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RESEARCH PAPER

Estimation of irrigation water requirement of strawberry crop under polyhouse and shadenet house conditions

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Abstract : Strawberry is a commercial crop with high added value, which was extended to new cultivation zones of India.Therefore, it is important to know the suitability of climate condition for growing strawberry in Indian condition. Protected cultivation structures are used to cultivate crops under partial controlled climatic condition to get higher yield and better quality harvest. There are different kinds of protected cultivation structure normally adopted in India such as greenhouse, shadenet house and low tunnels. Exact of amount water and nutrients required to applied to get higher yield through minimizing loss of quality. The objective of the study is to assess the effect of protected cultivation structure on ambient temperature, relative humidity and crop water requirement of strawberry with drip irrigation system grown during winter season (November-February). Reference evapotranspiration was calculated using the FAO-56 Penman-Monteith equation considering the locally recorded weather parameters. Monthly average of daily reference evapotranspiration values are ranging between 1.3 to 3.3 mm day^{-1}, 1.4 to 3.7 mm day^{-1} and 2.0 to 4.9 mm day^{-1} for polyhouse, shadenet house and open field, respectively. The total water requirement of drip irrigated straw berry in protected cultivation structure is reduced by about 35.2 % under polyhouse and 25.5 % under shade net house in comparison to open field cultivation.

Key Words : Strawberry, Low tunnel, Shade net house, Reference evapotranspiration

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INTRODUCTION

Strawberry (*Fragaria ananassa*) is fruit of great commercial importance with high added value in the horticultural sector (Stewart and Folta, 2010). Strawberry is normally cultivated in thestates of Himachal Pradesh, Uttar Pradesh, Maharashtra, West Bengal and Rajasthan. Strawberry cultivation during winters in north Indian plains and hills, the temperature and solar radiations available less in comparison to the other places of India. Therefore, it is strongly recommended to adopt protected cultivation structures to cultivate strawberry during winter season.

Polyhouse is made up of galvanized iron structure covered with 200 micron UV stabilized transparent linear low density polyethylene (LLDPE) which partially control the micro climatic parameters of structures (Santosh *et al.*, 2017). Shadenet house is made up of galvanized iron or bamboo materials and covered with LLDPE net made

up of 100% polyethylene thread with UV stabilized facility. It partially control the entry of light in to the structure. Therefore, year round cultivation is possible under these structures (Kittas *et al.,* 2012). Cladding materials like greenhouse film and shadenet both reduces water requirements and increases irrigation water use efficiency (Moller and Assouline, 2007).

Accurate determination of crop water requirement is one of the important factors to get greater yield in protected cultivation structures (Yuan *et al.,* 2001). Estimation of reference evapotranspiration (ET_0) under protected cultivation structures normally done by measuring water evaporation with a pan evaporimeter (Yuan *et al.,* 2001). The Modified Penman-Monteith model also can be used to estimate the crop water requirements under greenhouse and shade net houses. This equation requires weather parameter measured inside the structures. This study estimates the crop water requirement of straw berry under different protected cultivation structures.

MATERIAL AND METHODS

Two different types (polyhouse and shadenet house with 75% shade) of protected cultivation structures were considered for the study. Evapotranspiration was estimated by using climatic data recorded under different protected cultivation structures on daily basis.

The daily irrigation water requirement for the vegetable crops were estimated by using the following relationship

$$WR = ET_0 \times Kc \times Wp \times A$$

where,

WR = Crop water requirement (L d^{-1})

ET_0 = Reference evapotranspiration (mm d^{-1})

Kc = Crop co-efficient (Table 1 lists typical values for Kcini, Kc mid and Kc end for various winter vegetable crops)

Wp = Wetting fraction (taken as 1 for close growing crops)

A = Plant area, m^2 (*i.e.* spacing between rows, m x spacing between plants, m).

The daily meteorological data recorded for the years 2017-2020 were used to compute reference evapotranspiration (ET_0). The modified Penman-Monteith method suggested by Allen *et al.* (1998) was used to compute reference evapotranspiration (ET_0).

RESULTS AND DISCUSSION

The existence of greenhouse cover or shadenet cover will change inside micro climatic conditions. Sun radiation and air velocity reduced and temperature increased inside the protected cultivation structures. These changes make better yield and quality of straw berry in poyhouse and shadenet house. Polyhouse temperature increased due to influence of poythelene cover. The maximum and minimum temperature found in shadenet house was less in comparison to the temperature found inside the polyhouse and higher in comparison to the open field condition.

Weekly mean of daily maximum and minimum ambient temperatures during the winter season (November to February) in poly house, shadenet house and in open condition are shown in the Fig. 1. Polyhouse cover increases the inside temperature due to change of solar radiation to long wave radiation.

