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Yield response of cucumber (*Cucumis sativus* L.) to shading percentage of shade net

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ABSTRACT : The field experiment was conducted at Instructional Farm of Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri, to study the yield response of cucumber (cv. Gypsy) grown under shade net house to 35, 50, 75 per cent shading and in open field condition. Biometric characteristics *viz.*, days to 50 per cent flowering, average diameter of fruit, average length of fruit, average weight of fruit, length of vine at last harvest, number of fruits per vine and yield of fruit were observed throughout the growth period. The results were compared with the performance of the crop grown in open field (control) condition and also statistically analysed. Irrespective of nutrient sources applied, the performance of crop grown inside the shade net was comparatively better than grown in open field conditions.

KEY WORDS : Cucumber (*Cucumis sativus* L.), Shade net, Shading per cent, Biometric characteristics

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Cucumber (*Cucumis sativus* L.) is an important and commercially popular cucurbitaceous vegetable crop which holds a very coveted position in the vegetable market. India's population which was 238 million in 1901, increased to 846 million in 1991, it has crossed 1000 million marks at end of 20th century and at the end of 2011, it reached 1210 million (Chandramouli, 2011). Vegetable and food production of India which was 50.82 million tonnes in 1950-51 has reached to the mark of 218.20 million tonnes at the end of year 2009-10 (Anonymous, 2011). It is necessary to keep the pace of food production with increasing population.

During the last decades, due to increased air temperature and intensity of solar radiation caused by climate changes, an increasing area of crops is being grown under shading materials of various types. (Anonymous, 2001). According to Sganzerla (1987), the advantages that the greenhouses can provide to the protected plants are numerous, among these advantages some can be highlighted including harvesting crops of the season, higher product quality, early crop maturity, seedling production, better control of diseases and pests, conservation of raw materials and water, planting of selected varieties and considerable increase in production.

The shading of crops results in number of changes on both local microclimate and crop activity. These changes on local microclimate modify CO_2 assimilation and consequently crop growth and development. Further, under shading nets the air temperature is lower than that of the ambient air, depending on the shading intensity and is negatively associated with the rate of shading and is variably affected by the quality of light filtered through the different colored shade nets (Elad *et al.*, 2007). Photo-selective, light-dispersive shade nets provide a unique tool that can be further implemented within protected cultivation practices (Shahak *et al.*, 2008).

The performance of the crop grown inside the poly-greenhouse was better than the crop grown in open condition. Nearly 3½ times higher fruit yield was reported in poly-green house (Ganesan and Subashini, 1999). The yield potential of greenhouse is about 1.5 times more than the open field (Patel *et al.*, 2003). The total fruit yields (t/ha) under the colored shade nets were higher by 113 to 131 per cent, relative to the open field (Zoran *et al.*, 2011).

The primary advantages with greenhouses are that any crop can be grown in any season of the year depending on the market demand, excellent quality of the produce, disease free produce etc. This study was conducted to study the yield response of cucumber to different shading percentage as well as open field conditions.

METHODOLOGY

Treatments and experimental details:

The experiment was conducted at Instructional Farm of Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri during Feb – 2012 to May – 2012. The experiment was carried out in three shade net of a green white net houses with 35, 50, 75 per cent intensity and in full sunlight that is control treatment with split plot design. The hybrid variety "Gypsy" of cucumber was grown under shade net house and in control treatment. The size of the each shade net and the open field was 18 m × 16 m. The size of each plot was 2 m × 3.9 m. A 0.5 m buffer strip was provided between two beds to avoid lateral movement of water from one bed to another. Regular irrigation, fertigation and crop protection measures were adopted as per the package of cultivation practices. Fig. A and B shows the external and internal view of shade net house.

Fig. A : General view of shade net house

Fig. B : Internal view of shade net house

Main treatment details:

S_1: – 35 % shading
S_2: – 50 % shading
S_3: – 75 % shading
S_4: – 0 % shading *i.e.* full sunlight.

