

Effect of Fertigation Levels and Different Spacings on Yield and Yield Attributes of Bell Pepper (*Capsicum annuum* L.var.grossum sendt.) in Polyhouse condition

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Abstract— An experiment was carried out in bell pepper (*Capsicum annuum* L.var.grossum sendt.) to study the influence of fertigation levels and different spacings on yield and yield attributes under polyhouse condition. The perusal of the data revealed that widely spaced (45 cm x 60 cm) plants produced the highest number of fruits plant⁻¹ (13.75), fruit girth (25.23 cm) and fruit yield plant⁻¹ (1.53 kg) while fruit yield m⁻² (8.92 kg) was the highest for closely spaced (45 cm x 30 cm) plants. Yield and yield attributes were significantly influenced by fertigation levels. Among the fertigation levels, 100 % *ad hoc* recommendation of KAU for precision farming (230: 25: 250 N, P₂O₅ and K₂O kg ha⁻¹) registered the highest number of fruits plant⁻¹ (15.15), fruit girth (26.24 cm), fruit yield plant⁻¹ (1.72 kg) and fruit yield m⁻² (8.30 kg).

Keywords— bellpepper, fertigation, spacing, foliar nutrition, yield and yield attributes.

I. INTRODUCTION

Bell pepper (*Capsicum annuum* L.var.grossum sendt.) also known as capsicum, sweet pepper or shimla mirch is one among the most popular vegetables grown in polyhouses worldwide. The bell pepper fruits are available in different attractive colours and they have great demand in markets. Bell pepper is rich in proteins, vitamin A, ascorbic acid, riboflavin, thiamin, niacin and minerals like potassium, magnesium and calcium (Joshi and Singh, 1975). Being a cool season crop, year round production of quality bell pepper fruits is not possible in open field condition. Crops are more vulnerable to weather fluctuations in open field (Ochigbu and Harris, 1989) with more pests and diseases incidence leading to low productivity as well as quality. Protected cultivation techniques can be effectively utilized for the production of good quality produce with high productivity. Compared to open field cultivation, polyhouse cultivation resulted in 2-3 times yield enhancement in bell pepper (IIHR, 2011). Efficient and optimum application of fertilizer under protected condition ensures improved growth, yield and quality of bell pepper along with minimized loss of inputs

and increased economic benefits. Adoption of appropriate plant spacing is one of the important aspects of successful crop production. Optimum plant spacing ensures proper growth and development of plants resulting in maximum yield of crop and economic use of land.

II. MATERIALS AND METHODS

A field trial was done to study the influence of fertigation levels and different spacings on yield and yield attributes of bell pepper under polyhouse condition. The soil of experiment plot was sandy clay loam, acidic in reaction, high in organic carbon and available phosphorus, low in available nitrogen and potassium. The study was laid out in split plot design with 12 treatment combinations replicated three times. The main plot treatments consisted of four levels of fertigation viz., 100 % *ad hoc* recommendation of KAU for precision farming (F₁), 50 % *ad hoc* recommendation of KAU for precision farming (F₂), 50 % *ad hoc* recommendation of KAU for precision farming + foliar spray of combined solution of urea and potassium chloride each at 1.25 % at 30 and 60 DAT (F₃) and 25 % *ad hoc* recommendation of KAU for precision

farming + foliar spray of combined solution of urea and potassium chloride each at 1.25 % at 30 and 60 DAT (F₄). Farmyard manure @ 25 t ha⁻¹ was given as basal to all the treatments. The KAU *ad hoc* recommendation of bell pepper for precision farming is 230:25:250 N, P₂O₅ and K₂O kg ha⁻¹ as fertigation along with 24 kg ha⁻¹ rajphos as basal. The details of nutrients used for fertigation as per KAU *ad hoc* recommendation of bell pepper for precision farming are given in Table 1. For treatments requiring foliar nutrition combined solution of urea and potassium chloride each at 1.25 % was given. The subplot treatments consisted of three spacings viz., 45 cm x 30 cm (S₁), 45 cm x 45 cm (S₂) and 45 cm x 60 cm (S₃).

