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Influence of capsicum hybrids to micronutrients on growth and quality of capsicum (*Capsicum annuum* L.) under naturally ventilated poly house

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Abstract
The present experiment entitled "Influence of capsicum hybrids to micronutrients on growth and quality of capsicum (*Capsicum annuum* L.) Under naturally ventilated poly house" was carried out during *Rabi* season of 2021-22 and 2022-2023 at Vegetable Research Farm, Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in split plat design with 45 treatment combinations replicated thrice. The experiment was comprised of three capsicum hybrids varieties (Indira, Swarna and Bomby) with five levels of different micronutrients. On the basis of results of the present investigation, The capsicum hybrid (Indira) with foliar Application of vegetable special @ 5 g/at 15 day were recorded maximum on growth parameters *viz.*, plant height (cm), number of branches, Stem diameter (cm), number of leaves, days to first flowering, internodes length (cm), Similar trend was also recorded in quality parameters *viz.*, pericarp thickness, dry matter, TSS and Shelf life. Among the level of micronutrient, foliar application of vegetable special @5/lit showed highest growth and quality parameter of capsicum.

Keywords: Capsicum hybrids, foliar application, micronutrients, vegetable special

Introduction
Sweet pepper (*Capsicum annum* L.) is a member of the family *Solanaceae* and the genus capsicum. Tropical South America, especially Brazil is thought to be the original home of Sweet pepper. Sweet pepper is very rich in vitamin C, pro-vitamin A and rich source of minerals Ca, P, K, and Fe. Yellow and especially green color chilli (which is content unripe green fruit) certain considerably lowest contain both substance. Nutritionally, sweet pepper is rich in vitamin A (8493 IU), vitamin C (283 mg) and minerals like calcium (13.4 mg), magnesium (14.9 mg) phosphorus (28.3 mg) and potassium, (263.7 mg) per 100 g fresh weight. From every 100 gram of edible portion of bell pepper 24 k cal of energy, 1.3 g of protein, 4.3 g of carbohydrate and 0.3 g of fat is provided especially as sources of vitamins (C, A, B1, B6, B9, E), minerals, dietary fiber and phytochemicals (Sreedhara *et al.*, 2013) [26]. Yellow capsicum provides 24 Kcal of energy, protein (1.3 g), carbohydrates (4.3 g), fat (0.3 g) specially green colourchilli (which is content unripe green fruit) certain considerably lowest contain both substance (Anon, 2007) [3]. The optimum temperature required by the capsicum plant is 20 to 25 °C during the day and 18 to 20 °C at night. The minimum humidity of the greenhouse should be around 65%. To control the temperature and humidity misters are started within the greenhouse every day for 3 to 4 minutes with half an hour interval. If temperature exceeds 35 °C or falls below 12 °C, fruit setting is affected. 18 °C night temperature inside greenhouse is most suitable for flowering and fruiting. Among the various protected structures, polyhouse production had been proven as more profitable protected technique for capsicum cultivation (Aruna and Sudagar, 2010) [5]. Generally, the main purpose of growing high value crops in protected condition is to give blemish free high quality material as it is easy to control diseases and pests throughout the year. More (1990) [18] started that greenhouse protected the crops from extreme high temperature and high rainfall to facilitate timely harvest as per demand and good quality of produce. Micronutrients are needed in very little quantity but are very important for proper growth of plants (Mousavi, 2011) [19]. Zinc and Boron are responsible for enhancement of photosynthesis (Gupta, 1993) [8] Zinc is responsible for many enzymatic activities i.e. aldolase, peptidase, isomerase and phosphohydrolase etc. (Rawat and Mathpal, 1984) [23] Zinc is involved in formation of protein.

