Journal of Agrometeorology 8(2) : 192 - 196 (Dec. 2006)

Influence of irrigation and light levels on transpiration in capsicum under polyhouse

G. S. BRAR, M.C. VARSHNEYA[1], R.N. SABALE, S.S. SALUNKE and A.K. HAZARI

Dept. of Agril. Meteorology, College of Agriculture, Pune-411005.
[1] A.A.U., Anand-388110.

ABSTRACT

A field experiment, to study the weekly pattern of leaf temperature and transpiration in capsicum under three levels of irrigation and two levels of light in open and polyhouse conditions, was conducted at College of Agriculture, Pune, during 2002-03. It was observed that transpiration increased with increase in air temperature and water availability. Under polyhouse conditions, (i) there was more transpiration than in open conditions. (ii) under unshaded conditions transpiration was less than that in shaded conditions.

Key words : Leaf temperature, transpiration, irrigation levels, light levels, polyhouse.

The Portuguese introduced capsicum, a native of Brazil, in India in the 16th century. Sweet pepper is generally regarded as *Capsicum frutescens* L. The climatic parameters should be optimum to obtain higher yield. In Maharashtra, most of land lies in semi-arid tropics. The bell pepper fruits obtain good returns all the year round. Due to this, a monoculture of the crop is being adopted in some pockets of the Maharashtra state. Even slight variation in microclimatic conditions at a critical stage of the crop growth can lead to significant differences in plant growth and fruit set which consequently results in uneconomic returns. Leaf temperature and transpiration increases rapidly with increase in solar radiation to some limiting value as the day advances and decreases thereafter. The leaf temperature and transpiration patterns are different under rainfed and irrigated conditions (Tanner, 1963). However, the research work on the capsicum is very limited in our country. Taking into consideration, the importance of hi-tech production of Capsicum, a trial was conducted with the objective of understanding and studying the influence of light and moisture levels on leaf temperature and transpiration in capsicum crop canopy.

MATERIAL AND METHODS

The experiment was conducted during September, 2002 to February, 2003 in Polyhouse of center of Advanced Studies in Agricultural Meteorology (CASAM), located at Modibaug, Horticulture section, College of Agriculture, Pune. Which is

situated at an elevation of 559 m a MSL at 18° 31' N latitude and 73° 57' E longitude, with an average annual rainfall of 677.9 mm. In polyhouse, raised seedbeds of size 3 x 1m and 25 cm height were prepared. The experimental layout consisted of 24 plots with gross plot size 3.0x1.0 m^2 and net plot size 2.25x0.90 m^2 laid in split plot design. Treatments under study were four irrigation treatment T_1, T_2 and T_3 (1.0,1.5, 2.0 l water applied per plant per day and T_4 (1.5l under controlled condition), respectively in main plot with two sub plot treatment of shade (S_1) and open (S_2). Locally recommended level of 1.5 liter water/ plant/day was taken as reference.

The seeds of cv. Bomby were sown in nursery on the raised bed with 10 cm distance between two successive rows. Transplanting of 40 days old healthy seedlings was done on 14th October, 2002 at the spacing of 45 x 45 cm on raised beds. Placement of plants was zigzag. Each replication was having twenty plants in Split Plot Design with three replications and three irrigation and two shade treatments. Various interculture operations viz. weeding, earthing up, staking were done from time to time. Fertilizers and plant protection measures were carried out as per the recommendations for protected cultivation.

The LI-COR Steady state porometer (LI-1600) a portable instrument was used for measurement of the leaf transpiration and temperature in situ. The measurement of leaf temperature and transpiration was started 2 days after transplanting (DAT) and continued during the crop growth period. The observations were recorded at local noontime. Two plants were selected in each replication to record the data on defined characters. Average leaf transpiration per plant was recorded at 7 day intervals from transplanting until the last harvest.