Table 1. Fertigation schedule as per KAU *ad hoc* recommendation of bell pepper for precision farming

Time of application	Fertilizer	Kg ha ⁻¹
Basal	Rajphos	24
3 DAP to 18 DAP	19:19:19	3.150
	13:00:45	3.700
	46:00:00	10.100
	12:61:00	0.000
21 DAP to 54 DAP	19:19:19	1.580
	13:00:45	14.700
	46:00:00	3.700
	12:61:00	0.490
57DAT to 120 DAT	19:19:19	1.580
	13:00:45	14.700
	46:00:00	9.500
	12:61:00	0.490

III. RESULTS AND DISCUSSION

Among different fertigation levels F₁ (100 % *ad hoc* recommendation of KAU for precision farming)

recorded the highest number of fruits plant⁻¹ (15.15) followed by F₃ (50 % *ad hoc* recommendation of KAU for precision farming + foliar spray at 30 and 60 DAT) (13.49) and F₂ (50 % *ad hoc* recommendation of KAU for precision farming) (12.37). Maximum fruit girth (26.24 cm) was recorded from F₁ and it was on par with F₃ (25.24 cm) and significantly superior to F₂ (23.89 cm) and F₄ (22.25 cm). F₁ also recorded higher fruit yield plant⁻¹ (1.72 kg) and fruit yield m⁻² (8.30 kg). Similar findings of increased yield in bell pepper with 252 kg N and 240 kg N was reported by Hartz *et al.* (1993) and Aliyu (2002) respectively. The increased availability of nutrients for the treatment F₁ might have increased the photosynthate accumulation enhancing the yield attributes and yield. Similar finding of increased fruit weight, yield plant⁻¹ and yield ha⁻¹ with higher dose of NPK (250:200:200 kg ha⁻¹) was reported by Shrivastava (1996).

Yield and yield attributes were significantly influenced by different plant spacings. The treatment S₃ (45 cm x 60 cm) recorded the highest number of fruits plant⁻¹ (13.75), fruit girth (25.23 cm) and fruit yield plant⁻¹ (1.53 kg). The number of fruits plant⁻¹ at 45 cm x 30 cm (S₁) and 45 cm x 45 cm (S₂) were 12.58, 12.67 respectively which were on par. The lowest fruit girth was reported by S₁ (23.33 cm) and it was on par with S₂ (24.66 cm). Similarly lowest fruit yield plant⁻¹ (1.30 kg) was obtained from S₁ (45 cm x 30 cm) and it was on par with S₂ (45 cm x 60 cm) (1.36 kg). Higher yield and yield attributes for S₃ might be due to higher availability of sunshine, more space and less competition for nutrients which in turn promoted more number of flowers and increased photosynthate accumulation. Similar results of higher yield and yield attributes with wider spacing in bell pepper were reported by Alam *et al.* (2011) and Biradar *et al.* (2014). Maximum total fruit yield m⁻² was obtained from closely spaced plants (45 cm x 30 cm) (8.92 kg) followed by S₂ (6.74 kg) and both the treatments were significantly superior over S₃ (5.67). The higher plant population in closer spacing resulted in higher fruit yields m⁻² compared to wider spacing. Similar findings of increased fruit yield ha⁻¹ with closer spacing were reported by Zende (2008) and Shivakumar *et al.* (2012).

Table 2. Effect of fertigation levels on yield and yield attributes of bell pepper under polyhouse condition.

Treatments	Number of fruits plant ⁻¹	Fruit girth (cm)	Total Fruit Yield Plant ⁻¹ (kg)	Total Fruit Yield m ⁻² (kg)
F ₁	15.15	26.24	1.72	8.30
F ₂	12.37	23.89	1.32	6.84
F ₃	13.49	25.24	1.40	7.19
F ₄	11.00	22.25	1.15	6.10
CD (0.05)	0.909	1.274	0.120	0.656

Table 3. Effect of different spacings on yield and yield attributes of bell pepper under polyhouse condition.

Treatments	Number of fruits plant ⁻¹	Fruit girth (cm)	Total Fruit Yield Plant ⁻¹ (kg)	Total Fruit Yield m ⁻² (kg)
S ₁	12.58	23.33	1.30	8.92
S ₂	12.67	24.66	1.36	6.74
S ₃	13.75	25.23	1.53	5.67
CD (0.05)	0.797	0.979	0.936	0.502

IV. CONCLUSION

The study revealed that for high yield and yield attributes the bell pepper plants should be treated with 100 % adhoc recommendation of KAU for precision farming. Among different spacing closer spacing of 45 cm x 30 cm is ideal for profitable cultivation of plants under polyhouse. Even though interaction of two treatments was not significant, higher net returns (₹ 1,88,956 10 cents-1) and B: C ratio (3.30) were recorded from the plants treated with 100 % adhoc recommendation of KAU for precision farming along with closer spacing of 45 cm x 30 cm (f₁S₁).

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