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Comparative performance of habanero pepper under open and protected conditions

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Abstract

The habanero pepper is botanically known as *Capsicum chinense* Jacq. grown in many parts of the world. Nowadays protected cultivation technologies of vegetable crops are being utilized in many places. A field study was taken up to evaluate the performance of habanero pepper crop under insect proof net house as well as in open field. The performance of capsicum under different environments in respect of plant growth characters, fruit characters and quality attributes were studied. Plant height, number of branches/plant, days to first flowering and days to first harvest showed higher result under insect proof net house cultivation over open field condition. Early flowering of pepper crop under insect proof net was also observed (75.66 days). Fruit length and diameter were the highest (4.87 cm, 2.86 cm), fruit girth and fruit weight were also recorded the highest (8.35 cm and 5.24 g) with the highest total number of fruits/plant (170.34) and fruit yield of 1.08 kg/plant under insect proof net house condition. Quality characters like polyphenol oxidase (2.08/min/g), total phenols (2.27 mg/100g), capsaicin (4.36%), vitamin C (123.52 mg/100g) and oleoresin content (16.53 %) were also found to be at increased level under insect proof net house grown condition than that of open field grown habanero pepper.

Keywords: Habanero pepper-protected and open field cultivation-field performance evaluation-quality parameters

Introduction

The habanero pepper is botanically known as *Capsicum chinense* Jacq. It is also known as Bonnet pepper, is one of the popular vegetable grown in many parts of the world. It is widely cultivated for its unique fruit in south and central America. Because of its novel qualities, it is widely applied in food, pharmaceutical and cosmetic industries. But so far, there is no variety developed in this species commercially. Nowadays protected cultivation technologies of vegetable crops are being utilized in all over the world but the level and extent of their use may be varying depending upon the country's economy. Singh and Sirohi (2008) ^[1] examined that protected cultivation of vegetables offers many advantages *viz.*, improvement in quality, productivity and market price to the growers. Protected cultivation of vegetables also offers off-season cultivation of many vegetables, fetching good returns to the farmers when the crop fails during normal season under open field cultivation.

Off-season cultivation of tomato, chilli, paprika, cucurbits and leafy vegetables under low plastic tunnels is one of the most profitable technologies under northern plains of India (Dixit, 2007) ^[6]. Farmers also got remunerative price for their produce due to high quality and yield under protected cultivation. Chemma *et al.*, 2004 ^[5] evaluated off season vegetable crops under net house conditions for total yield, earliness and other characters and incidence of pests and diseases. In protected cultivation the crops are protected from excessive sunlight by providing uniform shade that result in better yield. Insect proof net houses can be used for virus free cultivation of tomato, chilli, pepper and other vegetables mainly during the rainy season. These structures will also act as a barrier to hail-storms and other natural calamities and helps in reducing the loss of water through evaporation.

Habanero/bonnet pepper is an erect, multi-stemmed, evergreen shrub growing 60 - 100cm tall. This species is considered as the ancestor species to some of the hottest peppers. The plant is cultivated as an annual in the tropics and subtropics. It grows best in areas where annual daytime temperatures are within the range 20 - 26°C and can tolerate upto 32°C, but it is not tolerant to frost conditions.

It succeeds with a mean annual rainfall in the range 600 - 1,250mm and requires a very warm sunny day and a humus-rich, fertile, well-drained loamy soil to grow. It prefers a pH in the range of 5.5 - 5.6, but tolerates upto 8.3. The plant takes 120-150 days from sowing to first harvest of the fruit when grown as an annual. The speciality of habanero pepper is, it produces a pleasant ghee flavour when added in the food items. It has been reported that there are 63 number of chemical compounds present in the fruits and plays a major role in the induction of aromatic ghee flavour (Govindarajan, 1986) [9].

Capsicum chinense Jacq. is a self pollinated plant however, considerable cross pollination (up to 10%) may occur when insect population is high. It behaves as a semi-perennial herb if grown under optimal condition. (Roy and Sweat 2016) [13]. The fruits are vary in size and shape, ranging from 6mm in diameter, smooth and rounded, to wrinkled and elongated and up to 10cm long. The pungent fruit has tonic and antiseptic properties, stimulates the circulatory and digestive systems and increases perspiration. It also irritates the tissues, increasing blood supply to the area and gives sensitivity to pain (Kaur and Kapoor, 2001, Howard, 2000) [11,3, 12]. It is taken internally in the treatment of the cold stage of fevers, debility in convalescence or old age, varicose veins, asthma and digestive problems.

