Journal of Agrometeorology 8(2) : 197 - 200 (Dec. 2006)

PAR distribution and light use efficiency in capsicum (*Capsicum frutescens* L.) crop canopy

G. S. BRAR, M.C. VARSHNEYA[1], R.N. SABALE and S.S. SALUNKE
Dept. of Agril. Meteorology, College of Agriculture, Pune-411005.
[1] Anand Agriculture University, Anand-388 110 (Gujarat)

ABSTRACT

An experiment was conducted to study the photosynthetically active radiation (PAR) distribution and light use efficiency (LUE) in capsicum crop canopy for three different irrigation treatments and two sub treatments of shade and unshade in polyhouse and open conditions. Maximum PAR interception was from the end of vegetative growth stage reaching a peak between fruit development and picking stage. Albedo value was higher (11%) under shaded than open conditions. LUE was maximum, 28.52 g MJ^{-1} in green weight and 11.52 g MJ^{-1} in dry weight, under shaded treatment with two-liter water per plant per day, and is recommended for Pune region.

Key words : PAR, LUE, absorptivity , transmitted PAR, albedo.

The ultimate capacity of a plant to produce dry mater depends on degree of exposure to sunlight. Thus, a study of light interception and light use efficiency in crop canopy assumes great significance. Taking into consideration, the importance of production of Capsicum, experiment was undertaken with the objective of understanding the distribution pattern of PAR in capsicum crop canopy and to study its interception and light use efficiency. Effect of irrigation and different light levels on transpiration are reported by Brar *et al.* (2006) in this issue of the journal.

MATERIALS AND METHOD

The experimental details are presented in paper by Brar *et al.*(2006).

Absorbed radiation was calculated with the help of the formula,

Absorbed radiation = Incident radiation - (transmitted + reflected) radiation

All the components of PAR are expressed as percentage of incident radiation. cumulative absorbed PAR was calculated by summing up the daily total absorbed PAR; With this vegetative plant growth was used to compute the light use efficiency of a plant.

$$L.U.E = \frac{\text{Dry matter produce}}{\text{Cumulative light absorbed}}$$

Radiation was recorded in terms of $\mu mol m^{-2} s^{-1}$. But for estimation of LUE,

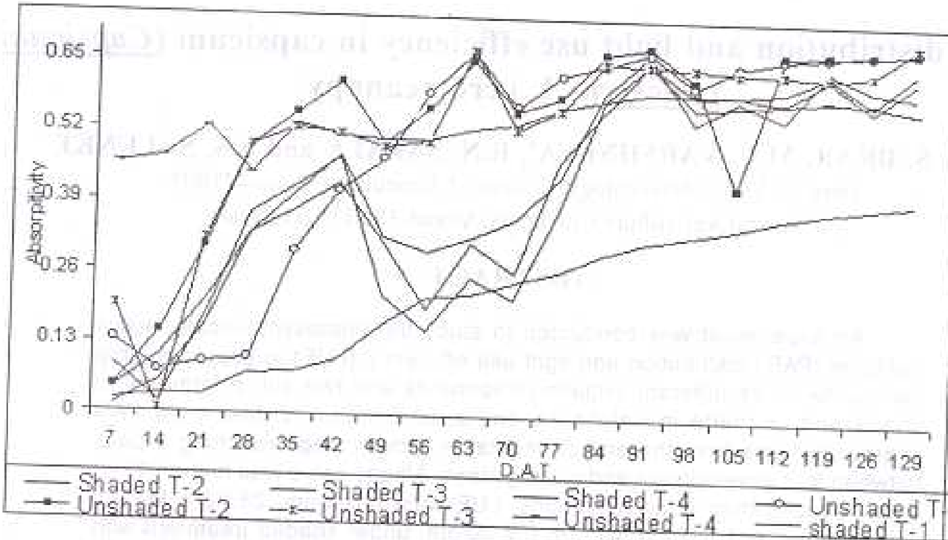

Fig.1 : Average absorptivity under different treatments.

Table 1 : Weekly mean incident radiation (μmol m^{-2} s^{-1}) under different irrigation and light levels.

Treatments	Shaded (S1)	Open (S2)
T_1	1190.6	4123.2
T_2	1192.3	4140.1
T_3	1206.8	4220.7
Mean	1196.6	4161.3
T_4	1339.0	5595.6

cumulated absorbed radiation was first estimated with the help of above equation and then converted from $\mu molm^{-2}s^{-1}$ to MJ m^{-2} by multiplication of factor 0.0188.

