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Effect of cladding materials, different irrigation regimes and fertigation levels on microclimate and yield of tomato under naturally-ventilated polyhouse and open field

PS Wankhede, SD Dahiwalkar, DB Kshirsagar and SD Gorantiwar

Abstract
The experiment was conducted to evaluate the yield response of tomato (*Solanum lycopersicum* L.) to different irrigation regimes and fertigation levels under polyhouse and open field conditions. The treatment consisted of three irrigation regimes 0.95 ETc, 0.70 ETc, and 0.45 ETc. and three fertigation levels 125% RD, 100 %RD and 75% RD. The experimental design was split plot with six replications. The biometric attribute plant height was measured at harvest condition and yield attribute *viz*., average weight of fruit, yield in kg per plant, kg per m^2 and yield in t/ha. It is seen from the data pooled over two years that the plant height of tomato under polyhouse and open field was maximum (240.5cm and 133.9 cm) due to 0.95 ETc (I_1) irrigation level over other irrigation levels. Data on plant height was not significant. The minimum plant height was found in 0.45 ETc (I_3). It is seen from the data pooled over two years that the fertigation level 125% RD (F_1) recorded the maximum and not significant plant height (227.81 and 128.86 cm) under polyhouse and open field over other fertigation levels. The pooled data show that the average weight of a fruit of tomato was maximum (123.83 g) due to 0.95 ETc irrigation level over other irrigation levels. It was at par with all irrigation levels. Irrigation level of 0.45 ETc recorded minimum fruit weight of tomato under polyhouse condition. Data on effect of different irrigation levels on average weight of fruit of tomato were statistically not significant under open field. The pooled data shows that the effect of irrigation levels on yield in kg per plant, kgm^{-2} and tha^{-1} was statistically not significant under polyhouse and open field. The pooled data shows that the effect of fertigation levels on yield in kg per plant, kgm^{-2} and tha^{-1} was not significant under polyhouse and open field. The average water use efficiency of tomato was in the range of 49.23 to 71.27 $kg/m^2\text{-}m^{-1}$ and 13.55 to 31.15 $kg/m^2\text{-}m^{-1}$ under polyhouse and open field conditions. It was observed that the air temperature, soil temperature and light intensity was higher in open field than polyhouse. The relative humidity was higher under in polyhouse than the open field.

Keywords: drip irrigation, fertigation, water use efficiency and microclimatic parameter

Introduction
Tomato is a warm season plant. It can withstand with severe frost conditions. Temperature and light intensity affect germination, vegetative growth, fruit set, pigmentation and nutritive value of this fruits. The minimum temperature for germination of seeds range from 8^0 to 10 ^{0}C. The night temperature is the critical factor in fruit setting with the optimum range of 16 ^{0}C to 22 ^{0}C. Fruits fail to set at 12^0C or below. Under greenhouse conditions tomato crop can grown for long duration (10-12 months) by cooling during summer months (April to June or July) and by heating the greenhouse during peak winter months (December and January) in northern parts of the country Singh (2006) [7]. Creating high values for agricultural crops by using low water inputs and high fertilizer efficiencies is one of the methods used in addressing the environmental and resources problems. Protected cultivation techniques including nethouse technology provide optimum environmental medium for better crop growth in order to gain maximum yield and high-quality products. These require comparatively less land area for agricultural production system resulting in increased land productivity and facilitate yea round production of crops. Many studies were reported on tomato cultivation under green/nethouse conditions with different advantages Dunage *et al.* (2009) [4].

Materials And Methods
The field experiment was conducted at the Instructional Farm of Department of Irrigation and Drainage Engineering, Dr. Annasaheb Shinde College of Agricultural Engineering and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri during the period from November 2013 to May 2014 and November 2014 to May 2015. Geographically the farm lies at 74^0 38'

00" E longitudes and 19^0 20' 00" N latitude at 557 m above the mean sea levels in the central campus of Mahatma Phule Krishi Vidyapeeth, Rahuri.

Climatological data
The meteorological data on maximum and minimum temperature, minimum and maximum relative humidity, actual sunshine hour and daily wind speed etc. weather parameter during the crop growth period (30 November 2013 to 5th May 2014) and (1 December 2014 to 5th May 2015) were collected on daily basis from the meteorological observatory situated at the Instructional Farm of Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri.

