

## Influence of various protected structures on the fruit quality traits of different capsicum hybrids

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Received: May, 2018; Revised accepted: July, 2018

### ABSTRACT

The present study was undertaken in three protected structures viz., naturally ventilated polyhouse (NVPH), net-house and walk-in tunnel to evaluate the performance of different coloured capsicum hybrids for the two consecutive cropping seasons i.e. August 2014-15 and 2015-16. All the plant characters under study were significantly influenced by the protected structures along with their interaction effects. Among the three green coloured hybrids, the hybrid Indira was found more profitable over hybrid Pasrella and Starlet. Among structures, NVPH cultivation recorded maximum individual fruit weight (176.41 g), total yield per plant (3.32 kg), rind thickness (0.82 cm), fruit volume (358.44 cc) and fruit shelf life (7.9 days), whereas, walk-in-tunnel structure had a great influence on fruit length (9.36 cm) and fruit diameter (7.17 cm) in green group hybrids. Among red and yellow colour hybrids, the NVPH structure recorded highest individual fruit weight, total yield per plant, rind thickness, fruit volume, fruit shelf life and under walk-in-tunnel, maximum fruit length and diameter were recorded. The hybrids Inspiration and Bachata were recorded best for all the qualitative parameters under study among the red and yellow coloured group hybrids respectively.

Key words: Capsicum, protected cultivation, hybrids, polyhouse, walk-in-tunnel

### INTRODUCTION

The bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.) is commonly known as sweet pepper, capsicum or green pepper. Capsicum differs from hot peppers in size and shape of the fruits, capsaicin content etc. Capsicum is one of the highly remunerative vegetables crop cultivated in subtropical regions of Asian continent. India is the second largest producer of vegetables in the world next to China with an estimated production of about 136 million tonnes from an area of 8.23 million hectares with an average yield of 16.5 tonnes per hectares. India shares about 15% of the total world output of vegetables from about 4% of cropped area in the country (Anon, 2014). India has entered in the era of greenhouse cultivation more recently and the total area under protected vegetable production is not more than 10,000 hectares (Devi and Thakur, 2013).

Nutritionally, Capsicum provides Vitamin A (8493 IU), Vitamin C (283 mg), and minerals like calcium (13.4 mg), magnesium (14.9 mg), phosphorus (28.3 mg), potassium (263.7 mg), energy (24 Kcal), protein (1.3g), carbohydrate (4.3g) and fat (0.3g) per 100 g fresh weight (Yellavva, 2008). Capsicum also finds place in fast food chain especially in preparations like

pizza stuffing's and burger. The high market price is attributed to the heavy demand from the consumers. There is a good demand for export too. The export market has specific requirements like fruits with longer shelf life, medium size tetra lobed fruits with attractive colour. Capsicum can be grown under open field conditions and in protected structures i.e., net-house, polyhouse, walk-in-tunnels, low tunnels, etc (Singh and Sirohi, 2006). Due to erratic weather behaviour, the crops grown under open fields are often exposed to fluctuating levels of temperature, humidity, and wind flow etc (Kanwar *et al.* 2014). The cultivation of capsicum under polyhouse, net-house, walk-in-tunnels, low tunnels are the most suitable solutions to the challenging environmental factors and it prevents spreading of insects, pests, and viral diseases. Capsicum fruits obtained from polyhouse had a higher ascorbic acid and total soluble solids (TSS) as compared to fruits harvested from open fields (Jeevansab, 2000). The trend of crop production under protected conditions is increasing due to high productivity/unit of area, improved shelf life of fruits (Rai *et al.* 2004) and its demand throughout the year. Hence, to obtain a good quality produce during off-season, there is a great need to cultivate capsicum under protected conditions.

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The cultivation of capsicum under protected structures is gaining importance in the plains of north India because of early, high yield, and excellent fruit quality as compared to open field conditions. Now-a-days due to environmental impact, good quality and safe to eat vegetable produce are attracting consumer's demand. Therefore, this experiment was conducted to evaluate the performance of different capsicum hybrids with respect to their qualitative characters under various protected conditions.

