Internat. J. agric. Sci. Vol.3 No.1 January 2007 : 56-59

Influence of growing media, irrigation regime, integrated nutrient management and mulching on the performance of sweet pepper (*Capsicum annuum* L. cv. GROSSUM) hybrid under polyhouse condition

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ABSTRACT

A polyhouse experiment was undertaken at Coimbatore during December, 2002 to June, 2003 to evaluate the effect of different levels of growing media, irrigation regime, integrated nutrient management and mulching on the performance, in terms of growth and yield of sweet pepper hybrid Indra. The growth, yield and quality parameters varied significantly among the treatments. The package consisting of soil: FYM: coir pith (2:1:1) as growing medium, irrigation at 20 kPa, INM with 50 kg each of NPK ha^{-1} as basal with straight fertilizers and 150 kg each of NPK ha^{-1} through fertigation with water soluble fertilizers and with mulching was found to be effective in improving the performance in terms of growth, yield and quality.

Key words : Polyhouse, Coir pith, Irrigation regime, Water soluble fertilizer, Mulching.

INTRODUCTION

Sweet pepper is one of the most popular and high value vegetable crops grown for its immature fruits throughout the world. It occupies a place of pride among vegetables in Indian cuisine because of its delicacy and pleasant flavour coupled with the rich content of ascorbic acid and other vitamins and minerals. Despite its economic importance, the productivity under open field was adversely affected by weather factors (Ochigbo and Harris, 1989). Though polyhouse cultivation comes as a rescue from such deleterious weather situations, the performance of the crop differs under different cultural practices like growing medium, irrigation regime, nutrient management and mulching. Therefore, the present study was undertaken to find out the influence of different combinations of growing media, irrigation regime, integrated nutrient management and mulching on growth, yield and quality parameters of sweet pepper hybrid under polyhouse condition.

MATERIALS AND METHODS

A polyhouse experiment was conducted with sweet pepper hybrid Indra as a test crop during December, 2002 to June, 2003 at the College Orchard, Horticultural College and Research Institute, Coimbatore. The experimental site is situated between 11°02' North latitude and 77°03' East longitude and at an altitude of 426.72 m above MSL. The seeds of the hybrid Indra were sown in protrays and 48-day old seedlings were transplanted adopting a spacing of 45×30 cm. The experiment was laid out in a RBD with three replications. A plot size of 3.5 m^2 was adopted. There were totally eight treatments with different combinations of growing media, irrigation regime, integrated nutrient management and mulching as presented in Table 1.

Fertilizer application:

- SF– straight fertilizers - urea, SSP and MOP for basal as well as fertigation
- WSF – water soluble fertilizer - polyfeed (19:19:19), applied once in 3 days except T_5 (once in 5 days) starting from third week after planting and up to 2o week after planting
- Biofertilizers - Azospirillum, Phosphobacteria and VAM @ 35: 35:175 g/ 3.5 m^2 bed

Irrigation regime:

20 and 40 kPa, monitored using tensiometer which was placed in between two rows of plants

Mulching:

A black polyethylene sheet of 200-gauge thickness was used as mulching material for all the treatments except $T_{8'}$

Observations recorded:

Growth parameters observed on 30, 60, 90 and 120 days after planting and at final harvest were:

1. Plant height
2. Number of branches/plant
3. Dry matter production/ plant

The following yield parameters were studied from second to fourth harvest:

1. Number of fruits/plant
2. Single fruit weight
3. Fruit length
4. Fruit breadth
4. Pericarp thickness

The quality parameters analysed were:

1. Ascorbic acid
2. Total soluble solid

I. Growth parameters

Three plants in each treatment were selected at random and utilized for recording observations. The height

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Table 1 : Treatments:

Treatment	Growing medium (2:1:1)	Irrigation regime (kPa)	INM		Black polyethylene Mulching
			Basal	Fertigation	
T_1	Soil: FYM: sand	20	SF - 50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	with mulch
T_2	Soil: FYM: coir pith	20	SF- 50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	with mulch
T_3	Soil: FYM: paddy husk-smoked	20	SF - 50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	with mulch
T_4	Soil: FYM: saw dust	20	SF - 50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	with mulch
T_5	Soil: FYM: sand	40	SF- 50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	with mulch
T_6	Soil: FYM: sand	20	SF - 50 kg K ha^{-1} + biofertilizers	WSF-150 kg each of NPK ha^{-1}	with mulch
T_7	Soil: FYM: sand	20	SF-50 kg each of NPK ha^{-1}	SF- 150 kg each of NPK ha^{-1}	with mulch
T_8	Soil: FYM: sand	20	SF-50 kg each of NPK ha^{-1}	WSF-150 kg each of NPK ha^{-1}	without mulch

of the plant was measured from the cotyledonary node to the tip of the plant and expressed in cm. The number of branches produced on each plant was counted and recorded in number. The total dry matter production of a single plant was found out by recording the dry weight of leaves, stem and fruits using hot air oven at 70°c for 12 hours and expressed in kg/plant.