Materials and Methods

A field study was taken up to evaluate the performance of habanero pepper crop under insect proof net house as well as in the open field at Horticultural Research Station, Thandiyankudisai during the year 2014-15 and 2015-16. The seeds were sown in raised nursery bed on the lines drawn at 10cm distance and covered with sand and dried leaves. Necessary intercultural operations and irrigation were given. It took about 60 days for the germinated seeds to reach transportable size. Inside the insect proof net house soil was brought to fine tilth after applying the basal dose of N, P and K recommended for chilli (*C. annuum*). Under open field, the seedlings were transplanted inside the coffee plantation and

required cultural operations and input applications were carried out for better establishment and cultivation of the crop.

The seedlings were transplanted on the same day in the open field and under insect proof net house at a spacing of 60 cm between plants and 60 cm between rows. At the time of transplanting half the dose of nitrogen along with full dose of phosphorus and potash was applied. Remaining nitrogen was top dressed at flowering followed by earthing up stage. The NPK fertilizers were given through urea, single super phosphate and muriate of potash.

The experiment was carried out at Randomized Block Design with three replications. Periodical field operations and input applications were taken up. Five randomly selected plants were used for recording important growth and yield characters. The crop growth parameters along with flowering, fruiting and yield were recorded. Fruits collected from five randomly selected plants grown under two different environment were used for quality analysis viz., vitamin C, polyphenol oxidase, total phenols, capsaicin and oleoresin content and the quality parameters were recorded. The mean of recorded values were statistically analysed and tabulated.

Results and Discussion

The data on the performance of habanero pepper under two different environments in respect of plant growth characters, fruit characters and quality attributes under insect proof net house condition and open field conditions are given in tables 1, 2 and 3 and in figure 1 and 2. Analysis of variance showed significant differences among the growing environments. The significant differences indicated the presence of wide variation for the observed characters under two different environments in the study.

Plant growth characters

Plant growth characteristics such as plant height, number of branches, days to first flowering, days to 50% flowering and days to first harvest was measured for habanero pepper under insect proof net house and under open field. (Table 1).

Table 1: Performance of habanero pepper under insect proof net house and open field conditions for plant characters and earliness

S. No.	Growing environment	Plant height (cm)	No. of branches	Days to first flowering (Days after transplanting)	Days to 50% flowering (Days after transplanting)	Days to first harvest (Days after transplanting)
1	Insect proof net house	76.57	5.62	75.66	87.36	95.36
2	Open field as a mixed crop in coffee plantation	68.32	5.07	82.67	94.36	107.86
	Percentage increase over open filed cultivation	12.07	10.84	9.26	8.01	13.10
	Mean for both the environment	72.44	5.34	79.16	90.86	101.61
	CD (5%)	10.21	1.28	8.33	7.56	8.76

From table 1 it was concluded that the plant height (76.57), number of branches/plant (5.62), days to first flowering (75.66) and days to first harvest (95.36) were found to be the highest for the crop cultivated under insect proof net over open field condition. This was in agreement with the findings of Rao *et al.*, 2013 [4]. Early flowering of habanero pepper crop under insect proof net was observed (75.66 days) under insect proof net house, whereas first flowering in open field was delayed under open field grown vegetables. This table shows that under insect proof net the crop growth parameters were increased than under open field condition.

