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RESEARCH PAPER

Growth and yield of chilli as influenced by spacing under greenhouse condition

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Abstract : An experiment was conducted at water management research unit of Kerala Agricultural University, Thrissur during 2011 and 2012 from June to November to asses the optimum spacing requirement of chilli grown inside greenhouse. Experiment was laid out in Randomized Block Design with four treatments and five replications. Treatments consisted of three spacing *viz.*, 45 × 45 cm, 50 × 50 cm and 55 × 55 cm in the greenhouse condition and it was compared with chilli grown under open field condition with spacing of 45 × 45 cm. Results revealed that chilli performed better under greenhouse condition than under open condition during rainy season. Spacing had significant influence on the growth and yield of chilli under green house condition. Spacing of 50 × 50 cm recorded highest yield followed by 55 × 55 cm.

Key Words : Protected cultivation, Spacing, Greenhouse, Yield

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INTRODUCTION

Protected cultivation is a widely used technology to achieve optimum plant growth and more yield from unit area with increased input use efficiency (Senger and Kothari, 2008). This technique can play vital role in the developing coutnries like Indian for increasing agricultural production and productivity. Off season cultivation is also possible under the greenhouse due to the improved microclimate inside it (Panwar *et al.*, 2009). In tropical region during rainy season greenhouse act as a rain shelter (Wani *et al.*, 2011). Prolonged rain could results inadequate maintenance of soil air, shedding of flowers, washing away of added nutrients as well as invitation of plant diseases. All these can be avoided by cultivating inside the greenhouse (Nair and Barche, 2014).

Chilli is a crop which can be grown in rainy season. Protected cultivation increases production and improves quality of produce. Cultivation under greenhouse increases vegetative growth of plant invariably (Juan *et al.*, 2007 and Panwar *et al.*, 2009). As such there is a need for an increase in spacing for crops grown in greenhouse conditions, so as to avoid mutual shading and competition for added inputs. Protected cultivation of vegetables emphasizes the need for having appropriate plant densities in order to boost-up the production per unit area (Zende, 2008). There is not much information available about the optimum plant density under

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greenhouse cultivation of various vegetables. Hence, this study was planned to find out the effect of spacing on growth and yield of chilli under the improved climatic conditions of a greenhouse.

MATERIAL AND METHODS

Field experiment was conducted in greenhouse and open condition during 2011 and 2012 from June to November at the Water Management Research Unit, Kerala Agricultural University, Vellanikkara, Thrissur. The site was located at 100 31' N latitude and 760 13' E longitude at an altitude of 40m above mean sea level. Chilli variety 'Anugraha' was selected for the study. It was cultivated in three different spacing such as 45×45 cm, 50×50 cm and 55×55 cm in the greenhouse and a spacing of 45×45 cm in the open condition. Drip irrigation was given to chilli under greenhouse condition, whereas, chilli grown in open condition was kept as rain fed. Fertilizers were applied as per package of practices recommendation of KAU (25t FYM, 37.5 kg N, 40 kg P_2O_5, 12.5 kg K_2O per ha as basal dose, 18.75kg N, 12.5 kg K_2O per ha 20 days after planting, 18.75 kg N per ha two months after planting), Experiment was laid out in Randomized Block Design with five replications and fifteen plants per plot.

A gable type greenhouse, oriented in north-south direction and having an area of 100 sq m. was used for the study. UV stabilized low density polyethylene sheet of 200 micron thickness was used as roofing material of the greenhouse. Partial air circulation was allowed by covering sides of the greenhouse using antivirus shade nets. One meter wide top ventilation, covered with antivirus shade net, was given in whole length of the roof.

Various biometric parameters were recorded from three observation plants in each plot at three weeks interval. Harvesting started after two months from planting. The data were analysed using ANOVA and mean separated least significant difference.

Statistical analysis :

The obtained data was analyzed by statistical significant at $P<0.05$ level, S.E. and C.D. at 5 per cent level by the procedure given by (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Plants grown under greenhouse showed significant difference in height with plants grown in open condition (Table 1). Height of the plants grown under greenhouse was more than double of the plants grown in open condition. The increase in height of plants may be due to improved microclimate inside the greenhouse. In the greenhouse plants with lowest spacing (45 × 45 cm) recorded the highest plant height (93.38 cm). This may be due to the competition among plants for light and other nutrients when plant density increases under greenhouse. Jovicich *et al.* (1999) and Zende (2008) also reported that stem length increases linearly with decrease in plant spacing inside the green house.

