



Yield and Yield Attributes of *Capsicum annum* as Influenced by Coloured Shade Net and Shading Intensity

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted at the Precision Farming Development Centre, ARS, Swami Keshwanand Rajasthan Agricultural University, Bikaner during 2015-16 to -2017-18 on loamy sand soil. The experiment comprised of four coloured shade net viz., green, red, white and black and three shading intensity (35%, 50% and 75%) under Factorial Randomized Block Design (FRBD) with three replications. Based on the three season pooled data the result revealed that capsicum gave maximum average fruit weight (86.77 g), average fruit length (25.91) and yield (558.24 q/ha) in red color shade net which is significantly higher over green and black colored shade net and remained at par with white colored shade net. Whereas, in shading intensity the maximum average fruit weight (87.14 g), average fruit length (26.15) and yield (542.44 q/ha) of capsicum was recorded with 50 percent of shading intensity which is closely followed by 75 percent shading intensity and significantly higher over 35 percent shading intensity. From the study it can be concluded that red coloured shade net with 50 per cent shading intensity would be ideal for cultivation of capsicum crops under protected conditions of shade net.

Keywords: *Capsicum; fruit length; India; shade net; shading intensity and yield.*

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1. INTRODUCTION

“Capsicum (*Capsicum annum* L.) commonly known as *simla mirch* or bell pepper, belongs to the botanical family Solanaceae and grown all over of the world and is believed to be the native of Tropical South America” [1]. “The domesticated peppers could be broadly classified into two groups viz. sweet and hot type on the basis of pungency content. It is well adopted to temperate part of American and European countries while tropical or sub-tropical parts of Asian countries. It is a high productivity crop and has high remunerative value. Capsicum are used as vegetable as well as condiment. The mature fruits of capsicum are eaten raw (salads) or widely used in stuffings, bakings, pizza and burger preparations due to its mild pungency and taste. Nutritionally 100 g of capsicum provides 8493 IU of Vitamin A, 283 mg of Vitamin C, 13.4 mg of Ca, 14.9 mg of Mg, 28.3 mg of P, 263.7 mg of K, 24 Kcal of energy, 1.3 g of protein, 4.3 g of carbohydrate and 0.3 g of fat” [2].

“India is the second largest producers of vegetables in the world next to China [3]. Capsicum was grown on an area of 46 thousand hectare with annual production of 288 thousand MT in India. However, in India per capita consumption of vegetables is 210 g/day, which is very low against WHO standards of per capita requirement of 300 g/day vegetables as recommended by FAO” [4]. “Capsicum can be successfully grown under open field conditions and in protected structures, i.e., net house, poly-house, walk-in-tunnels, plastic low tunnels, etc.” [5] “but its cultivation under open condition is not successful which might be due to poor adoptability under fluctuating atmosphere and produced poor quality food under erratic biotic and abiotic factors” [6]. “The cultivation of capsicum under different protected structures like net house, poly-house, walk-in-tunnels and plastic low tunnels are the most suitable solutions to the challenging environmental factors as it prevents spreading of insect, pest, and viral diseases, hence plays a key role in integrated pest management”.

“Shade nets are made of 100 per cent polyethylene inter-woven thread with specialised UV treatment having different shade percentages. It provides partially controlled atmosphere and environment by reducing light intensity and effective heat during day time to crops grown under it. To create optimum climatic conditions, selection of the correct percentage of

shade factor plays an important role to enhance plant's productivity to its optimum. The photo selective, light-dispersive shade nets provide a new, multi-benefit tool for crop protection. Changing the light intensity and radiation spectrum has a large impact on the total production system. Coloured shade netting not only exhibit special optical properties that allow the control of light, but also have the advantage of influencing the microclimate to which the plant is exposed and offer physical protection against excessive radiation, insect pests and environmental changes” [7]. “Presently shade nets are available in different colours i.e. white, black, red, blue, yellow and green and in combinations. However, there is a need to study the performance of capsicum under shade net house conditions. Hence, the present study was conducted to assess the performance of capsicum under coloured shade net with suitable shading intensity”.

