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Original Research Article

Effect of Irrigation and Fertilizer Levels on Growth and Yield of Chilli (*Capsicum annuum* L.)

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A B S T R A C T

The field investigation entitled "Fertigation studies in chilli (*Capsicum annuum* L.) Cv. PBNC-1." was conducted during *Rabi* season of 2016-17 at experimental field of AICRP on Water Management, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani with a view to find out the optimum level of irrigation and fertigation for better growth and yield of chilli (*Capsicum annuum* L.) Cv. PBNC-1." The experiment was laid out in factorial randomised block design with three replication comprising three irrigation level of (0.6 PE, 0.8 PE. and 1.0 PE) and three fertilizer levels (60% RDF (100:50:50 NPK kg ha-1), 80% RDF and 100% RDF) there by involving nine treatment combinations on chilli Cv. PBNC-1. The seedlings were transplanted on dated 10 October, 2017 and all recommended cultural practices were followed. Among the different treatment combination I_3F_3 (1.0 PE + 100% RDF) noted highest plant growth and yield in respect to plant height (88.86 cm), stem diameter (5.03 cm), number of leaves (847.00), leaf area (973.33 cm^2), plant spread (66.90cm), and fruit yield (14.03 t/ha). The treatment combination of I_3F_3 (1.0 PE + 100% RDF) performed well in respect of growth which showed results viz. reduction in days required for flower initiation (20.84 days), days required for 50% flowering (68.90 days), and days required for first harvesting (37.23 days). Amongst all the treatment combinations I_3F_3 (1.0 PE + 100% RDF) recorded maximum growth and yield

Keywords

Chilli, plant height, diameter, leaves, fruit and yield

Introduction

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae and originated in Tropical America. It is most important spice crop of the world and is widely cultivated throughout the warm, temperate, tropical and subtropical countries. India is the largest producer, consumer and exporter of chilli, which contributes about 40 per cent of total world production. In India, chilli occupied an area of 760.98 thousands hectare with annual production of 1605.01 thousands Mt and its productivity is 1.64 Mt/ha. Maharashtra contribute 99.50 thousands hectare area with annual production of 45.60 thousands Mt/ha and productivity is of 0.45 Mt/ha (Anonymous, 2015).

Water is a major component for sustainable development of crop and an indispensable resource which needs careful handling and proper management in order to achieve maximum yield and better water use efficiency. The drip irrigation system helps to protect, conserve this valuable resource and it is a potential system which could bring additional area under cultivation of crops with the same quantity of available water. Micro irrigation and fertigation

opened new possibilities for controlling water and nutrients to crops, maintaining the desired concentration distribution in the soil. It is possible to increase the yield by three times with the same quantity of water, saving about 45 to 50 per cent of water and increasing the productivity about 40 per cent.

Fertigation is supplying fertilizers along with irrigation is one of the most effective and convenient method of supplying nutrients of water according to requirements of crop to maintain optimum soil fertility and to increase the quality of the produce (Shirgure *et al.,* 1999).

(Prabhakar and Hebbar 1999) conducted trials at IIHR, Bangalore and reported that highest fruit yield of capsicum hybrid Green Gold was obtained with 100 per cent fertigation using water soluble fertilizers, irrigated at 0.7 Epan level. The higher yield was the result of better plant growth coupled with yield components like more number of marketable fruits per plant and higher fruit size. To be more competitive in today's market of vegetables, the vegetable growers are looking for new ways to achieve superior quality produce with higher yields than the conventional methods. Presently, the vegetable crop production suffers mainly on the availability of water and nutrients. The water and fertilizer use efficiency through drip fertigation method can be maximized by the improved techniques, here an experiment is undertaken.

Materials and Methods

The present experiment was conducted on experimental field of All India Coordinated Research Project on Water Management, Sub Campus Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Rabi* season of 2016-2017. Seeds of PBNC-1 were obtained from the Vegetable Research Scheme and seedlings were prepared on raised beds of 3.0 x 1.0 x 0.15 m^3. The uniform healthy seedlings six weeks were transplanted on flat beds on dated 10th October 2016, at 60 cm x 45 cm and light irrigation was given till the seedlings were established, gap filling was done with healthy seedlings wherever required.