Table 1 : Plant height in (cm) of chilli as influenced by treatments

Sr. No.	Treatments	Pooled data		
		3 weeks after planting	6 weeks after planting	9 weeks after planting
1.	T_1-Insidegreenhouse, 45×45cm	20.15	83.43	93.38
2.	T_2- inside greenhouse, 50×50cm	18.72	80.45	88.88
3.	T3- inside greenhouse, 55×55cm	16.77	68.48	31.38
4.	T_4- open field 45×45cm	9.50	26.10	32.67
	C.D. (P=0.05)	2.099	7.996	8.869

Table 2 : Number of branches of chilli as influenced by treatments

Sr. No.	Treatments	Pooled data	
		6 weeks after planting	9 weeks after planting
1.	T_1- inside greenhouse, 45×45cm	7.20	17.65
2.	T_2- inside greenhouse, 50×50cm	9.30	21.70
3.	T_3- inside greenhouse, 55×55cm	8.70	22.25
4.	T_4- open field 45×45cm	4.60	9.90
	C.D. (P=0.05)	1.734	2.274

Table 3 : Number of leaves of chilli as influenced by treatments

Sr. No.	Treatments	Pooled data		
		3 weeks after planting	6 weeks after planting	9 weeks after planting
1.	T_1- inside greenhouse, 45×45cm	11.45	54.55	80.05
2.	T_2- inside greenhouse, 50×50cm	13.30	82.85	113.55
3.	T_3- inside greenhouse, 55×55cm	11.30	64.25	96.85
4.	T_4- open field 45×45cm	11.70	29.40	48.20
	C.D. (P=0.05)	NS	15.43	19.51

NS=Non-significant

Table 4 : Yield of chilli as influenced by treatments

Sr. No.	Treatments	Ist year		IInd year		Pooled data	
		g/plant	t/ha	g/plant	t/ha	g/plant	t/ha
1.	T_1- inside greenhouse, 45×45cm	566.6	27.76	173.6	8.51	370.10	18.13
2.	T_2- inside greenhouse, 50×50cm	818.4	32.74	304.4	12.18	561.40	22.46
3.	T_3- inside greenhouse, 55×55cm	763.8	25.20	282	9.31	523.90	17.26
4.	T_4- open field 45×45cm	480.0	23.52	120.8	5.92	300.40	14.72
	C.D. (P=0.05)	60.40	2.573	39.88	1.554	33.17	1.483

Plants grown under the greenhouse showed more branching tendency than plants grown in open condition (Table 2). Within the greenhouse 45cm × 45cm spacing gave significantly lower number of branches (17.65) and 55 cm × 55 cm spacing recorded the highest value (22.25). 50 × 50 cm spacing was equally effective as that of widest spacing in the production of branches. Wider spacing treatments produced more stout plants with more number of branches. This may be due to reduced competition for space and nutrients. This agree with the finding of Rasha *et al.* (2013), that increase in plant spacing significantly increased plant branching under greenhouse.

During early stages of growth there was no difference in number of leaves under greenhouse and open condition (Table 3). Whereas the later stages showed significant difference in leaf production. Growing chilli under greenhouse condition resulted in more number of leaves compared to the open condition. Considering the different levels of spacing inside the greenhouse, 50 cm × 50 cm spacing recorded highest number of leaves (113.55). Closer spacing (45 cm × 45 cm) recorded significantly less number of leaves compared to wider spacing levels (Tiwari *et al*., 2013).

Difference in growth rate of plants between various treatments reflected in the yield also. Yield per plant was significantly higher in 50 × 50 cm and 55 × 55 cm spacing plots as compared to normal spacing under the greenhouse and open condition (Table 4). Under greenhouse cultivation yield per plant was increased with decrease in plant population due to less competition among the plants for space and nutrients. Jiang *et al.* (2013) opined that in summer maize narrow plant spacing generates less root biomass and reduced the reductive activity of roots, thereby resulted in low yield per plant. Even though per plant yield was higher in widest spacing 55×55 cm, it was not reflected in per hectare yield. This may be due to reduced plant population under this spacing level. The 50×50 cm spacing under greenhouse recorded highest yield in gram per plant as well as tones per ha and in this case improved production per plant due to enhanced plant spacing overcome the reduction in plant population.

Performance of chilli under green house and open condition were poor during the second year. This may be due to fungal attack occurred during this year. But, in both years different treatments showed a same trend in growth and yield parameters.

Excellent performance of plants in growth and yield was obtained under greenhouse cultivation. Improved growth of plants under greenhouse condition requires more space than recommended one for open field. Even though increase in spacing increased yield per plant under greenhouse, beyond a certain limit it affected the production per unit area due to reduction in plant density. From this study 50 × 50 cm plant spacing was found best for chilli under greenhouse.

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