## MATERIALS AND METHODS

The study was carried out for the two consecutive cropping seasons i.e. 2014-15 and 2015-16 under naturally ventilated polyhouse (NVPH), net-house and walk-in-tunnel at Centre of Excellence for Vegetables (An Indo-Israel project), Kartarpur, Jalandhar, Punjab, India located at 31.440 N (latitude) and 75.50 E (longitude) at the altitude of 228 m above sea level. The crop nursery for the two consecutive seasons was raised using pro-trays of 99 cells or cavities in polyhouse (in soilless media) during August 2014 and 2015, respectively. One month old seedlings were transplanted during September 2014 for the first season and September 2015 for the second season. The experiment was laid out in split plot design

keeping naturally ventilated polyhouse, net-house and walk-in-tunnel as main plots and three different hybrids of each of green coloured capsicum (Indira, Pasrella, Starlet), red coloured capsicum (Bomby, Inspiration, Mazillia) and yellow coloured capsicum (Orobelle, Bachata, Sven) in sub plot treatments with three replications each, maintaining plant to plant distance of 40 cm and row to row distance of 30 cm. The improved package of practices for cultivation was followed along with improved irrigation/fertigation schedule to raise the crop. The plants were pruned to retain two branches per plant for prolonged fruiting span. The observations were recorded for individual fruit weight (gm), fruit length (cm), fruit diameter (cm), fruits rind thickness (cm), fruit volume (cc), shelf life (days) at ordinary room temperature and total fruit yield per plant (kg) for two continuous seasons. The data was pooled over two seasons and subjected to statistical analysis by using software CPCS1 (Cheema and Singh, 1990) at  $P = 0.05$ .

## RESULTS AND DISCUSSION

Among the green coloured hybrids, all the plant characters were significantly influenced by the growing (protected) structures and the interaction effects were also significant for all the characters under study (Table 1).

Table 1: Performance of green coloured capsicum hybrids under various protected structures

Name of variety	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit rind thickness (cm)	Fruit volume (cc)	Shelf life (days)	Total fruit yield/plant (Kg)
NVPH							
Indira	171.20	9.10	6.76	0.82	350.66	8.59	3.62
Pasrella	178.96	9.46	6.00	0.85	363.66	7.69	3.28
Starlet	179.06	7.60	6.56	0.80	361.00	7.40	3.05
Mean (Structure)	176.41	8.72	6.44	0.82	358.44	7.90	3.32
Net-house							
Indira	165.43	9.36	6.43	0.78	337.00	7.00	2.58
Pasrella	167.76	9.06	5.50	0.82	353.33	6.40	2.28
Starlet	171.96	8.36	6.16	0.78	347.33	6.23	2.13
Mean (Structure)	168.38	8.93	6.03	0.79	345.88	6.54	2.33
Walk-in-tunnel							
Indira	169.96	9.7	7.50	0.80	344.33	7.90	3.04
Pasrella	175.93	9.63	7.00	0.83	360.66	7.00	2.92
Starlet	176.40	8.76	7.03	0.82	352.00	6.53	2.78
Mean (Structure)	174.10	9.36	7.17	0.82	352.33	7.14	2.91
CD (Structure)	1.62	0.13	0.18	0.005	2.01	0.050	0.06
CD (Interaction)	2.02	0.24	0.22	0.013	2.25	0.169	0.10

The NVPH structure recorded highest individual fruit weight (176.41g) followed by walk-in-tunnel (174.10 g). Among the three hybrids in green group, Starlet had the highest individual fruit weight (179.06 g) which was statistically at par with hybrid Pasrella (178.96 g) under NVPH. Maximum fruit length (9.36 cm) was observed under walk-in-tunnel structure followed by net-house (8.93 cm) and NVPH (8.72 cm) (Table 1). The hybrid Indira possessed maximum fruit length (9.7 cm) which was at par with hybrid Pasrella (9.63 cm) under walk-in-tunnel. The maximum fruit diameter (7.17 cm) was obtained under walk-in-tunnel as compared to NVPH (6.44 cm) and net-house (6.03 cm). The hybrid Indira had maximum fruit diameter (7.50 cm) followed by hybrid Pasrella (7.0) under walk-in-tunnel structure. Maximum fruit rind thickness was recorded under both the NVPH (0.82 cm) and walk-in-tunnel (0.82 cm) followed by net-house (0.79 cm). The hybrid Pasrella had maximum fruit rind thickness (0.85 cm) under NVPH and hybrid Indira and Starlet has minimum fruit rind thickness (0.78 cm) under net-