RESULTS AND DISCUSSION

During the cropping season various weather elements were recorded in open conditions. Maximum weekly mean temperature ranged between 28.3 °C (1 MW) and 34.2 °C (41 MW) and minimum weekly mean temperature ranged between 10.1 °C (3 MW) and 20.6 °C (42 MW). Weekly mean RH-I ranged from 78 per cent (7 MW to 95 per cent (50 & 51 MW)) and Weekly mean RH-II ranged from 21 per cent (8 MW) to 50 per cent (41 MW). Weekly mean Bright sunshine hours were minimum 5.8 during 42 MW and maximum 10.1 during 44 MW.

The data on weekly pattern of transpiration ($\mu g\ m^{-2}\ s^{-1}$) and leaf temperature (°C) under irrigation and shaded treatments is graphically depicted in Fig.1 and 2 respectively. As the light intensity increases with the advancement of day, attaining a peak at noon, there was heating of air as well as the crop canopy which resulted in higher leaf temperatures causing transpiration to increase. Therefore, the net result was to increase the transpiration rate for keeping canopy cool within a reasonable limit. Palla *et al.* (1967) observed that the leaf temperature was positively correlated with light intensity.

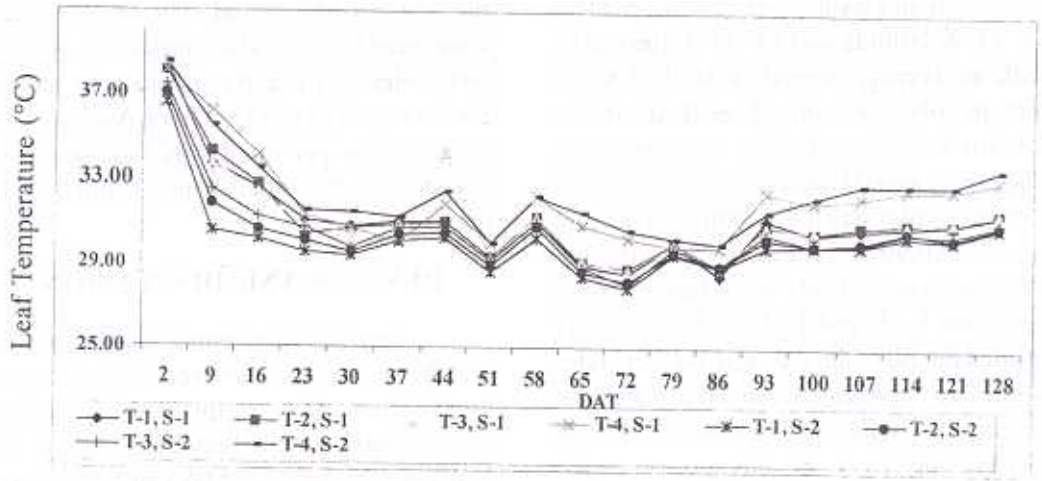

Fig. 1 : Average leaf temperatures under different irrigation and light levels

Leaf temperature

There was not much difference in leaf temperature among the main irrigation treatments and sub treatments of light intensity. Generally, leaf temperatures decreased continuously upto 72 DAT and then increased upto 128 DAT in all treatments. After 100 DAT there was increase in the leaf temperature upto 128 DAT as seasonal air temperature raised from 28.7 to 34.1 °C.

Highest leaf temperature was observed at 2 DAT in all treatments. It ranged from 38.1 to 38.5°C for shaded plants and 36.5 to 38.5°C for unshaded plants. Lowest leaf temperature was observed between 72 and 86 DAT.

Leaf temperature outside polyhouse, T-4 treatment under shaded (S1) and unshaded (S2) conditions, was higher than that inside polyhouse. Under different light treatments, it was observed that T-1 (unshaded conditions with 1 litre water per plant per day inside polyhouse) treatment showed the lowest leaf temperature. Overall, T-4 (unshaded conditions with 1.5 litre water per plant per day in controlled conditions) treatment showed the highest leaf temperature. Leaf temperature under shaded treatments was more than unshaded treatments.