Water source: Water for the experiment was pumped from an open dug well situated at the Instructional Farm of Department of Irrigation and Drainage Engineering.

Experimental Details
Two experiments was conducted under this investigation for two consecutive years. The details are given below.
Response of tomato to irrigation regimes and fertigation levels under polyhouse condition and open field conditions. Two experiments were conducted under this investigation for two consecutive years. This experiment was carried out in split plot design with nine treatments based on different combinations of the irrigation levels and fertigation levels. Crop verity was Hy. Phule Raja. Plot size was 2.7 m X 1 m and plant spacing was 60 cm x 45 cm. Number of plants per bed was 12. The area of polyhouse and open field was 25 m x 20 m. The soil media in polyhouse consisted of red soil, farm yard manure (FYM) and sand. Irrigation was given at daily basis over the whole crop period of tomato by drip irrigation method. And fertigation was given at an alternat days. The fogger system had automatic controller to operate the system for 30 second ('ON' period) after the interval of ('OFF' period) period about 8 minute. Fogger system was operated at 2-2.5 kg/cm^2. The microclimatic observations were recorded daily at two hours interval for the year 2013-14 from 0800, 1000,1200, 1400 and 1600 hrs such as air temperature, soil temperature, relative humidity and light intensity under polyhouse and open field with the help of air thermometer, soil thermometer, hygrometer and lux meter. Soil thermometer installed in the bed at 15 cm depth.

Treatment Details

Sr. No.	Factor A : Shading percentage	Factor B: Irrigation levels
1	I_1 = 0.95 ETc	F_1= 125% RD
2	I_2 = 0.70 ETc	F_2 = 100% RD
3	I_3 = 0.45 ETc	F_3 = 75% RD

In order to study the response of tomato to irrigation regimes and fertigation levels under polyhouse and open field condition, it was necessary to collect data on the plant and yield attributes of the tomato crop. These data were collected during the experimental period and analyzed further for interpretations. The crop growth parameters including plant height were recorded at harvest condition with 5 randomly selected plants from each plot. These plants were properly labeled and growth parameters were monitored on them. The observations include average weight of tomato fruit, total yield of tomato fruit. The water use efficiency for each treatment was determined from the data on corresponding yield and volume of water applied using the following equation:

$$WUE = \frac{\sum Y}{WR} \quad (1)$$

Where, WUE = Water use efficiency (t/ha-cm)
Y = Yield of crop product (t/ha), WR = Total depth of water applied in the field (cm)
In order to compare the treatments of different shading percentages with irrigation levels separate analysis split plot design was prepared.

Result And Discussion
The observations were recorded daily at two hour interval such as air temperature, soil temperature, relative humidity and light intensity and presented on weekly basis.

Air temperature: The air temperature was recorded at two hour intervals at 0800, 1000, 1200, 1400 and 1600 hrs under poly house and open field condition and are presented on weekly basis in Fig. 1. The air temperature recorded under polyhouse was 18.25^{0}C, to 31.75^{0}C for the months December, 2013 to April, 2014. The air temperature recorded under open field was 20.75^{0}C to 35.50^{0}C for the months December, 2013 to April, 2014 during period 0800 to 1600 hrs. The average air temperature under polyhouse was observed less than the open field. It was also observed from the Table1 that there was 5 to 10 % decrease in temperature in the polyhouse due to UV PE film and foggers as compare to open field. Thus, UV PE film showed the significant difference in air temperature reduction during 0800 to 1600 hrs. Temperature plays a major role in phenological development and productivity of tomato plants. These results are inline with the results obtained by Nangare *et al*. (2015) [5].

Soil temperature: The soil temperature was recorded at two hour interval at 0800, 1000, 1200, 1400 and 1600 hrs under poly house and open field condition and are presented on weekly basis in Fig 2. The soil temperature recorded under poly house was 20 ^{0}C to 24 ^{0}C for the months December, 2013 to April, 2014. The soil temperature recorded under open field was 21^{0}C to 25.75^{0}C for the months December,2013 to April, 2014. The average soil temperature under polyhouse was lower in comparison with open field. The minimum variation in soil temperature due to UV PE film was due to the provision of controlling the climate inside the polyhouse.