Climatological data:

The meteorological data on important weather parameter during the crop growth period were collected on daily basis from the meteorological observatory situated at the Instructional Farm of Department of Irrigation and Drainage Engineering. The data included maximum and minimum temperature, minimum and maximum relative humidity, actual sunshine hour and daily wind speed etc. On the basis of climatological data, daily water requirement for cucumber was estimated.

The field topography for the experiment was uniform and leveled. The soil media in shade net house consisted of red soil, farm yard manure (FYM) and sand mixed with wheat husk in the proportion of 3:3:3:1 and black cotton soil with textural class "clay" used for control treatment. Daily irrigation and fertigation was given as per the requirement of cucumber crop. Physio-chemical properties of soil were determined for shade net and control treatment. Irrigation with 60 per cent of ET0 was given on daily basis through drip system (Tribhuvan *et al.*, 2010). Gator pump was used to inject the fertigation in drip system as per the requirement of cucumber. Fruits were harvested at their marketable size.

Biometric observations recorded:

For recording various biometric observations sample plants were selected from each treatment and tagged for their identification. The observations such as average diameter of fruit, average length of fruit, average weight of fruit, days to 50 per cent flowering, average length of vine at last harvest, number of fruits per vine, total yield per plot were recorded throughout the growing season. The fruit yield of cucumber in shade net house was compared with that in open field conditions and correlated with other data.

Days to 50 % flowering:

The number of days required for flower initiation was recorded from the sowing to the date at which 50 per cent flowers were visible from each treatment plot.

Average diameter of fruit:

The average circumference of fruit at three points was recorded with the help of vernier calliper and the average diameter was worked out and recorded. Five fruits from the identified sample plants were randomly selected for computing the average diameter of fruit.

Average length of fruit:

Average length of fruit was recorded from stalk to style end with the help of steel tape and the average length of fruit

was worked out and recorded.

Average weight of fruit:

Immediately after the harvest, the five fruits were weighed on electronic balance and the average weight of fruit was worked out and recorded.

Length of vine at last harvest:

The length of main shoot of vine was measured from collar of stem upto growing tip with the help of steel scale for tagged plants at last harvest and average length of vine was worked out for each treatment plot.

Number of fruits per vine:

The number of fruits harvested from each vine at each harvesting was counted and recorded.

Yield of fruit :

The weight of fruit harvested per plot at each picking was recorded and the total yield of fruits per plot was obtained.

■ RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Soil:

The bulk density, field capacity, permanent wilting point for soil were observed as 1.32 g cm^{-3}, 27.48 %, 18.21 % and that for media in shade net house were 1.19 g cm^{-3}, 22.20 %, 15.02 %, respectively and seems media in shade net was more porous than the open field. The water holding capacity was higher in clay soil as compared to media of the shed net house.

Water requirement:

Total water requirement of cucumber crop was 475.27 mm for the entire season. The Fig. 1 reveals that, the net water requirement for cucumber crop varied from 1.38 mm to 7.26 mm. The higher water requirement in later growth period of cucumber may be due to higher temperature, sunshine hours and wind speed during the later growth period of cucumber crop.

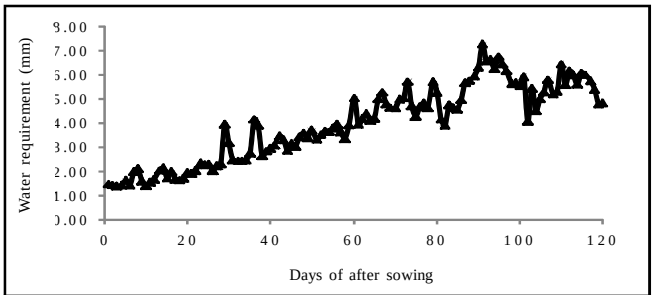

Fig. 1 : Variation in net daily water requirement

Biometric observations:

It was observed that the vegetative growth of cucumber in shade net house was abundant as compared to that in open field conditions. Fig. 2 and 3, show the flowering and fruit setting stage of cucumber. All the biometric parameters are significantly influenced by shading percentage of shade net and are tabulated in table given below and graphically represented as in Fig. 4.