Leaf transpiration

The data recorded on transpiration is illustrated in Fig 2. Leaf transpiration varies with air temperature as well as availability of water to plants. The higher is the air temperature and available water, more was the transpiration.

There was a sharp increase in the transpiration at 9, 51, 86 and 107 DAT. As

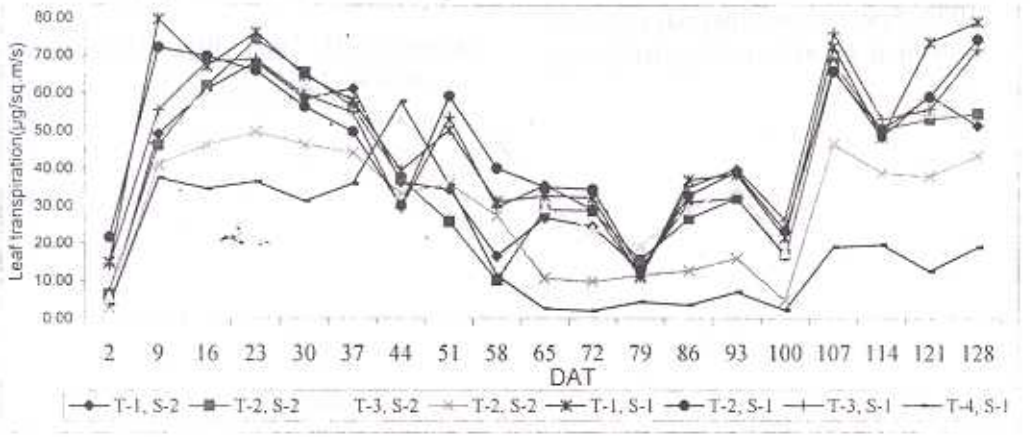

Fig 2 : Leaf transpiration under different irrigation and light levels

weekly mean air temperature incereased, leaf transpiration also increasesed. At 128 DAT mean air temp. was 33.4 °C. Upto 23 DAT there was more transpiration because of rapid vegetative growth of plant and then at 100 DAT transpiratlon increased because of fruiting stage of crop.

Under different light treatments, inside polyhouse, except upto 9 DAT and at 86 DAT, leaf transpiration was directly proportional to average air temperature. Outside the polyhouse upto 9 DAT leaf transpiration increased with increase in mean air temperature. T-4 (shaded conditions with 1.5 litre irrigation outside polyhouse) treatment had the lowest leaf transpiration. Highest transpiration was recorded in T-3 (unshaded conditions, with 2.0 litre irrigation inside polyhouse) treatment. Singh *et al.*, 1990 made similar observations for stressed than well-irrigated crops. T-4 (unshaded conditions with 1.5 litre irrigation outside polyhouse) treatment showed the lowest transpiration. For leaf transpiration, in comparing the polyhouse and open conditions, it was observed that outside the polyhouse leaf transpiration was less than that inside the polyhouse. Under different irrigation treatments, with increase in irrigation levels leaf transpiration also increased. The transpiration under irrigation remained high and kept canopy cool (Carter and Sheaffer, 1983).

REFERENCES

Carter, P. R. and Sheaffer, C. C. 1983. Alfalfa response to soil water deficits II. Plant water potential, leaf conductance and canopy temperature relationship. *Crop Sci.*, 23 : 476-480.

Palla, J. E., Michel, J. B. E. and Harris, P. G. 1967. Photosynthesis, transpiration, leaf temperature and stomatal activity of cotton plants under varying water potentials. *Pl. physiol.*, 42 : 214-219.

Singh, C. B., Singh, G. and Khera, K. L. 1990. Spectral and thermal response of wheat as affected by irrigation regimes. *Ann. Bot.*, 6(1) : 41-47.

Tanner, C. B. 1963. Plant temperatures. *Agron. J.*, 55: 210-211.