Relative humidity: The relative humidity was recorded at two hour interval at 0800, 1000, 1200, 1400 and 1600 hrs under poly house and open field these are presented in Fig 3. The relative humidity recorded under poly house was 92% to 28% for the months December, 2013 to April, 2014. The relative humidity recorded under open field was 80% to 22% for the months December, 2013 to April, 2014. The average relative humidity under polyhouse was higher during in comparison with open field. The UV PE film was most effective in increasing average relative humidity by 10 to 15% over open field. This was due to the provision of foggers, side curtains and open vent at the top of polyhouse, and white shadenet (50% shading) below the UV PE film at top for controlling the air temperature. These results are inline with the results obtained by.

Light intensity: The light intensity was recorded at two hour interval at 0800, 1000, 1200, 1400 and 1600 hrs under poly house and open field condition and are presented in Fig 4. The light intensity recorded under polyhouse was 1022 lux to 65540 lux for the months December, 2013 to April, 2014. The light intensity recorded under open field was 1231 lux to 160090 lux for the months December, 2013 to April, 2014. The average light intensity under polyhouse was lower in comparison with open field. It is seen that the average light intensity increased continuously from 0800 to 1200 hrs and it decreased afterwards up to 1600 hrs. figure shows that the per cent reduction in average light intensity was due to UV PE film over that of open field. These results are inline with the results obtained by Andhale (2012) [1].

The field investigation was carried out to compare the growth and yield attributing characteristics, water saving and water use efficiency under different irrigation levels and fertigation levels. The growth and yield characteristics of tomato were periodically monitored and recorded during the crop growth period.

Plant height: It is seen from the data pooled over two years that the plant height of tomato under polyhouse and open field was maximum (240.5cm and 133.9 cm) due to 0.95 ETc (I_1) irrigation level over other irrigation levels. Data on plant height was not significant. The minimum plant height was found in 0.45 ETc (I_3) these are presented in Table 1. It is seen from the data pooled over two years that the fertigation level 125% RD (F_1) recorded the maximum and not significant plant height (227.81 and 128.86 cm) under polyhouse and open field over other fertigation levels as presented in Table 1. Height of plant were significantly influenced by different levels of N and K fertigation. Better growth of plant height due to increasing fertigation levels as compared to the conventional fertilization. Highest plant heights (146.10 cm) were recorded in 100% fertigation of RD of N and K, whereas conventional fertilization recorded the minimum plant height (110.63 cm). Positive effect of fertigation on plant height of tomato grown inside polyhouse. Natarajan *et al.* (2005) [6]. The interaction of both the factors in respect of plant height was not significant.

Yield Characteristics

The pooled data show that the average weight of a fruit of tomato was maximum (123.83 g) due to 0.95 ETc irrigation level over other irrigation levels. It was at par with all irrigation levels. Irrigation level of 0.45 ETc recorded minimum fruit weight of tomato under polyhouse condition. Data on effect of different irrigation levels on average weight of fruit of tomato were statistically not significant under open field are presented in Table 2. The pooled data show that the different fertigation levels under polyhouse and open field were statistically not significant. The interaction of both the factors in respect of average weight a fruit was significantly influenced. It was found that the interactions of 0.95% ETc x 100% RD (I_1 x F_2) recorded the maximum average weight of fruit (125.68 g) which was at par of all interaction except 0.45 ETc x 75 % RD (I_3 x F_3) under polyhouse conditions these are presented in Table 3. Tomato plant grown under polyhouse was observed to be earlier in flowering and fruit setting by about 3 and 5 days, respectively when compared to the crop raised under open field conditions. The early and higher fruit weight and yield of tomato crops inside polyhouse was mainly because of better microclimate than the open field observed during winter months. Therefore, the polyhouse environment may provide a new scope for commercial production of high value vegetable crops like tomato. Cheema *et al.* (2004) [3].