2. MATERIALS AND METHOD

2.1 Experimental Site and Weather Conditions

An experiment was conducted at the Precision Farming Development Centre, ARS, Swami Keshwanand Rajasthan Agricultural University, Bikaner during 2015-2018 on loamy sand soil. Geographically, the study area is located at 28° 10' N latitude, 73° 18' E longitude and 223.88 meters above mean sea level and this region falls under agro-climatic zone I C of Rajasthan. The climate of this tract is typically arid nature by aridity of the atmosphere and some salinity in the rhizosphere with extremes of temperature in summers and winters. There is wide range of temperature in summer (40° to 48°C) and in winter (-1° to 10°C) with annual rainfall of 250-270 mm. The soil of experimental field was loamy sand in texture, slightly alkaline in reaction.

2.2 Cropping Husbandry

The experiment was laid out in Factorial Randomized Block Design with three replications. The experiment comprised of four coloured net treatment viz., green, red, white and black and three shading intensity (35%, 50% and 75%). Standard crop production practice and methods were followed for weeding, fertilizer application and crop protection management to grow the crop. Capsicum was grown as per standard horticulture practices.

2.3 Data Collection

The yield attributes and yields were recorded according to standard methods. Fruit Length of ten randomly selected mature fruits at marketable stage was measured in centimetre using Vernier calliper and average was worked out. Fresh weight of ten randomly selected mature fruits at marketable stage was recorded in grams using electronic balance and the average fruit weight was calculated.

Total number of plants (n) was calculated in 1 m² cropping area and total yield was worked out (as n * x) on the basis of total fruit yield per plants (x) and recorded as fruit yield per square metre. After that fruit yield per square metre was used to calculate fruit yield per hectare.

2.4 Statistical Analysis

The experimental data were subjected to statistical analysis by adopting appropriate method of analysis of variance assuming homogeneity, analysis of the data was carried out to establish the trend of treatments applied as per Panse and Sukhatme [8]. Wherever, the F values were found significant at 5% level of probability, the critical difference (CD) values were computed for making comparison among the treatment means.

3. RESULTS AND DISCUSSION

3.1 Effect of Different Coloured Shade Net on Yield Attributes and Yield

“Based on three-year experimental data as well as three years pooled mean (Table 1, 2 and 3), it is evident that red coloured shade net exhibited maximum average fruit weight (86.77 g), average fruit length (25.91 cm) and yield (558.24 q/ha) which is significantly higher over green and black colored shade net and remained at par with white colored shade net. Red shade-nets significantly increased the total yield which was associated with both higher productivity per plant and larger fruits. The major response to the photosensitive filtration was the production of more fruits per plant, with essentially no reduction of fruit size or quality. This might be due to the reduced transpiration and improved plant water status and net photosynthesis under shaded conditions. According to the available literature, it is evident that shading is one of the promising methods to control the plant growth characteristics in order to increase yield of pepper. In Serbia, bell

pepper grown under coloured shade nets had higher total yields compared with unshaded plants” [9]. “It also recorded that greater yield for sweet pepper hybrids grown under photo-selective (red and blue) shading net houses compared with those obtained from open field. Peppers grown in an arid region under red and yellow shade-nets (30% relative shading in PAR) had a significantly higher yield compared with black nets of the same shading factors, with no reduction in fruit size” [10]. “Shade can increase total and marketable yields of pepper grown in the open field in hot climates, but shade is far more deleterious in a cool and cloudy environment. This could be attributed to highest extent of fruit set leading to a greater number of fruits per plant due to the favourable climatic conditions like optimum temperature, light intensity and relative humidity that prevailed inside the shade net” [11]. “These results are close agreement with Mashego [12] in tomato and Ilic et al. [9] and Jakhar et al. [13] in capsicum”.