The details of treatments are A) Factor A *i.e.* I_1- Irrigation of 0.6 PE by drip, I_2- Irrigation of 0.8 PE by drip, I_3- Irrigation of 1.0 PE by drip B) Factor B *i.e.* F_1- 60% RDF (Recommended Dose of Fertilizer, F_2- 80% RDF F_3- 100% RDF and Control- surface irrigation. Recommended dose of fertilizer (RDF):100:50:50 (N: P: K) kg/ha. The daily pan evaporation data measured by U.S.W.B. class-A pan evaporimeter at Instructional Farm, Department of Meteorology, V.N.M.K.V. Parbhani was collected during experimental period. The collected data was analysed by statistical method suggested by Panse and Sukhatme (1985).

Results and Discussion

The data was presented in Table 1 as influenced by irrigation, fertilizer levels and their interactions on growth parameters of chilli.

Plant height

Effect of irrigation levels

At all the growth stages irrigation levels did not influences significantly plant height.

Effect of fertilizer levels

Application of fertilizer through drip irrigation significantly increased the plant height. With respect to fertilizer levels, highest plant height (87.08 cm) was found in

treatment F_3 (100% RDF) however lowest plant height (76.48 cm) was found in treatment F_1 *i.e.* (60% RDF).

Interaction of (I X F)

The interaction effect of irrigation and fertilizer levels on plant height (I X F) was found to be non-significant.

Application of fertilizers especially nitrogen enhances chlorophyll synthesis which causes an increase in carbohydrate synthesis, which in turn responsible for higher vegetative growth. These result are in the agreement with Ughade and Mahadkar (2015) and Tumbare and Bhoite (2002).

Stem diameter (cm)

Effect of irrigation levels

The effect of irrigation levels on diameter of stem shows non-significant.

Effect of fertilizer levels

Significantly maximum stem diameter (2.69 cm) was observed in treatment F_3 *i.e.* 100% RDF and minimum stem diameter was found in F_1 (2.35 cm).

Interaction of (I X F)

An interaction of irrigation and fertilizer levels on stem diameter of chilli was found to be non-significant. These findings are supported by Imamsaheb *et al.*, (2011).

Number of leaves per plant

Effect of irrigation levels

With respect to irrigation levels, higher number of leaves per plant (788.24) were found in treatment I_3 (1.0 PE) and lowest number of leaves per plant (726.96) were found in treatment I_1 *i.e.* (0.6 PE).

Effect of fertilizer levels

Significantly highest number of leaves per plant (823.24) was observed in treatment F_3 *i.e.* 100% RDF and lowest number of leaves (695.89) was found in treatment F_1 *i.e.* 60% RDF.

Interaction of (I X F)

Maximum number of leaves (847.00) was found in treatment combination of I_3F_3 *i.e.* 1.0 PE + 100% RDF which was at par with treatment combination of I_2F_3 *i.e.* 0.8 PE + 100% RDF (822.27).

Increased number of leaves due to the application of irrigation levels and fertilizer levels were also reported by Ughade and Mahadkar (2015), Chaurasiya and Sahu (2016) and Kapoor *et al.*, (2013).

Leaf area (cm^2)

Effect of irrigation levels

Significantly highest leaf area (582.22 cm^2) was observed in treatment I_3 *i.e.* (1.0 PE) while lowest leaf area (475.28 cm^2) was observed in I_1 *i.e.* (0.6 PE).

Effect of fertilizer levels

Significantly maximum leaf area (661.67 cm^2) was recorded in treatment F_3 *i.e.* 100% RDF and minimum leaf area (398.11 cm^2) was observed in F_1 *i.e.* 60% RDF.

Interaction of (I X F)

Significantly higher leaf area (713.33 cm^2) was found in treatment combination of I_3F_3 *i.e.* 1.0 PE + 100% RDF which was

statistically at par with treatment combination of I_2F_3 (675.00 cm^2) and lower leaf area (339.67 cm^2) was found in control.

Increase in leaf area in chilli due to increase in irrigation and fertilizer levels, similar results were also reported by Fifah *et al.*, (2015) and Imamsaheb *et al.,* (2011).

Plant spread (cm)

Effect of irrigation levels

The results indicate that the effect of irrigation levels on plant spread was found to be non-significant.

Effect of fertilizer levels

Significantly maximum plant spread (63.94 cm) was recorded in treatment F_3 *i.e.* 100% RDF however minimum leaf area (56.28 cm) was observed in F_1 *i.e.* 60% RDF.

