ENGINEERING AND TECHNOLOGY IN INDIA

Volume 6 | Issue 1 | Apr, 2015 | 29-34
e ISSN-2230-9284 | Visit us : *www.researchjournal.co.in*
DOI : 10.15740/HAS/ETI/6.1/29-34

ARTICLE CHRONICLE :
Received : 23.02.2015;
Revised : 06.03.2015;
Accepted : 16.03.2015

RESEARCH PAPER

Response of coloured capsicum under protective cover for different irrigation and fertilizer levels

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ABSTRACT

The experiment was conducted during year 2008-09 at Hi-Tech Project, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri under shed net condition to study the response of coloured capsicum for different irrigation and fertilizer levels in terms of growth and yield. The study concluded that the coloured capsicum showed positive response to the different irrigation and fertilizer levels under shed net house over open field condition. The alternate day irrigation and split application of WSF fertilizers with different levels through drip irrigation system responded well by coloured capsicum in terms of growth and yield. The higher levels of irrigation and fertilizer were also boost the yield of coloured capsicum under shed net house. The study suggested that treatment I_3F_3 (1.0 PE, 120 % RD) gave maximum gross monetary returns (Rs. 239.50/m^2) and B:C ratio. (8.60).

KEY WORDS : Protective cover, Shed net, Net benefits, B:C ratio, Coloured capsicum, Drip irrigation

How to cite this Article : Kadam, U.S., Ingle, P.M., Thokal, R.T. and Mahale, D.M. (2015). Response of coloured capsicum under protective cover for different irrigation and fertilizer levels. *Engg. & Tech. in India,* **6** (1) : 29-34.

INTRODUCTION

Higher productivity of the crop is mostly governed by improved package of practices, in which efficient management of irrigation water and application of fertilizers plays vital role. Coloured capsicum is one of the important vegetable crop and mostly consumed in salads, cooked mixed and stuffed vegetable. The cultivation of capsicum needs favorable climate, proper management practices and optimum fertilizer and irrigation levels. The capsicum crop responses well when fertilizers are applied in split doses (Tumbare *et al.*, 2007). According to Khurana *et al.* (2006) application of nitrogen in four equal split doses improves the growth and yield of chilli. Atre *et al.* (2003); Antony and Singandhupe (2004) claimed that capsicum under drip irrigation with higher level of irrigation provides excellent results in term of growth and yield.

Greenhouse cultivation provides potential area for higher production of vegetables and other horticultural produce (Singh *et al.*, 2003) with excellent quality round the year even in adverse climatic conditions (Zabeltitz, 1999). Green house technology provides crop need atmospheric conditions such temperature, light, CO_2, concentration and radiation within certain permissible range to obtain the optimum yield (Atre *et al.*, 2003). The protective cover provides favorable climate condition for capsicum for germination (Pathania and Sharma, 2003), growth (Atre *et al.*, 2003; Singh *et al.*, 2003 and Brar *et al.*, 2006) and yield (Atre *et al.*, 2003; Thorat *et al.*, 2008).

The above review showed that the capsicum crop response well to irrigation and fertilizer levels under shed net/ protective condition. Many researches had worked on capsicum crop for water and fertilizer requirement independently. However, there were limited study and literature on combine study of water and fertilizer requirement under protective condition are available. Therefore, it is essential to study the capsicum crop under shed net condition for combine

effect of irrigation and fertilizer. The present work was undertaken to study the response coloured capsicum under protective cove for different irrigation and fertilizer levels in terms of growth and yield.

EXPERIMENTAL PROCEDURE

The experiment was carried out at Hi-Tech project, Central Campus, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri on sandy loam soil during year 2008-09. The experiment was planned in semi circular type shed house with off white shed net with 50 per cent opening over 220 m^2 (20 m × 11 m) area. The experiment was carried out in Split Plot Design with three main plot treatments and three sub-plot treatments with control treatment replicated thrice. The treatment includes main plot treatment: I_1: Irrigation at 0.6 PE by drip irrigation method, I_2: Irrigation at 0.8 PE by drip irrigation method and I_3: Irrigation at 1.0 PE by drip irrigation method. The irrigation schedule was done on alternate day basis.

Sub-plot treatment includes 80, 100 and120 per cent of fertilizer dose through water soluble fertilizers according to recommended does (280:30:415 NPK kg/ha). A suitable control with conventional method of irrigation was maintained. The nine treatment combinations of three irrigation schedules and four fertilizer levels were studied in split plot design with three replications and one control treatment replicated thrice. The experimental plot was 20 m × 11 m with 20 m × 0.7 m × 0.15 m treatment plots. The seedlings of capsicum were prepared in coco pit tray. The healthy 45 days seedlings of capsicum (cv. BOMBAY RED) were transplanted at spacing of 0.30 × 0.45 m on 22nd August 2008 on raised beds (20 m × 0.70 × 0.15m). One lateral commended two rows of capsicum crop.