The pooled data shows that the effect of irrigation levels on yield in kg per plant, kgm^{-2} and tha^{-1} was statistically not significant under polyhouse and open field. The pooled data shows that the effect of fertigation levels on yield in kg per plant, kgm^{-2} and tha^{-1} was not significant under polyhouse and open field. Different fertigation treatments 100% RD of N and K recorded the highest yield attributes and marketable fruit yield (122.59 t/ha) of tomato compared to 75% and 50% levels of fertigation and significantly superior to the conventional fertilization (control). Results revealed that marketable fruit yield between 50% fertigation levels and conventional fertilization were at par indicating that fertigation saved fertilizers to the tune of 50% as compared to the conventional control. It was concluded from the study that drip fulfilment at 100% ER with 100% supplementation of RD of N was found to be beneficial for higher growth, yield, quality of tomato grown inside naturally ventilated polyhouse under the agro-climatic conditions. Brahma *et al.* (2009) [2]. The interaction of 0.95ETc x 125 % RD (I_1 x F_1) was maximum yield in kg per plant (8.04) and significantly superior to the other interactions under polyhouse conditions. The interaction effect on yield in kgm^{-2} and tha^{-1} was not significant under polyhouse and open field as presented in Table 4,5,6 and 7.

Water use efficiency under polyhouse and open field: The average water use efficiency of tomato was in the range of 49.23 to 71.27 $kg/m^2\text{-}m^{-1}$ and 13.55 to 31.15 $kg/m^2\text{-}m^{-1}$ under polyhouse and open field conditions as presented in Table.8 and Table 9.

Conclusion

The experiments were conducted to know the influence of different irrigation levels, with fertigation levels on growth and yield of tomato. The results of the experiments were analyzed and following specific conclusions were derived. The yield of tomato is enhanced when cultivated in polyhouse compared to open field condition. The yield of tomato is more in polyhouse as compared to open field. The irrigations to the tomato should be scheduled daily 0.95 ETc in polyhouse. The fertigation to the tomato should be scheduled alternate day 125% RD in polyhouse.

Table 1: Plant height of tomato at harvest as affected by different treatments for the year 2013-14, 2014-15 and pooled under polyhouse and open field

Treatments	Plant height cm (At harvest)					
	Poly house			Open field		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
A. Irrigation level (I)						
I_1=0.95 ETc	223.56	257.44	240.5	124.17	143.78	133.97
I_2=0.70 ETc	205.06	236.22	222.64	115.00	135.78	125.39
I_3=0.45 ETc	192.44	216.94	204.69	107.89	125.78	116.83

S.E.±	2.09	2.22	1.62	1.87	3.31	1.82
C.D. at 5%	6.61	7.003	NS	5.90	10.44	NS
B. Fertigation level (F)						
F_1=125 % RD	211.56	244.06	227.81	118.33	139.39	128.86
F_2=100 % RD	207.78	237.11	222.44	115.39	133.83	124.61
F_3=75 % RD	201.72	229.44	215.58	113.33	132.11	122.72
S.E.±	1.91	1.90	1.34	1.83	1.80	1.26
C.D. at 5%	5.51	5.50	NS	NS	5.21	NS
C. Interaction (IxF)						
S.E.±	5.01	5.04	2.44	4.72	5.26	2.13
C.D. at 5%	NS	10.94	NS	NS	NS	NS

Table 2: Average weight of a fruit as affected by different treatments for the year 2013-14, 2014-15 and pooled means under polyhouse and open field

Treatments	**Average weight of a fruit, (g)**					
	Poly house			**Open field**		
	2013-14	**2014-15**	**Pooled**	**2013-14**	**2014-15**	**Pooled**
A. Irrigation level (I)						
I_1=0.95 ETc	117.53	130.14	123.83	88.08	81.53	84.80
I_2=0.70 ETc	111.01	94.27	102.64	72.97	64.57	68.77
I_3=0.45 ETc	107.28	64.55	85.91	63.03	50.58	56.80
S.E.±	2.273	3.713	13.84	1.232	1.286	0.95
C.D. at 5%	7.163	11.69	41.52	3.881	3.99	NS
B. Fertigation level (F)						
F_1=125 % RD	114.08	104.0	109.07	78.86	72.95	75.90
F_2=100 % RD	112.20	97.10	104.65	75.09	66.87	70.98
F_3=75 % RD	109.54	87.80	98.67	70.13	56.86	63.49
S.E.±	2.216	3.162	1.97	2.202	2.188	1.56
C.D. at 5%	NS	9.131	NS	6.36	6.31	NS
C. Interaction (IxF)						
S.E.±	5.774	8.385	12.31	5.499	5.47	2.72
C.D. at 5%	NS	NS	40.15	NS	11.39	NS