Interaction of (I X F)

Highest plant spread (66.90 cm) was found in treatment combination of I_3F_3 *i.e.* (1.0 PE + 100% RDF) which was at par with treatment combination of I_2F_3 (63.65 cm), I_1F_3 (61.28 cm), I_3F_2 (59.96 cm), I_2F_2 (59.63 cm) and I_1F_2 (59.20 cm).

However lowest plant spread (54.96 cm) was found in control. These results are in close agreement with Ughade and Mahadkar, (2015) they found that in brinjal the fertigation level F_1 (100 per cent RDF through drip (WSF)) recorded maximum (73.75 cm) plant spread.

Yield parameters

The data presented in Table 2 indicates that the irrigation, fertilizer levels and their interactions on yield parameter of chilli

Days required for flower initiation

Effect of irrigation levels

The irrigation levels did not shows significant effect on days to initiation of flowering.

Effect of fertilizer levels

The effect of fertilizer levels on days required for initiation of flowering was significant. The fertigation level F_3 (100% RDF) required minimum days to flowering initiation (21.78 days).

Interaction of (I X F)

With respect to flower initiation, treatment combination of I_3F_3 *i.e.* 1.0 PE + 100% RDF recorded significantly minimum days for flower initiation (20.84 days) which was statistically at par with treatment combination of I_2F_3 (21.82 days), I_1F_3 (22.69 days) and I_3F_2 (23.71 days). However maximum days required for flower initiation (29.12 days) were found in control. These results are in agreement with Sharma *et al.*, (2010) in tomato, (Pariari and Khan 2013) in chilli.

Days required for 50 per cent flowering

Effect of irrigation levels

The effect of irrigation levels on days required for 50 per cent flowering was found to be non-significant.

Effect of fertilizer levels

Effect of fertilizer levels on days required for 50 per cent flowering was found significant. The minimum days in required for 50 per cent flowering were observed in F_3 (69.91 days) while maximum days

required for 50 per cent flowering in F_1 (84.15 days).

Interaction of (I X F)

Significantly minimum days required for 50 per cent flowering (68.90 days) was found in treatment combination of I_3F_3 *i.e.* 1.0 PE + 100% RDF which was at par with treatment combination of I_2F_3 *i.e.* 0.8 PE + 100% RDF (69.20 days) and I_1F_3 *i.e.* 0.6 PE + 100% RDF (69.45 days). However maximum days required for 50 per cent flowering (86.07 days) were found in control.

Days required for flowering to harvesting

Effect of irrigation levels

The effect of irrigation levels on days required for flowering to harvesting shows significant effect. The minimum days required for flowering to harvesting in I_3 (1.0 PE) (40.18 days) as compared to I_1 (45.72 days) and I_2 (42.13 days).

Effect of fertilizer levels

The effect of fertilizer levels on days required for flowering to harvesting shows significant effect. The minimum days required for flowering to harvesting (39.37 days) was observed in F_3 (100% RDF) however maximum days (46.40 days) was recorded in *i.e.* F_1 (60% RDF).

Interaction of (I X F)

With respect to days required for flowering to harvesting, treatment combination of I_3F_3 *i.e.* 1.0 PE + 100% RDF recorded significantly minimum days required for flowering to harvesting (37.23 days) which was statistically at par with treatment combination of I_2F_3 (38.90 days), I_3F_2 (39.43 days) and I_1F_3 (42.00 days). However maximum days required for flowering to harvesting (50.33 days) found in control.

Fruit yield (t/ha)

Effect of irrigation levels

The effect of irrigation levels on fruit yield (t/ha) was found to be significant. Significantly highest fruit yield (11.91 t/ha) was recorded in I_3 (1.0 PE) and minimum fruit yield (8.72 t/ha) was recorded in I_1 (0.6 PE).

Effect of fertilizer levels

The effect of fertilizer levels on fruit yield (t/ha) was found to be significant. The results indicate that, maximum fruit yield (12.59 t/ha) was observed in treatment F_3 *i.e.* (100% RDF) and lower fruit yield (9.03 t/ha) was found in F_1 *i.e.* (60% RDF).