Water soluble fertilizers of grade 19:19:19, 0:0:50 and urea (46% N) was used for fertigation levels of F_1, F_2, F_3. The water soluble fertilizers were applied with one week interval as per different treatments. The fertilizer dose was divided into thirteen equal splits. The effect of fertigation levels and irrigation levels on growth and yield contributing parameters *viz.*, number of leaves, plant height, stem girth, number of flowers, number of fruits, yield per plant and yield per square meter were observed and recorded.

EXPERIMENTAL FINDINGS AND ANALYSIS

It is seen that the maximum 90 cm depth of irrigation was applied for control treatment followed by 30.46, 40.62 and 50.78 cm as in irrigation levels I_1, I_2, and I_3, respectively through drip system. The maximum saving of water in I_1 (66.15 %) was achieved with drip irrigation over the control. It was observed that the yield of coloured capsicum differed significantly due to irrigation levels. The yield of 3.37 kg/m^2 was recoded in I_3 (1.0 PE), which was significantly superior to I_1 (0.6PE) and I_2 (0.8 PE) and I_2 (0.8 PE). The minimum of 1.83 kg/m^2 was recoded in I_1 (0.6 PE). Similar results were also confirmed by Antony and Singandhupe (2004) for capsicum, Hasan *et al.* (2008) for rose crop. Similarly, it was revealed that yield of coloured capsicum differed significantly due to fertilizer levels. The maximum yield (2.81 kg/m^2) was observed in F_3 (120 % RD) and was significantly superior over fertilizer levels F_1 and F_2. The interaction effect between irrigation levels and fertilizer levels was found significant in respect of yield. According to Khurana *et al.* (2006) split application of fertilizer improve the growth and yield of Chilli. In control the yield was very less *i.e.* 0.063 kg/m^2 over other levels.

From Table 1, it was observed that WUE ranged from 0.050 to 0.066 kg/m^2-cm due to different irrigation levels. It was revealed that maximum WUE was reported in irrigation level I_3 (1.0 PE) and fertilizer level F_3 (120 % RD). The increase in WUE was due reduction in total water applied. The above results are in close agreement reported by Thorat *et al.* (2008) for capsicum. The maximum value of FUE (34.86) was observed in fertilizer level F_2 (100 % RD) followed by F_1 and F_3, whereas, in case of irrigation levels FUE was observed maximum (46.80) in I_3 (1.0 PE) followed by I_2 (0.8 PE) and I_1 (0.6 PE). The drip irrigation system evidence maximum values of FUE as compared to those obtained with conventional method of irrigation.

Biometric and yield contributing parameters :

From Table 2, it was observed that the maximum number of levels of 71.08 was recorded in treatment combination I_1F_3 followed by I_2F_3 (70.25) treatment combination. Treatments I_2F_2, I_3F_1 and I_1F_1 were found at par. The minimum numbers of leaves were recorded in control (41.0). The individual irrigation and fertilizer levels showed non-significant effect in respect of number of leaves also the interaction effect was found to be non-significant. The maximum plant height was recorded in treatment combination I_1F_3 followed by I_2F_1. While minimum in treatment I_1F_1. The irrigation level I_2 and fertigation level F_3 recorded maximum height and minimum in I_3 and F_1. The combine effect of irrigation and fertilizer levels was found significant. Similarly the fertilizer levels also showed significant response to the plant height. But the irrigation level was found non-significant.

Table 2 also revealed that the maximum girth of 15.59 mm was recorded in treatment combination I_2F_3 and minimum in I_1F_1 (11.54 mm). The treatments I_1F_3, I_2F_1 and I_3F_2 were found at par. The minimum numbers of leaves were recorded in control. (41.0). The individual irrigation and fertilizer levels showed non-significant. The maximum plant height was recorded in treatment combination I_3F_3 followed by I_2F_1. While minimum in treatment I_1F_1. While minimum in treatment I_1F_1. The irrigation level I_2 and fertigation level F_3 recorded maximum height and minimum in I_3 and F_1. The combine effect of irrigation and fertilizer levels was found significant. Similarly the fertilizer levels also showed significant response to the plant height, but the irrigation level was found non-significant.