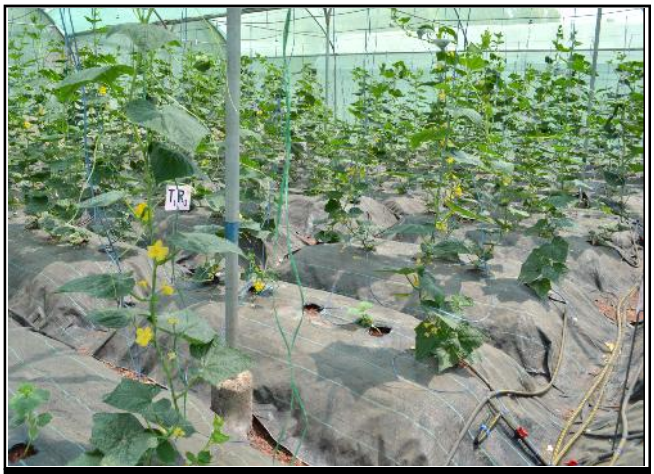

Fig. 2 : Flowering stage of cucumber under shade net

Fig. 3 : Fruit setting stage of cucumber

Days to 50 % flowering:

Days to 50 per cent flowering recorded as 29.25, 30.58 and 33.33 under shade net with 35, 50 and 75 per cent shading, respectively as it shows early flowering in shade net house whereas, in control it was found 45.71 which was more as compared to shade net house (Table 1 and Fig. 4a).

Average diameter of the fruit :

The highest diameter (4.19 cm) was recorded under shade net with 75 per cent shading which was at par with 35