Interaction of (I X F)

Treatment combination of I_3F_3 recorded significantly maximum fruit yield (14.03 t/ha) which was statistically at par with treatment combination I_2F_3 (12.88 t/ha). However minimum fruit yield (9.66 t/ha) was found in control. These results are in agreement with Ughade and Mahadkar 2015, Krishnamoorthy *et al.,* 2014, Imamsaheb *et al.,* 2011 and Hebbar *et al.,* 2004. On the basis of present findings it can be concluded that application of 1.0 PE + 100% RDF was significantly effective for enhancive growth parameters.

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Table.1 Effect of irrigation, fertilizer levels and their interactions on growth parameters of chilli

Treatments	Plant height (cm)	Stem diameter (cm)	Number of leaves per plant	Leaf area (cm^2)	Plant spread (cm)
Factor A – Irrigation levels (I)					
I_1 (0.6 PE)	79.76	5.11	726.96	475.28	58.83
I_2 (0.8 PE)	80.68	5.13	764.30	540.56	59.85
I_3 (1.0 PE)	86.37	5.16	788.24	582.22	61.14
SE±	**1.93**	**0.16**	**17.47**	**11.09**	**1.43**
CD at 5 % level	**NS**	**NS**	**52.31**	**33.22**	**NS**
Factor B – Fertilizer levels (F)					
F_1 (60% RDF)		5.09	695.89	398.11	56.28
F_2 (80% RDF)	83.25	5.13	760.37	538.28	59.67
F_3 (100% RDF)	76.48	5.18	823.24	661.67	63.94
SE±	**1.93**	**0.16**	**17.47**	**11.09**	**1.43**
CD at 5 % level	**5.80**	**NS**	**52.31**	**33.22**	**4.28**
Interactions (I X F)					
I_1F_1	70.20	5.08	643.03	347.66	56.03
I_1F_2	83.67	5.12	737.37	481.50	59.20
I_1F_3	85.41	5.15	800.47	596.66	61.28
I_2F_1	75.96	5.09	711.57	406.66	56.26
I_2F_2	79.13	5.14	759.07	540.00	59.63
I_2F_3	86.97	5.18	822.27	675.00	63.65
I_3F_1	83.28	5.11	733.06	440.00	56.56
I_3F_2	86.97	5.15	784.67	593.33	59.96
I_3F_3	88.86	5.21	847.00	713.33	66.90
Control	74.46	5.03	651.73	339.67	54.96
SE±	**3.35**	**0.28**	**13.26**	**19.22**	**2.47**
CD at 5 % level	**NS**	**NS**	**39.78**	**67.95**	**7.05**

Table.2 Effect of irrigation, fertilizer levels and their interactions on yield parameter of chilli

Treatments	Days required for flower initiation	Days required for 50% flowering (days)	Days required for flowering to harvesting (days)	Fruit yield/ha (ton)
Factor A – Irrigation levels (I)				
I_1 (0.6 PE)	24.87	77.40	45.72	8.72
I_2 (0.8 PE)	24.20	77.00	42.13	10.20
I_3 (1.0 PE)	23.60	76.69	40.48	11.91
SE±	**0.63**	**1.99**	**1.01**	**0.57**
CD at 5 % level	**NS**	**NS**	**3.04**	**1.72**
Factor B – Fertilizer levels (F)				
F_1 (60 % RDF)	26.29	84.15	46.40	9.03
F_2 (80 % RDF)	24.60	77.75	42.57	10.21
F_3 (100%RDF)	21.78	69.91	39.37	12.59
SE±	**0.63**	**1.99**	**1.01**	**0.57**
CD at 5 % level	**1.89**	**5.98**	**3.04**	**1.72**
Interactions (I X F)				
I_1F_1	26.40	84.54	49.64	7.85
I_1F_2	25.53	78.21	45.53	8.37
I_1F_3	22.69	69.45	42.00	9.96
I_2F_1	26.22	84.16	46.43	9.48
I_2F_2	24.56	77.64	42.74	10.29
I_2F_3	21.82	69.20	38.90	12.88
I_3F_1	26.26	83.76	43.13	9.76
I_3F_2	23.71	77.40	39.43	11.93
I_3F_3	20.84	68.90	37.23	14.03
Control	29.12	86.07	50.33	9.66
SE±	**1.09**	**1.46**	**1.75**	**0.79**
CD at 5 % level	**3.26**	**4.22**	**5.15**	**1.20**

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