II. Yield parameters

The number of green and red ripe fruits in each plant over all harvests was counted and expressed in number. The weight of five fruits from each plant was measured and the mean worked out and expressed in grammes. The length of fruit was recorded from the base to apex and expressed in cm. The breadth of fruit was measured at the broadest point and expressed in cm. The fruit was cut and the thickness of the pericarp was measured at calyx end using screw gauge and expressed in mm.

III. Quality parameters

Three fruits from each treatment from second to fourth harvest were used for analyzing the quality parameters like ascorbic acid and TSS. The ascorbic acid content of the fruits was analysed using 4% oxalic acid and 2, 6-dichlorophenol indophenol and expressed in mg $100g^{-1}$ The total soluble solids (TSS) content of the fruits was estimated using a refractometer and corrected to 21°C and expressed in °Brix.

Statistical Analysis

The data obtained from the various growth and yield attributes were subjected to statistical analysis (Panse and Sukhatme, 1961). Based on the results inferences were drawn. Whenever the treatment differences were significant, critical differences were worked out.

RESULTS AND DISCUSSION

I. Growth parameters

The results of the growth parameters analysed on 30, 60, 90 and 120 days after planting and at final harvest are discussed here.

1. Plant height:

The plant height differed significantly among treatments. At all the five stages, plant height was the highest in T_2 consisting of growing medium with soil: FYM: coir pith in 2:1:1 ratio, irrigation regime of 20 kPa, basal application of 50kg NPK with straight fertilizers and fertigation with NPK @ 150:150:150 kg ha^{-1} with water soluble fertilizer and black polyethylene mulching (69.06, 93.81, 144.68, 171.20 and 177.41cm respectively). The improved plant height in T_2 could be attributed to better physico-chemical properties of growing medium incorporated with coir pith. This might also be due to increased availability of water and nutrients provided by irrigation at 20 kPa, split application of NPK through fertigation and with mulching. These results endorse the findings of Cleland and Bonner (1956), Tisdale and Nelson (1966) and Savithri and Khan (1993).

3. Number of branches/plant

The data on number of branches per plant (Table 2) revealed that at all the stages, the highest number of branches per plant was recorded in T_2 with 4.74, 7.13, 7.98, 11.22 and 14.56 respectively. The increased number of branches with coir pith application might be due to production of more CO_2 during its microbial decomposition. Improvement in growth parameters like plant height, branch number and leaf number due to CO_2 enrichment was reported by Patterson and Flint (1980) and Rogers *et al.* (1983). In addition to coir pith, precise and steady state supply of water and nutrients through irrigation at 20 kPa and fertigation with WSF would have also contributed for improving growth.

3. Dry matter production/plant

Inclusion of coir pith as one of the components of growing medium in T_2 registered the highest values of 7.16, 58.55, 122.20, 255.03 and 350.82 g $plant^{-1}$ respectively. Addition of coir pith in the growing medium of T_2 seems to increase humic acid production and in turn total phenol content in plants. The increased phenol content inhibits IAA oxidase activity leading to prolonged persistence of IAA, which may be one of the possible reasons for the greater

Table 2: Effect of growing media, irrigation regime, INM and mulching on growth parameters of sweet pepper (30, 60, 90, 120)