Table 3: Interaction effect of irrigation and fertigation levels on fruit weight (g) of tomato under polyhouse condition

Fertigation levels (F)	**Irrigation levels (I)**			
	I_1=0.95 ETc	**I_2=0.70 ETc**	**I_3= 0.45 ETc**	**Mean**
F_1=125 % RD	122.77	111.25	93.185	109.07
F_2=100 % RD	125.68	102.43	85.83	104.65
F_3=75 % RD	123.05	94.24	78.72	98.67
Mean	123.83	102.64	85.91	104.13
I x F	S.E.± = 12.31, C.D. at 5% = 40.15			

Table 4: Fruit yield of tomato (kgplant^{-1}) as affected by different treatments for the year 2013-14, 2014-15 and pooled means under polyhouse and open field conditions

Treatments	**Polyhouse**			**Open field**		
	Yield, kg plant^{-1}			**Yield, kg plant^{-1}**		
	2013-14	**2014-15**	**Pooled**	**2013-14**	**2014-15**	**Pooled**
A. Irrigation level (I)						
I_1=0.95 ETc	6.60	7.10	6.85	2.05	2.16	2.10
I_2=0.70 ETc	3.93	3.82	3.87	1.26	1.28	1.27
I_3= 0.45 ETc	2.48	1.91	2.19	0.86	0.81	0.83
S.E.±	0.28	0.23	0.19	0.076	0.070	5.05
C.D. at 5%	0.88	0.73	NS	0.239	0.22	NS
B. Fertigation level (F)						
F_1=125 % RD	5.11	5.15	5.13	1.61	1.68	1.64
F_2=100 % RD	4.27	4.23	4.25	1.37	1.37	1.37
F_3 =75 % RD	3.62	3.45	3.53	1.19	1.20	1.19
S.E.±	0.137	0.046	4.35	0.069	0.064	0.046
C.D. at 5%	0.396	0.133	NS	0.199	0.186	NS
C. Interaction (IxF)						
S.E.±	0.414	0.231	0.24	0.181	0.169	7.82
C.D. at 5%	NS	0.556	0.73	NS	NS	NS

Table 5: Interaction effect of irrigation and fertigation levels on yield (kgplant^{-1}) of tomato under polyhouse condition

Fertigation levels (F)	**Irrigation levels (I)**			
	I_1=0.95 ETc	**I_2=0.70 ETc**	**I_3= 0.45 ETc**	**Mean**
F_1=125 % RD	8.04	4.76	2.58	5.13

F_2=100 % RD	6.81	3.76	2.17	4.25
F_3= 75 % RD	5.68	3.1	1.81	3.53
Mean	6.85	3.87	2.19	4.30
I x F	S.E.± =0.24, C.D. at 5% = 0.73			

Table 6: Fruit yield of tomato (kgm^{-2}) as affected by different treatments for the year 2013-14, 2014-15 and pooled means under polyhouse and open field

Treatments	Polyhouse kg m^{-2}			Open field kg m^{-2}		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
A. Irrigation level (I)						
I_1 =0.95ETc	37.91	38.54	38.22	12.64	12.77	12.70
I_2=0.70 ETc	26.36	26.22	26.29	7.45	7.48	7.46
I_3= 0.45ETc	17.54	16.83	17.18	4.10	4.04	4.07
S.E.±	1.327	1.23	0.87	0.151	0.161	0.10
C.D. at 5%	4.18	3.89	NS	0.475	0.48	NS
B. Fertigation level (F)						
F_1=125 % RD	31.19	31.23	31.21	9.60	9.69	9.64
F_2=100 % RD	27.01	26.96	26.98	7.89	7.90	7.89
F_3=75 % RD	23.62	23.40	23.51	6.70	6.71	6.70
S.E.±	0.56	0.52	0.37	0.216	0.21	0.14
C.D. at 5%	1.637	1.50	NS	0.625	0.61	NS
C. Interaction (IxF)						
S.E.±	1.80	1.66	0.63	0.546	0.36	0.24
C.D. at 5%	NS	NS	NS	1.14	1.06	NS