Fruit characters and yield

Fruit characters like fruit length, fruit diameter, fruit girth,

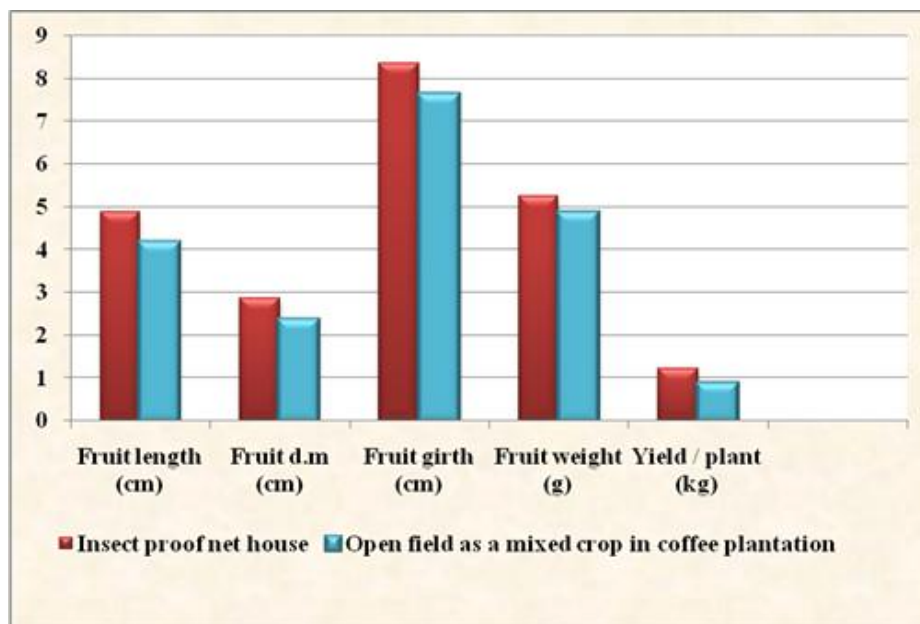
fruit weight, no of fruits/plant and yield per plant were observed under both open field and insect proof net house conditions (Table 2). The table showed that fruit characters and yield were on positive side under net house conditions. Fruit length and girth was maximum (4.87 cm, 2.86 cm) under insect proof net and minimum (2.86 cm, 2.36 cm) at open field condition. A total number of 170.34 fruits/ plant was harvested from net house grown plants. Fruit girth and fruit weight was also recorded highest under insect proof net house (8.35 cm and 6.34g). Totally there were 9.35 harvests were made at insect proof net house, whereas it was only 7.62 under open field. These findings are in accordance with Singh and Asrey, 2005 in capsicum.

Table 2: Performance of habanero pepper under insect proof net house and open field conditions for fruit and yield characters

S. No.	Growing environment	Fruit length (cm)	Fruit D. m (cm)	Fruit girth (cm)	Fruit weight (g)	No of fruits/plant	No. of harvest	Duration of harvest (Days)	Yield / plant (kg)
1	Insect proof net house	4.87	2.86	8.35	6.34	170.34	9.35	86.53	1.08
2	Open field as a mixed crop in coffee plantation	4.16	2.36	7.63	5.86	139.93	7.62	64.37	0.82
Percentage increase over open filed cultivation		17.06	21.18	9.43	7.59	21.73	22.70	34.42	38.20
Mean for both the environment		4.51	2.61	7.99	5.05	155.14	8.48	75.45	1.06
CD (5%)		0.46	0.38	0.33	0.34	11.52	2.35	7.86	0.14

The data on yield has been given in table (2). The mean fruit yield per plant was recorded under insect proof net was 1.08

kg/plant and under open field condition it was 0.82 kg/plant as mean yield.

**Fig 1:** Fruit characters and yield of habanero pepper grown under insect proof net and open field.

Quality Characters

Oleoresin, which represents the total flavour extract of the ground spice is now being extensively used in processed foods and pharmaceutical products. The current investigation revealed considerable variation for oleoresin content both under insect proof net (16.53%) and mixed crop in coffee plantation (15.46%). This was in agreement with the results

obtained by Rao *et al.*, 2013^[4]. The nutritive value of pepper is largely determined by the content of ascorbic acid (vitamin c). The mean ascorbic acid content were 123.52 mg/100g and 120.27 mg/100g. (Under insect proof net under open field conditions). The crop grown under insect proof net showed high value of ascorbic acid content and found to be suitable for vegetable purpose.