Treatment	Plant height (cm)					Branch number					Total dry matter production (g/plant)				
	30	60	90	120	FH	30	60	90	120	FH	30	60	90	120	FH
T_1	59.33	93.79	144.62	168.93	175.10	4.56	7.06	7.90	11.14	14.45	6.38	52.21	108.97	227.46	312.90
T_2	69.06	93.81	144.68	171.20	177.41	4.74	7.13	7.98	11.22	14.56	7.16	58.55	122.20	255.03	350.82
T_3	38.00	69.94	101.75	121.33	128.71	4.35	6.78	7.61	10.81	14.09	4.21	34.42	71.82	149.92	206.21
T_4	20.77	59.42	87.91	107.84	114.60	2.16	3.91	4.76	7.92	10.93	3.58	29.27	61.10	127.51	175.39
T_5	34.83	65.67	97.37	117.20	121.64	3.49	5.65	6.51	9.70	12.87	4.16	34.02	71.01	148.19	203.84
T_6	56.95	88.03	129.67	148.39	163.33	4.51	6.99	7.82	11.03	14.31	6.14	50.23	104.85	218.85	301.04
T_7	47.80	87.34	121.35	138.78	149.86	3.70	5.88	6.73	9.93	13.12	5.76	47.07	98.24	205.06	282.07
T_8	44.32	82.87	124.33	141.26	152.39	3.79	5.96	6.88	10.11	13.35	5.80	47.87	99.89	208.49	286.82
S. Ed	0.46	0.78	1.15	1.33	1.42	0.04	0.06	0.07	0.10	0.1 3	0.08	0.44	0.87	1.04	2.01
CD (0.05)	0.98	1.68	2.46	2.86	3.04	0.08	0.13	0.15	0.21	0.28	0.19	0.89	1.74	2.03	4.03

(day after planting and at final harvest)

dry matter production. This endorses the reports of Balasubramanium *et al*. (1989). Besides coir pith, split fertilization of N, P and K also improved the respective nutrient content of growing medium resulting in a marked increase in biomass production (Mahajan *et al*., 1999).

II. Yield parameters

The results on yield parameters (Table 3) revealed that they were significantly influenced by different treatments. The highest number of fruits (15.00), fruit weight (150 g), fruit length (12.13 cm), fruit breadth (7.07 cm) and pericarp thickness (6.63 mm) were observed in T_2 with soil:FYM:coir pith (2:1:1) as growing medium. The increased availability of P and K, key elements for fruit set and development (Das, 2001) in the growing medium might be one of the possible reasons for the production of more fruits with better size. This agrees with the findings of Baskar and Saravanan (1998) in tomato and Hartz *et al*., (1993) and Bowen and Frey (2002) in capsicum. The highest number of fruits per plant could also be due to the resultant effect of more primary branches per plant.

III. Quality parameters

1. Ascorbic acid

The nutritional quality of sweet pepper is decided by the parameters like ascorbic acid and total soluble solids. The highest ascorbic acid content was recorded in T_2. The possible reason might be increased protoplast and acid metabolism with higher availability of water provided by irrigation at 20 kPa and composted coir pith. This is in line with the findings of Mary and Balakrishnan (1990) and Agarwal and Narda (1992) in tomato and Panchal *et al*. (2001) in chilli.

2. Total soluble solids

The highest TSS (Table 3) was registered in T_5 with irrigation regime of 40 kPa. This could perhaps be due to the increased accumulation of osmolytes *viz.,* sugar with the onset of water stress. This is in line with the findings of Orzolek and Angell (1975), Phill and Lambeth (1980) and Alizadeh *et al*. (2001) in tomato and Hegde (1987) and Carvalho *et al*. (2001) in capsicum. The best performing treatment in terms of yield (T_2) was found to have low TSS. This negative relationship of yield with TSS might be attributed to low conversion of starch to sugar with higher water availability (Stevens *et al*., 1978) or, regular irrigation (Varga *et al*., 2000).

Table 3 : Effect of growing media, irrigation regime, INM and mulching on yield and quality parameters of sweet pepper (second to fourth harvest)

Treatment	Fruit number	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Pericarp thickness (mm)	Ascorbic acid (mg $100g^{-1}$)	TSS (°Brix)
T_1	13.59	143	11.15	6.91	6.18	113	5.82
T_2	15.00	150	12.13	7.07	6.63	116	5.92
T_3	13.27	130	9.42	6.33	5.09	109	4.78
T_4	12.23	125	8.72	6.83	4.98	102	5.66
T_5	12.55	129	8.96	6.69	5.56	99	6.23
T_6	13.64	139	10.25	6.87	6.19	123	5.78
T_7	12.82	134	10.05	6.48	5.56	108	4.92
T_8	12.76	136	9.41	6.49	5.38	121	6.21
S.Ed	1.87	1.19	0.09	0.09	0.05	1.05	0.05
CD (0.05)	3.74	2.56	0.20	0.20	0.12	2.25	0.11

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Received : March, 2006; Accepted : September, 2006