RESULTS AND DISCUSSION

Weekly / Seasonal variation in PAR

Weekly average incident radiation ranged between 1190.67 and 5595.6 $\mu molm^{-2}s^{-1}$, which was recorded in main treatments of irrigation and sub treatments of shaded and unshaded throughout the growth period of capsicum (Table I).

Incident radiation at noon was 76% higher than that under shade with 1339.04 $\mu molm^{-2}s^{-1}$ being recorded in control treatment. Incident radiation without shade under polyhouse (4161.36 $\mu molm^{-2}s^{-1}$) was 26% less than outside radiation. Results show that shade net reduced the incident radiation by 76%, UV treated 100 m polythene film reduces radiation by 26% and shade net inside polyhouse reduces the radiation by 79%.

Seasonal variation in the PAR interception (absorpitivity) was studied at total canopy level of the capsicum crop. Lower values of PAR interception (absorpitivity) were observed upto first 21 DAT in all treatments (except in open

Table 2 : Absorptivity (percentage) in Capsicum under different irrigation and light levels.

	Polyhouse						Control	
	T1		T2		T3		T4	
	S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2
Max	65	68	65	68	67	69	41	60
Min	1.6	7.7	2.3	2.9	4.6	0.8	2.6	44.1

Table 3: Effect of light use efficiency (g MJ^{-1}) under different irrigation and

Treatment		Absorbed radiation($MJ\ m^{-2}$ growth period)	Biomass (economic yield + green weight) g m^{-2}	Light use efficiency (g MJ^{-1})	Biomass (economic yield + dry weight) g m^{-2}	Light use efficiency (g MJ^{-1})
T-1	S-1	163.19	2656	16.27	1264	7.74
	S-2	643.55	1639	2.54	412	0.63
T-2	S-1	166.06	3237	19.49	1464	8.81
	S-2	753.04	1846	2.45	698	0.92
T-3	S-1	174.73	4984	28.52	2014	11.52
	S-2	731.05	2620	3.58	967	1.32
T-4	S-1	188.97	1634.5	8.64	635	3.35
	S-2	1114.92	684	0.61	234	0.20

condition) due to less vegetative growth. The PAR absorpitivity for whole canopy showed a rapid increase from the end of vegetative growth stage (77 DAT) reaching a peak between fruit development and picking stage (91 DAT).

It was also noticed that absorptivity under open conditions was more than shaded conditions. Main treatment of irrigation at 2-liter water per plant per day under both shaded and open conditions had the highest absorptivity (Table 2).

Light use efficiency

Green weight light use of efficiency in open conditions was maximum 3.58 g MJ^{-1} in T3 and minimum 0.61 in T4 treatments (Table 3). Green weight LUE in shaded treatments was maximum 28.52 g MJ^{-1} in T3 and minimum 8.64 g MJ^{-1}in T4 treatments. Dry weight light use efficiency in unshaded conditions was maximum 1.32 g MJ^{-1} in and minimum 0.20 g MJ^{-1} in T4 treatments. Dry weight light use efficiency under shaded conditions was maximum 11.52 g $MJ^{-1}$and minimum 3.35 g MJ^{-1} in T4 treatments.

Green weight light use efficiency, was the highest in 2 litre water per plant per day under shaded conditions. These results are in agreement with those of Tollenar and Bruulsema (1988). LUE values observed in this experiment are in close agreement with those reported by (Kinery *et al.*, 1988) who obtained mean values for five crops viz., maize, sorghum, wheat, sunflower and rice respectively. Further Kene (2003) reported the similar result in capsicum in summer season.

REFERENCES

Brar, G. S., Sabale, R. N., Varshneya, M. C., Salunke, S. S. and Hazari, A. K. 2006. Influence of irrigation and light levels onleaf temperature and transpiration in capsicum under polyhouse. *J. Agrometeorol.* 8(2) : 192-196.

Kene, S. N. 2003. Effect of irrigation and light levels on growth and development of capsicum (*capsicum frutescens* L.) under polyhouse condition in summer season. A thesis submitted to M.P.K.V., Rahuri for award of M. Sc. (Agri.)

Kinery, J. R., Jones, C. A., O'Toole, J. C., Blanchet, R., Cabelguene, M. and Spanel, D. A. 1988. Radiation use efficiency in biomass accumulation prior to grain filling for grain crop species. *Field Crop Res.*, 20 : 51-54.

Sivkumar, M. V. K. and Virmani S. M. 1984. Crop productivity in relation to interception of photosynthetically active radiation. *Agric. For. Met.* 31 : 131-141.

Tollenaar, M. and Bruulsema, T. W. 1988. Efficiency of maize dry matter production during periods of completert leaf area expansion. *Agron. J.*, 80 : 580-585.