Table 3: Performance of habanero pepper under insect proof net house and open field conditions for quality parameters

S. No.	Growing environment	Polyphenoloxidase (Activity/min/g)	Total phenol (mg/100g)	Capsaicin (%)	Vitamin C (mg/100g)	Oleoresin
1	Insect proof net house	2.08	2.27	4.36	126.52	16.53
2	Open field as a mixed crop in coffee plantation	1.96	2.02	4.13	120.27	15.46
Percentage increase over open filed cultivation		6.12	12.37	5.56	2.70	6.92
Mean for both the environment		2.02	2.14	4.24	121.89	15.99
CD (5%)		0.73	0.25	0.56	3.27	1.84

Polyphenol oxidase also known as phenolase, tyrosinase, monophenol is a group of copper enzyme that catalyzes the oxidation of phenolic compounds by two different reactions by using molecular oxygen as a co-substrate (Materska, 2005)^[10]. It prevents browning in chilli/ pepper and reduction of deterioration reaction that is catalyzed by polyphenoloxidase is a major problem in food industry. In this study, the polyphenoloxidase activity was analyzed in habanero pepper both under insect proof net and under open field conditions. The results revealed that under insect proof net condition the

polyphenoloxidase activity was 2.08/min/g and in the fruits harvested under open field condition and activity was reduced (1.9/min/g) in the fruits cultivated under insect proof net. Total phenolic content was also an important factor in peppers. Howard *et al.*, 2000^[3, 12] found that, total soluble phenolics and total phenols were increased with maturation. Phenol content also high under insect proof net (2.27 mg/100g) the phenol content of the fruit was obtained as and under open field and it was measured as 1.96 mg/100g in the fruits collected under open field.

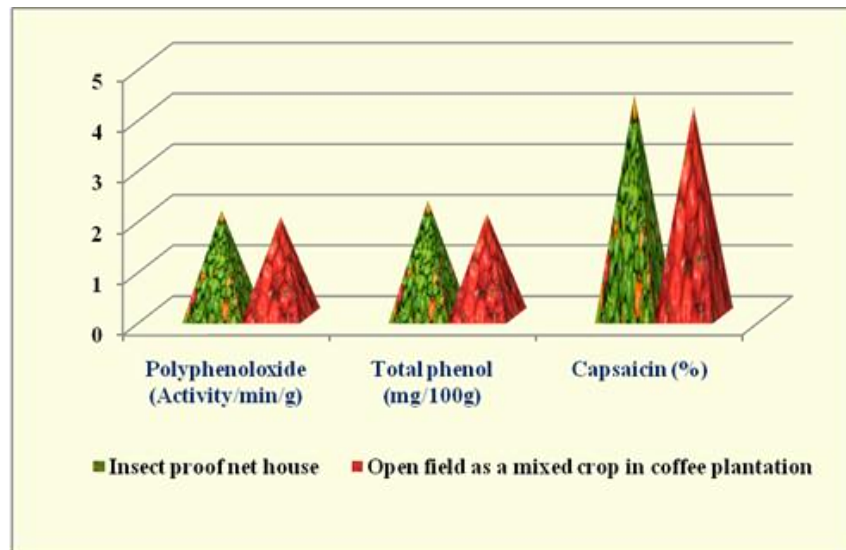


Fig 2: Quality parameters of habanero pepper grown under insect proof net and open field.

Capsaicin, the pungent principle of capsicum was found to be 4.36 % (under insect proof net house) and 4.13 % (under open field condition) in the two different environmentally grown fruits (Table 3). This variation could probably due to the presence of genes modifying factors for pungency and the ratio of placental tissue to seed and pericarp under open field condition and insect proof net grown fruits. (Sreelathakumary, 2000). Under insect proof net house, the capsaicin content was increased.

This table reveals that under insect proof net the plant growth and fruiting characters and crop yield were increased with improved quality when compared to open field condition with the extended fruiting duration of about 22 more days, which led to higher returns from the crop. This is due to the micro climate surrounding was as per the plant requirement to enhance the growth and yield.

Conclusion

Under protected condition, cultivation of high value crops is gaining importance in recent past in India. In the present study, experimental trials were taken up to study the performance of chilli under two different growing conditions revealed that insect proof net give higher performance in chilli related to its growth and yield parameters when compared to crop under open cultivation along with water saving of about 40 per cent in covered cultivation.

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