Table 2 also revealed that the maximum girth of 15.59 mm was recorded in treatment combination I_3F_2 and minimum in I_1F_1 (11.54 mm). The treatments I_1F_3, I_2F_1, I_3F_2 and I_2F_2 were found at par. The individual irrigation and fertigation levels and interaction had significant effect on stem girth. Regarding the number of flowers treatment combination I_1F_1, I_2F_1 were found at par. Similarly treatments I_1F_2, I_2F_3, I_3F_3 were also found at par. The individual levels of irrigation and fertilizer and interaction showed significant effect on number of flowers. The over all biometric parameters showed significant effect to individual as well as interaction except number of leaves and plant height. According Antony and Singandhupe (2004) the drip irrigation at higher irrigation level (100 % CPE) is beneficial for capsicum plant in terms of yield, better plant morphological characters. Similar results was claimed by Hasan *et al.* (2008) for rose crop grown under greenhouse.

The yield contributing parameters like number of fruits and weight of fruit per plant were also recorded. It was observed that in treatment combination I_3F_3, the number fruits per plant (10.58) was maximum over other treatments. Treatment combination I_1F_1, I_1F_2, I_1F_3, I_2F_1 and I_2F_2 were found at par. The maximum number of fruits were observed in irrigation levels was found significant in respect of number of fruits per plant. The yield of colored capsicum on plant basis for different treatments combinations was recorded. The maximum yield of 551.53 g/plant was found in treatment combination I_3F_3. The treatments I_1F_1 and I_2F_2 were found at par. In irrigation level I_3 and fertilizer level F_3 showed maximum yield per plant. This clearly indicates that interaction and individual levels of irrigation and fertilizer

Table 1 : Water and fertilizer use efficiency influenced by different levels

Levels	Yield (kg/m^2)	Water applied (cm)	WUE (kg/m^2-cm)	% water saving	Fertilizer applied (kg/m^2)	FUE
Irrigation levels						
I_1	1.83	30.46	0.060	66.15	0.072	24.41
I_2	2.04	40.62	0.050	54.86	0.072	28.33
I_3	3.37	50.78	0.066	43.57	0.072	46.80
Fertilizer levels						
F_1	1.91	40.62	0.047	54.86	0.058	32.93
F_2	2.51	40.62	0.062	54.86	0.072	34.86
F_3	2.81	40.62	0.069	54.86	0.087	32.29
Control	0.063		0.0007		0.072	0.875
	Irrigation levels	Fertilizer levels	Interaction			
S.E. ±	1.89	1.66	2.88			
C.D. (P=0.05)	7.42	5.12	8.87			

showed maximum yield per plant. This clearly indicates that interaction and individual levels of irrigation and fertilizer showed significant effect on yield per plant. The yield per square meter area was also noted. The results claimed that in treatment combination I_3F_3 the maximum yield of 4.08 kg/m^2 was obtained followed by treatment combination I_3F_2 (3.56 kg/m^2). The minimum yield of 1.49 kg/m^2 obtained in I_1F_1. The maximum yield of 3.37 kg/m^2 was measured in irrigation level I_3 and minimum in I_1. The fertilizer level F_3 recorded maximum yield (2.81 kg/m^2) over other levels. The individual levels as well as interaction responded significant. The study also found that the fruit quality under shed net house was excellent that control. The yield contributing parameters also confirm significant effect to individual as

Table 2 : Biometric and yield contributing parameters influenced by different treatments

Treatments	No. of leaves	Plant height (cm)	Stem girth (mm)	No. of flowers	No. of fruits/plant	Yield (g/plant)	Yield (kg/m^2)
$T_1 = I_1F_1$	56.25	62.42	11.54	6.75	4.75	242.05	1.79
$T_2 = I_1F_2$	61.25	77.25	12.96	8.08	4.83	289.05	2.14
$T_3 = I_1F_3$	71.08	93.08	13.67	9.50	4.33	211.25	1.56
$T_4 = I_2F_1$	67.17	85.33	13.53	6.33	4.42	201.22	1.49
$T_5 = I_2F_2$	55.17	73.42	13.15	5.17	4.83	245.87	1.82
$T_6 = I_2F_3$	70.25	83.75	15.59	7.92	7.17	378.60	2.80
$T_7 = I_3F_1$	55.92	74.83	14.05	7.83	6.42	331.48	2.45
$T_8 = I_3F_2$	60.25	76.83	13.32	6.00	9.75	481.87	3.56
$T_9 = I_3F_3$	47.33	73.58	13.06	15.33	10.58	551.53	4.08
T_{10} =Control	41.00	62.00	15.00	5.00	2.00	9.00	0.063
I × F	60.52	77.83	13.50	8.94	6.34	325.89	2.42
S.E. ±	6.59	3.49	0.49	1.28	0.24	3.89	2.88
C.D. (P=0.05)	NS	10.79	1.51	3.95	0.75	12.00	8.87
I_1	62.86	77.58	12.94	7.66	4.64	247.45	1.83
I_2	64.19	80.83	14.08	6.08	5.47	275.23	2.04
I_3	54.50	75.08	13.47	13.05	8.91	454.96	3.37
S.E. ±	2.43	1.17	0.15	0.73	0.26	2.83	1.89
C.D. (P=0.05)	NS	NS	0.61	2.85	1.04	11.12	7.42
F_1	59.78	74.19	13.26	6.36	5.19	258.25	1.91
F_2	58.89	75.83	13.14	9.86	6.47	338.63	2.51
F_3	62.89	83.47	14.11	10.58	7.36	380.46	2.81
S.E. ±	3.80	2.02	0.28	0.47	0.14	2.25	1.66
C.D. (P=0.05)	NS	6.21	0.87	2.28	0.43	6.93	5.12