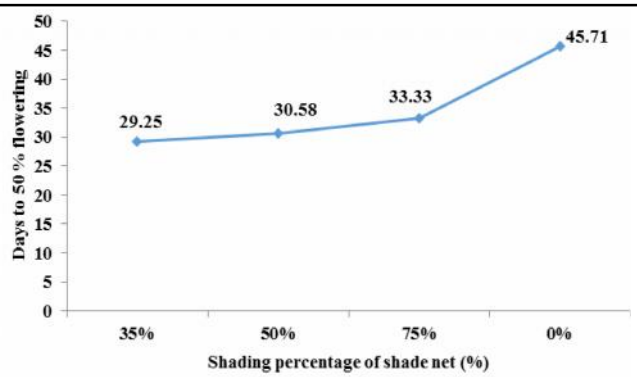

Fig. (a) : Effect of shading on days to 50% flowering

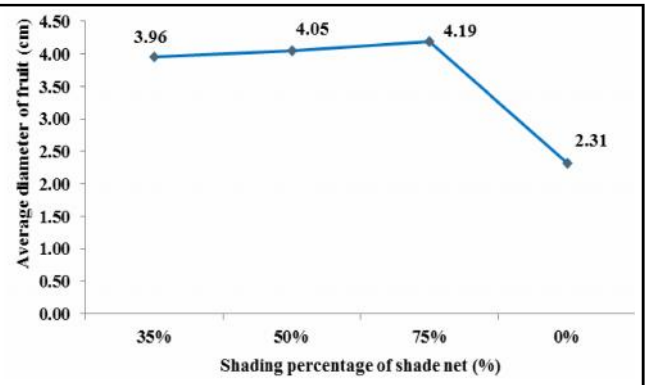

Fig. (b) : Effect of shading on diameter of fruit

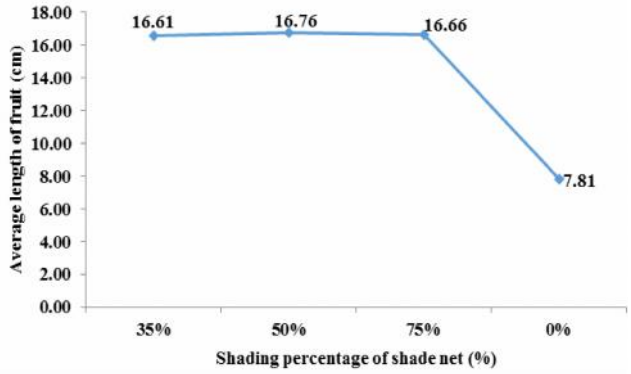

Fig. (c) : Effect of shading on length of fruit

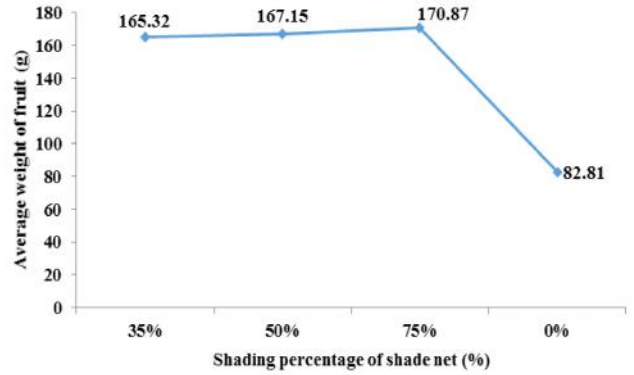

Fig. (d) : Effect of shading on weight of fruit

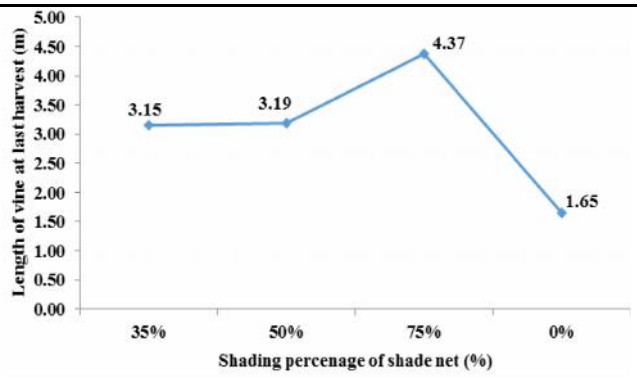

Fig. (e) : Effect of shading on length of vine

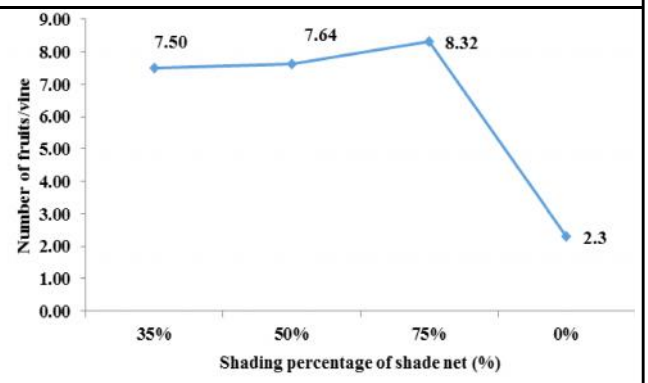

Fig. (f) : Effect of shading on number of fruits per vine

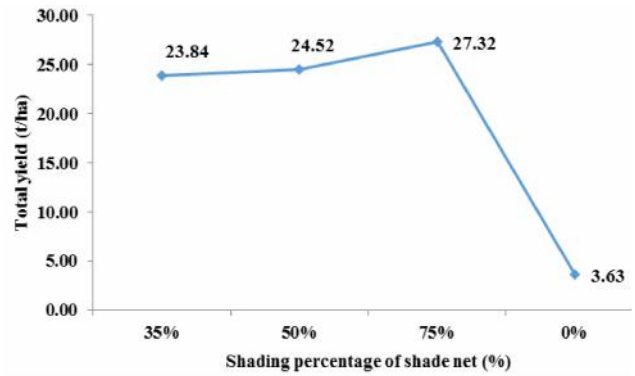

Fig. (g) : Effect of shading on yield

Fig. 4 : Effect of shading percentage of shade net on biometric observations

Table 1 : Effect of shading of shade net on performance and yield of cucumber

Treatments	Days to 50 per cent flowering	Average diameter of fruit (cm)	Average length of fruit (cm)	Average fruit weight (g)	Length of vine at last harvest (m)	No. of fruits per vine	Yield of fruit (t/ha)
S_1	29.25[d]	3.96[b]	16.61[b]	165.32[b]	3.15[b]	7.50[b]	23.84[b]
S_2	30.58[c]	4.05[b]	16.76[b]	167.15[b]	3.19[b]	7.64[b]	24.52[b]
S_3	33.33[b]	4.19[b]	16.66[b]	170.87[c]	4.37[c]	8.32[b]	27.32[c]
S_4	45.71[a]	2.31[a]	7.81[a]	82.81[a]	1.65[a]	2.30[a]	3.63[a]
S.E. ±	0.15	0.10	0.12	1.02	0.13	0.27	0.05
C.D.(P=0.05)	0.5	0.33	0.38	3.28	0.41	0.85	0.15

Note: Higher superscript denotes best treatments

and 50 per cent shading. The lowest diameter of the fruit (2.31 cm) was recorded in control (Table 1 and Fig. 4b).

Average length of fruit:

The maximum average length (16.76 cm) was recorded under shade net with 50 per cent shading which was at par with 35 and 75 per cent shading. The lowest length of the fruit was recorded from open field (7.81 cm) (Table 1 and Fig. 4c).

Average weight of fruit :