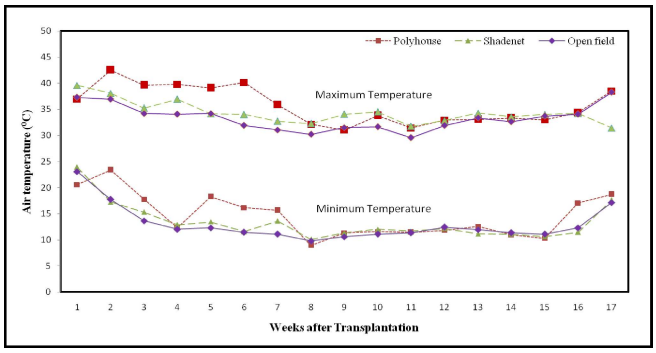

Fig. 1: Weekly average of daily maximum and minimum temperature recorded during the period of experimentation in polyhouse, shadenet house and open condition

Fig. 2 shows that the daily mean relative humidity increased in poly house and shadenet house by 2–20%

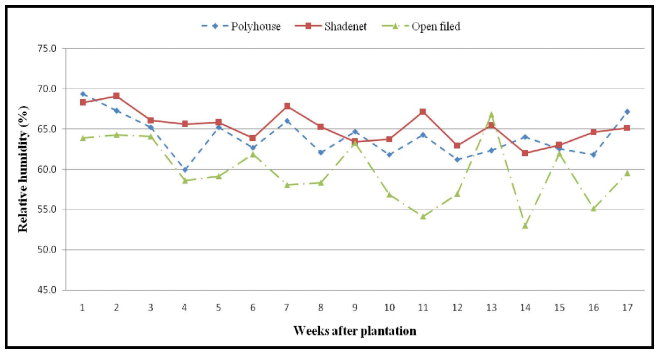

Fig. 2: Weekly average of daily mean relative humidity recorded during the period of experimentation in polyhouse, shadenet house and open condition

and 3-16%, respectively in comparison to the open field. During extreme winter of December and January (6-12 weeks after transplantation) more humidity observed in polyhouse compares to open field condition. Fig. 3 shows that poly film transmits solar radiations about 60 to 80% and shadenet transmits solar radiations about 70 to 94% depending upon the sunshine hours. The polyhouse covering material significantly influences the radiation balances relatively to the external environment.

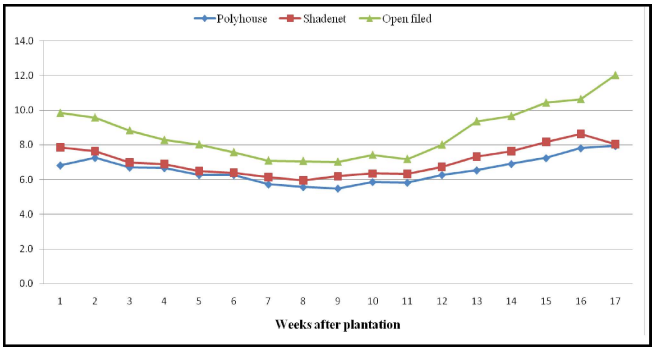

Fig. 3: Weekly average of daily radiation (W m^{-2}) recorded during the period of experimentation in polyhouse, Shadenet house and open condition

To determine the strawberry crop water requirement FAO-56 Modified Penman-Monteith Method was used. Weekly average of daily reference evapotranspiration under polyhouse, shadenet house and open condition is shown in the Fig. 4. The irrigation water requirement of Strawberry crop is the product of reference evapotranspiration and crop co-efficient of strawberry at different stages of the crop. For the present study the crop co-efficient (Kc) values wereconsidered from FAO-50 (Allen *et al.*, 1998). The crop water requirement of strawberry under for polyhouse, shadenet house and for open condition was determined and same presented in Table 1.

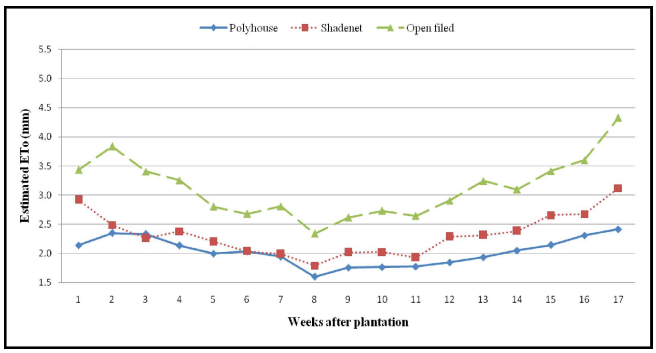

Fig. 4: Weekly average of daily reference evapotranspiration ET_0 (mm) estimated for the period of experimentation in polyhouse and open condition

Table 1: Estimated water requirement of strawberry under poly house, shadenet house and for open field condition

Weeks after plantation	Crop water requirement, L $plant^{-1}$ day^{-1}		
	Poly house	Shadenet house	Open field
1	0.32	0.44	0.52
2	0.39	0.41	0.63
3	0.42	0.40	0.61
4	0.41	0.46	0.62
5	0.41	0.45	0.58
6	0.45	0.45	0.59
7	0.46	0.47	0.66
8	0.40	0.45	0.58
9	0.46	0.53	0.69
10	0.46	0.52	0.70
11	0.45	0.49	0.67
12	0.46	0.57	0.72
13	0.47	0.56	0.79
14	0.49	0.57	0.74
15	0.50	0.62	0.80
16	0.53	0.61	0.83

Conclusion:

Present study shows that Polyhouse producing greater temperature inside structures which is favourable for cultivating strawberry. A total of 213 mm, 243 mm and 327 mm depth of irrigation water isrequired to grow strawberry crop under greenhouse, shadenet house and in open field condition, respectively.

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