house (Table 1). However, Kurubetta and Patil (2009) reported hybrid Indira having higher rind thickness (0.87 cm) and shelf life (8.60 days) under protected cultivation. The NVPH structure recorded highest fruit volume (358.44 cc) followed by walk-in-tunnel (352.33) and net-house (345.88). The hybrid Pasrella had the highest fruit volume (363) under NVPH. Shelf life (days) of fruits produced under NVPH (7.90) were significantly higher, followed by walk-in-tunnel (7.14) and net-house (6.54) at room temperature. The hybrid Indira had the highest shelf life (8.59 days) under NVPH structure. The highest total fruit yield per plant (3.32 kg) was recorded under NVPH followed by walk-in-tunnel (2.91) and net-house (2.33). The hybrid Indira recorded highest fruit yield/plant (3.62) followed by Pasrella (3.28) whereas; lowest fruit yield/plant (2.13) was recorded for hybrid Starlet under net-house (Table 1). Swamy (2013) reported that hybrid Indira possessed maximum fruit length, maximum fruit width, fruit volume, fruit wall thickness, maximum individual fruit weight under protected cultivation.

Table 2: Performance of red coloured capsicum hybrids under various protected structures

Name of variety	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit rind thickness (cm)	Fruit volume (cc)	Shelf life (days)	Total fruit yield per plant (kg)
NVPH							
Bomby	201.06	8.60	7.43	0.86	407.33	7.60	2.29
Inspiration	216.53	9.40	7.30	0.89	434.00	8.00	2.81
Mazillia	208.76	9.13	6.60	0.87	410.66	7.10	2.51
Mean (Structure)	208.78	9.04	7.11	0.87	417.33	7.56	2.54
Net-house							
Bomby	199.30	8.83	6.96	0.83	397.66	6.30	1.78
Inspiration	203.50	9.00	6.93	0.85	402.66	6.40	2.17
Mazillia	200.16	9.03	6.40	0.84	399.00	6.16	2.02
Mean (Structure)	200.98	8.95	6.76	0.84	399.77	6.28	1.99
Walk-in-tunnel							
Bomby	194.33	8.96	7.96	0.87	393.33	7.06	2.05
Inspiration	214.00	9.70	8.23	0.87	428.66	7.40	2.53
Mazillia	204.66	9.20	7.50	0.86	403.00	6.83	2.30
Mean (Structure)	204.33	9.28	7.90	0.87	408.33	7.10	2.29
CD (Structure)	2.04	0.13	0.21	0.008	2.10	0.091	0.05
CD (Interaction)	3.23	0.20	0.10	0.012	4.52	0.212	0.06

All the plant characters under study were significantly influenced by the growing (protected) structures among the red group hybrids, and the interaction effects were also significant for all characters (Table 2). The highest individual fruit weight (208.78g) was recorded under NVPH followed by walk-in-tunnel (204.33 g). The hybrid Inspiration has the

highest individual fruit weight (216.53 g) under NVPH. The walk-in-tunnel structure had maximum fruit length (9.28 cm) as compared to NVPH (9.04) and net-house (8.95). The hybrid Inspiration produced maximum fruit length under walk-in-tunnel (9.70 cm) and NVPH structure (9.40). The maximum fruit diameter (7.90 cm) was recorded under walk-in-tunnel followed by

NVPH (7.11) and net-house (6.76). Hybrid Inspiration had maximum fruit diameter (8.23 cm) as compared to hybrid Bomby (7.96) under walk-in-tunnel. Maximum fruit rind thickness was recorded under both NVPH (0.87 cm) and walk-in-tunnel (0.87 cm) followed by net-house (0.84 cm). The hybrid Inspiration had maximum fruit rind thickness (0.89 cm) under NVPH and hybrid Bomby had minimum fruit rind thickness (0.83 cm) under net-house (Table 2). The maximum fruit volume (417.33 cc) was recorded under NVPH followed by walk-in-tunnel (408.33 cc) and net-house (399.77 cc). The hybrid

Inspiration had maximum fruit volume (434 cc) under NVPH structure. Higher shelf life was recorded by the fruits produced under NVPH (7.56 days) followed by walk-in-tunnel (7.10) and net-house (6.28). The hybrid Inspiration had maximum shelf life (8.00) under NVPH. The highest total fruit yield per plant (2.54 Kg) was recorded under NVPH followed by walk-in-tunnel (2.29) and net-house (1.99). The hybrid Inspiration recorded highest fruit yield per plant (2.81 Kg) under NVPH while, the lowest fruit yield per plant (1.78 Kg) was recorded for hybrid Bomby under net-house (Table 2).