The maximum average weight (170.87 g) was recorded under shade net with 75 per cent shading, followed by average weight (167.15 g) recorded from 50 per cent shading at par to 35 per cent shading (165.32 g). The lowest average weight (82.81 g) was recorded from control treatment (Table 1 and Fig. 4d).

Length of vine at last harvest:

The maximum length of vine (4.37 m) was observed under 75 per cent shading, followed by 50 per cent shading (3.19 m) at par to 35 per cent shading (3.15 m). Minimum length of vine (1.65 m) was observed in control (Table 1 and Fig. 4e).

Number of fruits:

The maximum number of fruits was recorded from 75 per cent shading (8.32), which were at par to 35 per cent shading (7.50) and 50 per cent shading (7.64). The minimum number of fruits was recorded from control treatment (2.30) (Table 1 and Fig. 4f).

Yield of fruits:

The maximum yield of fruit per vine was observed in 75 per cent shading (1.42 kg), significantly superior over 50 per cent shading (1.28 kg) which was at par to 35 per cent shading (1.24 kg). Lowest yield per vine was observed in control (0.19 kg).

The maximum yield of fruit per plot was observed under 75 per cent shading (21.31 kg), significantly superior to 50 per cent shading (19.13 kg) which was at par to 35 per cent shading (18.60 kg). Minimum yield (2.83 kg) was observed in open field condition. The total fruit yield recorded from shade net with 35, 50 and 75 per cent shading were 23.84, 24.52 and 27.32 t/ha, respectively which were 8 to 10 times more than open field condition *i.e.* 3.63 t/ha (Table 1 and Fig. 4g).

Summary and conclusion:

Irrespective of nutrient sources applied, mean air temperature of 40.34 to 24.66 ^{0}C, mean relative humidity 91.80 to 30.53 per cent, mean sunshine hours 8.04 to 11.04 hrs, wind speed 1.72 to 6.55 km/hr were found to be optimum for higher yield of cucumber 27.32 t ha^{-1} under shade net house with 75 per cent shading. The climatic condition proved adverse for cucumber cultivation under open field.

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