD(0.05)	NS	NS	0.16	NS	NS	NS	0.004	0.05
30cmx15cm	0.04	0.31	0.57	0.85	1.15	1.39	1.59	1.62
40cmx20cm	0.03	0.21	0.51	0.75	1.03	1.26	1.52	1.20
CD (0.05)	NS	NS	NS	NS	NS	NS	0.003	0.05
RH 30	0.04	0.27	0.61	0.87	1.11	1.36	1.57	1.52
Luxmi	0.03	0.25	0.48	0.74	1.06	1.29	1.54	1.35
Varuna	0.03	0.25	0.58	0.77	1.09	1.32	1.56	1.36
CD (0.05)	NS	NS	0.06	NS	NS	NS	0.004	0.05

Table 2 : Maximum leaf area index (LAI), plant height (cm), dry matter (g m^{-2}) and seed yield (kg ha^{-1}) in mustard crop.

Treatment	LAI	Plant height (cm)	DM (g m^{-2})	Seed yield (kg ha^{-1})
Oct. 20	2.5	185	1438.2	2049.7
Nov. 10	2.1	180	1135.2	1437.3
Nov. 30	1.8	145	884.0	915.0
CD (0.05)	0.4	10.1	235.4	218.0
30cm x 15 cm	2.4	172	1280.2	1431.0
40 cm x 20 cm	1.9	172	1100.2	1453.4
CD (0.05)	0.4	NS	106.4	NS
RH 30	2.5	165	1209.7	1510.0
Luxmi	1.8	177	1199.2	1420.4
Varuna	2.1	167	1200.2	1471.7
CD (0.05)	0.4	6.2	8.9	NS

sowing to 40, 70, or 100 days after sowing (DAS). RUE was the highest at 115 DAS than at harvest.

Brassica crop sown on 20th October showed higher growth parameters (LAI, plant height and dry matter) and yield in comparison with other time sown crops (Table 2). Plant spacing also influenced growth parameters and yield of mustard crop however, the influence on yield and plant height was not significant. Brassica cultivars also differed significantly in respect of growth parameters, while in case of yield the difference was not statistically significant.

Decrease in leaf area index (LAI) resulted in decline in radiation interception. The higher interception of radiation by the crop canopy compared to that of 10th and 30th November sown crop. The effect of plant spacing on RUE was not significant up 100 DAS. However, the variations in RUE were significant during later stages. The crop with 30cm x 15cm spacing produced significantly more RUE than the 40cm x 20cm spacing treatment. The varieties did not differ in their RUE except at 55 DAS and later at maturity phase. Variety RH 30 attained higher RUE followed by Varuna and Luxmi.

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