3.2 Effect of Shading Intensity on Yield Attributes and Yield

It were revealed from three years experimental data and also from pooled mean (Tables 1, 2 and 3) that yield attributes and yield of capsicum were significantly enhanced due to shading intensity treatments. Among all the treatments, 50 percent shading intensity reported maximum average fruit weight (87.14 g), average fruit length ((26.15 cm) and yield (542.44 q/ha) of capsicum which was closely followed by 75 percent shading intensity and significantly higher over 35 percent shading intensity. This could be due to the favourable proportion of R/FR (red/far red) radiation that decreased the periods of mild temperatures required for the flower induction and also due to accumulation of maximum photosynthates by fast growth which triggered early initiation of flowers. This might be also due to good vegetative growth, a greater number of flowers, besides effective pollination, fertilization and lower abscission rate of flowers. “It was also a consequence of production of more flowers per plant and less interference of adverse climatic conditions like rainfall and wind velocity during crop growth and development. The favourable environmental conditions such as light intensity, temperature and relative humidity in 50% shading intensity, which had increased photosynthetic process and assimilate accumulation in capsicum. Similar results were also reported by Swagatika et al., [14] and Vethamoni and Natarajan [15] in cauliflower”.

Table 1. Effect of coloured shade net with different shading intensity on average fruit weight of capsicum

Treatment	Average fruit weight (g)			
Year	2015-16	2016-17	2017-18	Pooled
Net Colour				
Green	87.78	83.02	74.71	81.84
Red	92.89	88.04	79.37	86.77
White	91.32	86.48	77.93	85.24
Black	84.13	79.44	71.38	78.32
S. Em.±	0.66	0.76	0.70	0.68
C.D. (p=5%)	1.90	2.17	2.02	1.93
Shading intensity				
35%	81.33	76.71	68.84	75.62
50%	93.28	88.42	79.73	87.14
75%	92.47	87.61	78.98	86.35
S. Em.±	0.57	0.65	0.61	0.59
C.D. (p=5%)	1.65	1.88	0.68	1.67

Table 2. Effect of coloured shade net with different shading intensity on average fruit length of capsicum

Treatment	Average fruit length (cm)			
Year	2015-16	2016-17	2017-18	Pooled
Net Colour				
Green	25.80	24.82	22.09	24.24
Red	27.53	26.53	23.67	25.91
White	27.02	26.02	23.20	25.41
Black	24.62	23.73	21.07	23.14
S. Em.±	0.28	0.37	0.35	0.32
C.D. (p=5%)	0.81	1.07	1.00	0.92
Shading intensity				
35%	23.87	22.92	20.32	22.37
50%	27.74	26.79	23.92	26.15
75%	27.11	26.12	23.29	25.51
S. Em.±	0.24	0.32	0.30	0.28
C.D. (p=5%)	0.70	0.93	0.86	0.79

Table 3. Effect of coloured shade net with different shading intensity on yield of capsicum

Treatment	Yield (q/ha)			
Year	2015-16	2016-17	2017-18	Pooled
Net Colour				
Green	516.69	486.19	443.66	482.18
Red	596.13	563.25	515.32	558.24
White	576.24	543.95	497.38	539.19
Black	443.91	415.60	378.01	412.51
S. Em.±	9.60	9.45	8.79	8.94
C.D. (p=5%)	27.60	27.17	25.26	25.35
Shading intensity				
35%	449.16	420.69	382.74	417.53
50%	579.63	547.24	500.44	542.44
75%	570.94	538.82	492.60	534.12
S. Em.±	8.32	8.19	7.61	7.75
C.D. (p=5%)	23.90	23.53	21.88	21.95

4. CONCLUSION

Based on the results of three-year experimentation it may be concluded that capsicum gave maximum average fruit weight, average fruit length and yield in red color shade net with 50 per cent shading intensity. For getting higher yield of capsicum, red coloured shade net with 50 per cent shading intensity would be ideal under protected conditions of shade net.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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