Zinc availability to plants is dependent upon weather conditions i.e. zinc is more easily available to plants in less cold and release of zinc decreases in cold weather (Mallick and Muthukrishnan, 1979) [15] Zinc is very important immobile micronutrient for development and growth of plants. Zinc is also responsible for the synthesis of tryptophan which is involved in the formation of Indole Acetic Acid (Marschner, H. 1995) [17]. Boron deficiency can cause small fruit size and sterility in plants. Degeneration of tissues and disintegration of cambium cells may also be due to deficiency of boron (Agarwal, 2018) [1] the present experiment entitled "Influence of capsicum hybrids to micronutrients on growth and yield of capsicum (*Capsicum annuum* L.) Under naturally ventilated poly house" was carried out during season of 2021-22 and 2022-202.

Material and Methods

The field experiment was carried out during two consecutive seasons of 2021-22 and 2022-23, under naturally ventilated poly house at Department of Vegetable Science, Kalyanpur, Chandra Shekhar Azad University Agriculture and Technology, Kanpur, Uttar Pradesh. Kanpur is situated at 25.26^0 to 26.50^0 north latitude and 79.31^0 to 80.34^0 longitudes with an altitude of 125.9 m above the mean sea level. The climate of Kanpur region is typically sub-humid and sub-tropical with extreme winter and summer. The average rainfall is 800-850 mm, which mostly received from June to September and about 60-100 mm in the remaining months. The average maximum and minimum temperature are 30.41 and 14.02 °C, respectively. The soil of the experimental field was sandy loam, with adequate organic matter, loose textured and friable. The land was well leveled, well drained and fertile good water holding capacity. The soil was suitable for capsicum crop. Soil sample were collected randomly from ten places in the experimental area and mixed thoroughly. On the basis of results of the present investigation, the experiment was laid out in split plat design with 45 treatment combinations replicated thrice. The experiment comprised five levels of micronutrients *viz.*, Control (no micronutrients application), Soil application of Zn, Fe & B, Fertigation of EDTA of Zn & Fe and Solubor at 15 days interval, Foliar application of vegetable special @ 5 g/lit at 15 days interval, Foliar application of chelated combo micronutrients @ 1 g/lit at 15 days interval and three capsicum hybrids *viz.*, at Indira, Swarna and Bomby.

Plants were planting in lines at a spacing of 60×60 cm through zigzag method under poly house. The gap filling was carried out after 20 days after transplanting. The five plants were selected randomly from each plot and tagged. The observations were recorded on growth parameters *viz.*, plant height (cm), number of branches, Stem diameter (cm), number of leaves, internodes length (cm), days to first flowering, days to first fruit set, days to first fruit harvest, no. of flowers per plants. The quality parameters *i.e*. Pericarp Thickness (mm), Moisture content (%), Dry matter (%) TSS (º Brix) and Shelf life (Days).

Result and Discussion

Growth parameters: All growth parameters i.e.plant height (cm), number of branches, Stem diameter (cm), number of leaves, internodes length (cm), days to first flowering, days to first fruit set, days to first fruit harvest, no. of flowers per plants were significantly influenced by capsicum hybrids and micronutrients (Table 1 and Table 2). The resulted showed that increase in plant height 30 to 60 DAT was rapid as compared to final harvesting stage. In case of capsicum hybrid (Indira) recorded significantly highest of plant height (91.30 and 94.89 cm), number of branches (11.87 and 12.34), Stem diameter (4.31 cm and 4.60 cm), number of leaves (102.94 and 106.41) internodes length (13.82 and 14.01cm) and number of flowers (38.23 and 38.36) followed by Swarna while Bomby recorded lowest values. The capsicum hybrid Indira recorded significantly earliest flowering (51.11 and 50.32 days), first fruit set (61.85 and 60.83 days) and first harvesting (84.52 and 82.59 days). It was followed by Swarna while Bomby recorded latest value in both years.