NS=Non–significant

Table 3 : WUE (kg/m^2-cm), FUE and cost economic (Rs./m^2) for different treatments

Particulars	WUE (kg/m^2-cm)	FUE	Cost of production Rs./m^2	Gross monetary returns, Rs./m^2	Net income Rs./m^2	B:C ratio
I_1F_1	0.059	30.86	22.06	107.58	85.51	4.88
I_1F_2	0.070	29.72	24.93	128.61	103.69	5.16
I_1F_3	0.051	17.93	27.80	93..81	66.01	3.38
I_2F_1	0.037	25.69	22.10	89.81	67.71	4.06
I_2F_2	0.045	25.28	27.96	109.87	84.89	3.93
I_2F_3	0.069	32.18	27.83	168.45	140.62	6.05
I_3F_1	0.048	42.24	22.13	147.33	125.2	6.66
I_3F_2	0.070	49.44	24.99	214.16	189.27	.57
I_3F_3	0.080	46.90	27.86	239.5	211.64	8.60
Control	0.001	0.88	18.10	4.03	-14.06	0.22

well as interaction in terms of yield. The yield under protective over *i.e.* shed net was more than control might be due to favourable conditions like optimum temperature, light intensity and relative humidity. These results were also confirmed by Basavaraje *et al.* (2003); Ghosal and Tiwari (2001).

WUE, FUE and cost economics :

The maximum water use efficiency of 0.080 kg/m^2-cm was observed for treatment I_3F_3 followed by I_1F_2 and I_3F_2. The minimum water use efficiency of 0.037 kg/m^2-cm was found in treatment combination I_2F_1 which is due to more application of water and less yield obtained. The treatment I_1F_3, I_2F_2, I_3F_1 were found at par. From Table 3, the maximum fertilizer use efficiency of 49.44 was recorded in I_3F_2 followed by I_3F_3. The minimum fertilizer use efficiency was observed in treatment I_1F_3, which was due to higher level of fertilizers and less yield obtained. The treatments I_1F_3, which was due to higher level of fertilizers and less yield obtained. The treatments I_1F_1, I_1F_2, I_2F_3 were found at par. In control treatment the fertilizer use efficiency was 0.97. The cost of production was maximum in treatment I_3F_3 (Rs. 27.86/m^2) due to higher dose of fertilizers and minimum in I_1F_1 (Rs. 22.06/m^2). In control treatment the cost of production was Rs. 18.10/m^2. The gross monetary return was maximum in treatment combination I_3F_3 (Rs. 239.50/ m^2) due to more yield and minimum in treatment combination I_2F_1 (Rs. 89.81/m^2) due to less yield. In control treatment gross monetary return was Rs. 4.03/m^2. The net income of Rs. 211.64/m^2 was observed in treatment combination I_3F_3 due to higher gross monetary returns and minimum in I_1F_3 (Rs. 66.01/m^2). According to Singh *et al.* (2003) the cultivation of capsicum under greenhouse will not only help in getting higher productivity but also fetch better returns because of the premium price for excellent quality produce that will be available in the off-season. In control treatment there was loss of Rs. 14.06/m^{2}was observed. This indicate the under control treatment the coloured capsicum showed less response to irrigation and fertilizer levels. Similar results were closed agreement with green capsicum (Atre *et al*., 2003; Antony and Singamdhupe, 2004; Brar *et al.*, 2006 and Thorat *et al*., 2008).

Conclusion :

The study concluded that the coloured capsicum showed positive response to the different irrigation and fertilizer levels under shed net house over open field condition. The alternate day irrigation and split application of WSF fertilizers through drip irrigation system responded will by coloured capsicum in terms of growth and yield. The higher levels of irrigation and fertilizer were also boost the yield of coloured capsicum under shed net house. The study suggested that treatment I_3F_3 (1.0 PE, 120 % RD) gave higher yield with excellent quality, maximum gross monetary returns, net benefits and B:C ratio.

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