Table 7: Fruit yield of tomato (t ha^{-1}) as affected by different treatments for the year 2013-14, 2014-15 and pooled means under polyhouse and open field condition

Treatments	Polyhouse Yield, t ha^{-1}			Open field Yield, t ha^{-1}		
	2013-114	2014-15	Pooled	2013-14	2014-15	Pooled
A. Irrigation level (I)						
I_1=0.95 ETc	379.15	385.39	382.27	126.39	127.72	127.05
I_2=0.70 ETc	263.60	262.21	262.90	74.49	74.77	74.63
I_3=0.45 ETc	175.37	168.27	171.82	41.00	40.44	40.72
S.E.±	13.27	12.35	8.70	1.50	1.61	1.06
C.D. at 5%	41.82	38.91	NS	4.75	4.83	NS
B. Fertigation level (F)						
F_1=125 % RD	311.87	312.31	312.09	96.02	96.86	96.44
F_2=100% RD	270.08	269.58	269.83	78.89	78.95	78.92
F_3 =75 % RD	236.17	233.97	235.07	66.97	67.11	67.04
S.E.±	5.66	5.21	3.79	2.16	2.13	1.49
C.D. at 5%	16.37	15.06	NS	6.24	6.39	NS
C. Interaction (IxF)						
S.E.±	18.02	9.03	6.34	5.45	3.69	2.47
C.D. at 5%	NS	NS	NS	11.45	10.65	NS

Table 8: Average water use efficiency of tomato under different treatments of irrigation and fertigation levels under polyhouse condition

Treatments	Yield, kg m^{-2}			WUE, kg /m^{-2}-m^{-1}		
	2013-14	2014-15	Average	2013-14	2014-15	Average
I_1xF_1 (0.95ETc x 125 %RD)	43.43	44.17	43.80	81.86	60.67	71.27
I_1xF_2 (0.95ETc x 100% RD)	37.14	37.81	37.48	69.99	51.94	60.97
I_1xF_3 (0.95ETc x 75% RD)	33.17	33.64	33.41	62.52	46.21	54.37
I_2xF_1 (0.70ETc x 125 %RD)	29.53	29.58	29.56	75.52	55.15	65.34
I_2xF_2 (0.70ETc x 100 % RD)	26.51	26.39	26.45	67.81	49.21	58.51
I_2xF_3 (0.70ETc x 75% RD)	23.04	22.69	22.87	58.92	42.30	50.61
I_3xF_1 (0.45ETc x 125 %RD)	20.6	19.95	20.28	81.97	57.86	69.92
I_3xF_2 (0.45ETc x 100% RD)	17.37	16.67	17.02	69.13	48.35	58.74
I_3xF_3 (0.45ETc x 75 %RD)	14.64	13.86	14.25	58.25	40.21	49.23

Table 9: Average water use efficiency of tomato under different treatments of irrigation and fertigation levels under open field

Treatments	Yield, kg m^{-2}			WUE, kg /m^{-2}-m^{-1}		
	2013-14	2014-15	Average	2013-14	2014-15	Average
I_1xF_1 (0.95ETc x 125 %RD)	14.86	15.14	15.00	31.63	30.66	31.15
I_1xF_2 (0.95ETc x 100% RD)	12.42	12.49	12.46	26.44	25.30	25.87
I_1xF_3 (0.95ETc x 75% RD)	10.6	10.69	10.65	22.56	21.65	22.11
I_2xF_1 (0.70ETc x 125 %RD)	8.87	8.91	8.89	25.21	24.08	24.65