The capsicum hybrids and different levels of micronutrients could be found significant during both the year of experimentation. However, the highest value of plant height (93.73 and 96.78 cm), number of branches (12.67 and 13.39), number of leaves (105.52 and 108.69), stem girth (4.75 and 5.13 cm), internode length (14.75 and 15.04 cm) and no. of flowers (41.34 and 41.95) were observed in Indira hybrid along with the foliar application of vegetable special @ 5 g/litre followed by chelated combo micronutrients @ 1 g/litre and fertigation of EDTA of Zn & Fe and solubor at 120 DAT. The lowest values of stem girth and internodes length were found in control treatment during first and second year, respectively. The earliest first flowering (49.35 and 48.54 days), first fruit set (59.27 and 58.90 days) and first fruit harvesting and (85.42 and 84.51 days) were also found in Indira hybrid along with the foliar application of vegetable special @ 5 g/litre followed by chelated combo micronutrients @ 1 g/litre and fertigation of EDTA of Zn & Fe and solubor while lowest in control treatment during first and second year, respectively. This might be due the vigour of the individual plant governed by the genetical factors. These findings are in accordance with the reports of Dongre SM *et al*. (2000), Hamsaveni *et al*. (2003), Singh K *et al.* (2013), Singh HM, Tiwari J.K. (2013), Swamy (2013), Malshe *et al.* (2016), Angami T *et al*. (2017), Anshuman Singh *et al.* (2019), Malik A *et al.* (2020), Irfan Ashraf *et al* (2020), and Behera and Chitdeshwari 2021 [7, 9, 25, 24, 27, 16, 2, 4, 14, 10, 21].

Quality Parameters

The capsicum hybrid Indira recorded significantly highest Pericarp thickness (6.96 and 7.04 mm) while lowest (6.44 and 6.52 mm) was found in Bomby. The capsicum hybrid Indira recorded significantly lowest moisture content (80.93 and 79.68%) in fruit, while Bomby highest (82.45 and 81.27%). The capsicum hybrid Indira recorded significantly highest dry matter (19.61 and 19.88 %), while Bomby lowest (18.60 and 19.14%).The significantly highest TSS (7.89 and 8.12 0Brix) was recorded in capsicum hybrid Swarna, while lowest (7.04 and 7.26oBrix) in Indira. The capsicum hybrid Indira recorded significantly maximum shelf life (7.02 and 7.52 days), while Bomby minimum (6.46 and 6.82 days). These findings were accordance with Jeevansab (2000), Jaipaul *et al.* (2011). Kumar *et al.* (2016), Naik MR (2018) [12, 11, 13, 20].

Table 1: Effect of capsicum hybrids to micronutrients on plant height (cm), number of branches, stem girth (cm), Number of leaves, Internode length under naturally ventilated poly house.

Treatments	Plant height at 120 DAT (cm)			Number of branches per plants at 120 DAT			Stem girth at 120 DAT (cm)		Number of leaves per plants at 120 DAT				Internodes length at 120 DAT (cm)		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Capsicum hybrids															
Indira	91.30	94.89	93.10	11.87	12.34	12.11	4.32	4.61	4.47	102.94	106.44	104.69	13.820	14.011	13.820
Swarna	89.80	92.94	91.37	11.40	11.67	11.54	4.08	4.38	4.23	100.36	104.26	102.31	13.213	13.477	13.213
Bomby	88.72	91.43	90.08	11.15	11.55	11.35	4.01	4.30	4.16	99.11	102.41	100.76	12.939	13.208	12.939
SEm±	0.277	0.654		0.081	0.073		0.024	0.009		0.731	0.757		0.077	0.097	
CD 5%	1.116	2.635		0.325	0.294		0.095	0.036		2.948	3.054		0.309	0.392	
Micronutrients															
Control	83.45	86.48	84.97	9.84	10.21	10.03	3.04	3.23	3.14	96.25	99.75	98.00	11.621	11.792	11.71
Soil application of Zn, Fe & B	88.19	91.55	89.87	10.99	11.21	11.10	4.08	4.18	4.13	99.090	102.59	100.84	12.812	13.006	12.91
Fertigation of EDTA of Zn & Fe and solubor at 15 days interval	91.61	94.743	93.18	11.64	12.11	11.88	4.30	4.71	4.51	100.55	104.05	102.30	13.458	13.724	13.59
Foliar application of vegetable special @ 5 g/lit at 15 days interval	93.73	96.78	95.26	12.67	13.39	13.03	4.75	5.13	4.94	105.52	108.69	107.11	14.753	15.043	14.90
Foliar application of chelated combo micronutrients @ 1 g/lit at 15 days interval	92.74	95.89	94.32	12.22	12.49	12.36	4.52	4.88	4.70	102.61	106.78	104.70	13.974	14.260	14.12
SEm±	1.026	1.738		0.215	0.218		0.077	0.084		1.879	1.946		0.249	0.254	
CD 5%	3.011	5.103		0.631	0.641		0.23	0.25		5.517	5.713		0.731	0.746	