Table 3: Performance of yellow coloured capsicum hybrids under various protected structures

Name of variety	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit rind thickness (cm)	Fruit volume (cc)	Shelf life (days)	Total fruit yield per plant (Kg)
NVPH							
Orobelle	183.01	8.00	7.33	0.87	362.66	7.10	2.61
Bachata	190.73	8.29	7.30	0.90	388.66	7.50	3.00
Sven	156.10	7.96	6.80	0.81	312.33	7.00	2.43
Mean (Structure)	176.61	8.08	7.14	0.86	354.55	7.20	2.68
Net-house							
Orobelle	179.93	8.16	6.96	0.80	355.33	6.19	2.29
Bachata	187.06	9.03	7.03	0.84	379.33	6.53	2.43
Sven	153.60	7.60	6.63	0.78	304.33	6.10	1.92
Mean (Structure)	173.53	8.26	6.87	0.80	346.33	6.27	2.21
Walk-in-tunnel							
Orobelle	183.26	8.83	7.50	0.85	358.00	6.76	2.43
Bachata	186.16	9.76	7.63	0.89	376.00	7.13	2.76
Sven	157.13	8.13	7.10	0.82	306.66	6.56	2.04
Mean (Structure)	175.52	8.91	7.41	0.85	346.88	6.82	2.41
CD (Structure)	0.95	0.24	0.08	0.004	3.15	0.137	0.09
CD (Interaction)	1.66	0.19	NS	0.005	3.78	NS	0.10

Among the yellow group hybrids, all the plant characters under study were significantly influenced by the growing structures and the interaction effects were also significant for all characters except for fruit diameter and shelf life (Table 3). The highest mean individual fruit weight (176.61 g) was recorded by NVPH followed by walk-in-tunnel (175.52) and net-house (173.53). The hybrid Bachata had the highest fruit weight (190.73 g) under NVPH and hybrid Sven had the lowest fruit weight (153.60 g) under net-house. Maximum fruit length (8.91 cm) was observed under walk-in-tunnel structure followed by net-house (8.26) and NVPH (8.08). The hybrid Bachata possessed maximum fruit length (9.76 cm) under walk-in-tunnel and hybrid Sven had minimum fruit length (7.60) under net-house. Maximum fruit diameter (7.41 cm) was recorded under walk-in-tunnel structure followed by NVPH (7.14) and net-house (6.87). The

NVPH structure recorded maximum fruit rind thickness (0.86 cm) followed by walk-in-tunnel (0.85) and net-house (0.80). The hybrid Bachata had maximum fruit rind thickness (0.90 cm) under NVPH and walk-in-tunnel (0.89) (Table 3). The NVPH recorded maximum fruit volume (354.55 cc) followed by walk-in-tunnel (346.88) which was at par with the net-house (346.33). The hybrid Bachata had maximum fruit volume (388.66 cc) under NVPH. Significantly higher shelf life was observed under NVPH (7.20 days) followed by walk-in-tunnel (6.82) and net-house (6.27). The highest total fruit yield per plant (2.68 kg) was recorded under NVPH followed by walk-in-tunnel (2.41) and net-house (2.21). The hybrid Bachata recorded highest fruit yield per plant (3.00) under NVPH and walk-in-tunnel (2.76) (Table 3). Kurubetta and Patil (2009) were also concluded that fruit weight, fruit volume, rind thickness and shelf life of capsicum were

significantly higher under NVPH conditions. Higher fruit shelf life under NVPH is mainly due to the higher fruit rind thickness under this structure as comparative to net-house and walk-in-tunnel. It is the most important fruit quality trait for shipment of capsicum fruit over the longer distance. Similarly, Naik (2005) reported that the favorable environmental conditions prevailing in polyhouse might have helped in better growth of roots and shoots, which directly helped in better fruit weight per plant, fruit rind thickness, fruit length, and fruit breadth which finally led to highest total yield. In the protected structures, lesser infestation of diseases and insect-pest leads to perform crop plants as per their yield potential. Capsicum cultivation under polyhouse emerged as a profitable and economically viable option to increase the farmers' income (Murthy *et al.* 2009). Due to higher yield of capsicum under

protected conditions than the open field conditions, the net returns per acre of the crop will be much higher than the open field conditions.

It was concluded that among the various protected structures, naturally ventilated polyhouse (NVPH) cultivation was highly remunerative over walk-in-tunnel and net-house for capsicum cultivation in all of the green, red and yellow coloured hybrids with respect to qualitative characters. Walk-in-tunnel structure also recorded quality yield following NVPH, over the net-house cultivation. The hybrids Indira (green colour), Inspiration (red colour) and Bachata (yellow colour) out yielded other hybrids in their respective groups for protected cultivation under Punjab conditions and thus can be adopted for commercial and remunerative capsicum cultivation under protected structures.

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