I_2xF_2 (0.70ETc x 100 % RD)	7.27	7.30	7.29	20.66	19.73	20.20
I_2xF_3 (0.70ETc x 75% RD)	6.21	6.22	6.22	17.65	16.80	17.23
I_3xF_1 (0.45ETc x 125 %RD)	5.07	5.01	5.04	21.68	20.32	21.00
I_3xF_2 (0.45ETc x 100% RD)	3.95	3.89	3.92	16.89	15.79	16.34
I_3xF_3 (0.45ETc x 75 %RD)	3.28	3.23	3.26	14.02	13.08	13.55

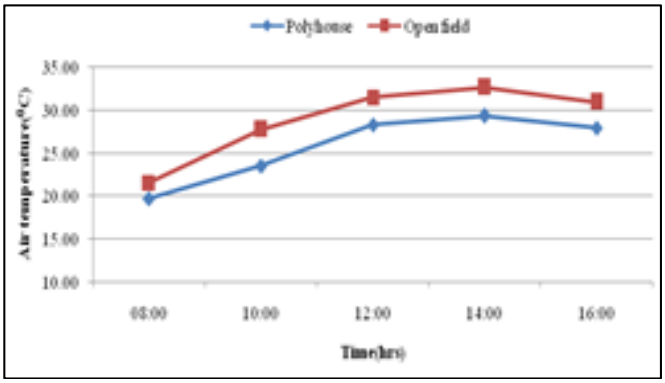

Fig 1: Average air temperature under polyhouse and open field

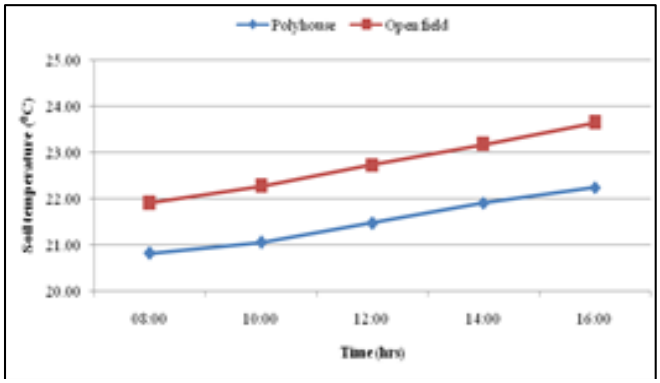

Fig 2: Average soil temperature under polyhouse and open field

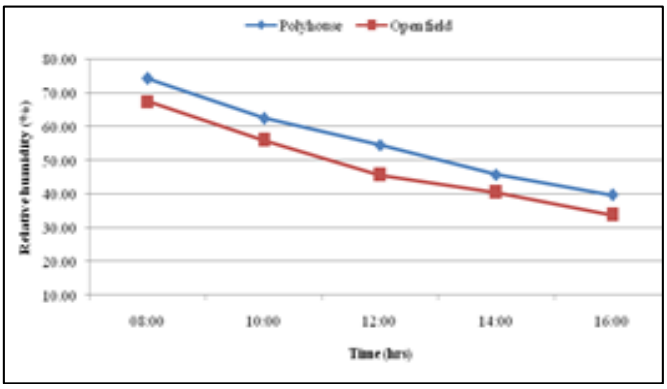

Fig 3: Average relative humidity under polyhouse and open field

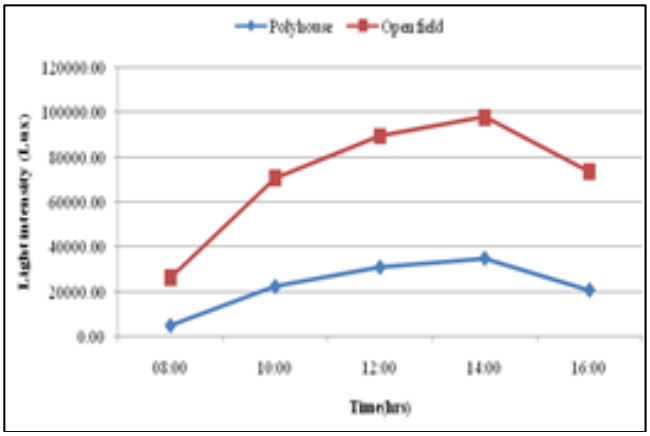

Fig 4: Average light intensity under polyhouse and open field

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