Table 2: Effect of capsicum hybrids to micronutrients on pericarp thickness (mm), moisture content (%), Dry matter (%) TSS (º Brix) and Shelf life Number of leaves, Internode length under naturally ventilated poly house.

Treatments	Pericarp Thickness			Moisture content			Dry Matter		TSS (^{0}Brix)				Shelf life		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Capsicum hybrids															
Indira	6.960	7.048	7.00	80.931	79.681	80.31	19.611	19.883	19.611	7.048	7.267	7.16	7.16	7.527	7.34
Swarna	6.527	6.635	6.58	81.745	80.581	81.16	18.935	19.395	18.935	7.899	8.127	8.01	8.01	7.036	7.52
Bomby	6.441	6.523	6.48	82.459	81.271	81.87	18.608	19.148	18.608	7.368	7.598	7.48	7.48	6.825	7.15
SEm±	0.038	0.057		0.309	0.388		0.108	0.135		0.048	0.049		0.035	0.043	
CD 5%	0.152	0.231		N/A	N/A		0.435	0.546		0.195	0.197		0.141	0.172	
Micronutrients															
M,k	5.423	5.473	5.45	84.413	83.670	84.04	17.031	18.014	17.52	5.939	6.1	6.8	5.457	5.539	5.49
Soil application of Zn, Fe & B	6.383	6.419	6.40	83.143	81.823	82.48	18.402	18.793	18.60	6.783	7.0	7.5	6.102	6.480	6.29
Fertigation of EDTA of Zn & Fe and solubor at 15 days interval	6.666	6.789	6.73	81.348	80.203	80.78	19.410	19.597	19.50	7.498	7.7	8.9	6.839	7.393	7.11
Foliar application of vegetable special @ 5 g/lit at 15 days interval	7.573	7.740	7.66	79.311	78.190	78.75	20.483	20.839	20.66	8.863	9.03	8.0	7.841	8.403	8.12
Foliar application of chelated combo micronutrients @ 1 g/lit at 15 days interval	7.169	7.257	5.45	80.343	79.133	79.74	19.930	20.133	20.03	8.108	8.0	6.8	7.317	7.830	7.57
SEm±	0.125	0.125		0.767	0.754		0.356	0.357		0.137	0.139		0.124	0.131	
CD 5%	0.366	0.366		2.252	2.215		1.045	1.047		0.402	0.407		0.364	0.383	

Conclusions

On the basis of results of the present investigation, it may be inferred that the combination of Indira and foliar application of vegetable special @ 5 g/litre had significant effect on growth parameters viz., plant height, no. of branches, stem girth, no. of leaves, internode length, quality traits viz., pericarp thickness, moisture content, dry matter content, and shelf life. TSS were higher in the combination capsicum hybrid Swarna and application of vegetable special @ 5 g/litre after transplanting (DAT). Hence, the combination of hybrid Bomby and foliar application of vegetable special @ 5 g/litre days after transplanting (DAT) may be recommended for farmers of the central plain zone of Uttar Pradesh for higher returns from capsicum crop under protected conditions.

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