Evaluation of Capsicum (*Capsicum annuum*) Varieties in Naturally Ventilated Poly House Condition

ABSTRACT

An experiment entitled, "Evaluation of Capsicum (*Capsicum annuum*) Varieties in Naturally Ventilated Poly House Condition." was conducted at Horticulture Research Farm, Department of Horticulture, during the year 2022-23. Ten Capsicum Varieties, Names Sweet Pepper Nemalite, Sweet Pepper Cebrail, Sweet Pepper Bungi. Capsicum Varun, Sweet Pepper Volante, Shehzadi. Alpine 8510, Alpine 8248, Capsicum Orange and Capsicum IMP were evaluated at SHUATS, Prayagraj in randomized block design with three replications during winter season 2022-23 for find out best performing variety in terms of growth, yield and quality. The Sweet Pepper Volante was found maximum performance with the maximum fruit weight (154.20g), Fruit length (8.83cm), Fruit yield per plant (1.47 kg), Fruit yield (17.72 q/200 sq. m.). Sweet Pepper Volante was found superior based on overall performance in term of growth, yield and quality and highest cost benefit ratio (2.79) was found for capsicum in Sweet Pepper Volante variety under naturally ventilated polyhouse condition.

Keywords: Capsicum, Performance,Varieties.

INTRODUCTION

Capsicum (Capsicum annuum L. var. grossum) belonging to Solanaceae family, is native to Mexico **(Bukasov, 1930; CABI, 2019)** with Guetemala as secondary centre of origin (Bukasov, 1930). In 16th century, Portuguese and Spanish explorers introduced bell pepper from South America to Asia through trade routes **(CABI, 2019).** It is highly variable herb, or sub-shrub type annual crop attending 0.5 to 1 m in height with highly branching characters **(CABI, 2019),** and is available in diverse colors, such as green, red, black, orange, purple etc**(Kumar *et al.*, 2015).** It is grown worldwide for cooked vegetable, salad, pickle and processing purpose. The reason behind its worldwide admiration is its delicate taste, pleasant flavor, and varied colors with nutritious qualities. Its beautifully shaped form and vivid diverse color entitled it as “The Christmas ornaments of the vegetable world” **(Sharma *et***

***al.*,2019)**. Furthermore, presence of vitamin C and zinc makes it better for strong and healthy immune system. Fatty acids, flavonoids, volatile oil, carotene pigment, beta carotene, iron, potassium, calcium, vitamin A and rutin (a bioflavonoid) are some compounds which are vastly available in bell pepper **(Agarwal *et al.*, 2007).**

The traditionally grown green capsicum, depending upon variety and season, usually yields 20-40 tons per hectare in about 4-5 months. In greenhouse, the crop duration of green and coloured capsicums is about 7 -10 months and yields about 80-100 t ha-1. Despite its economic importance, growers are not in a position to produce good quality capsicum with high productivity due to various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and crop factor (flower and fruit drop), which ultimately affects the crop productivity adversely **(Ochigbo and Harris, 1989).** Growing of capsicum under polyhouse has been reported to give high productivity of good quality produce in developed countries and several hybrids have been developed recently. Hence, there is a need to evaluate their performance under naturally ventilated polyhouse conditions for getting higher productivity of excellent quality under Indian conditions. Capsicum is one such vegetable which befits into cultivation under protection to increase the production and yield. There are several capsicum varieties and hybrids available and being cultivated by farmers on commercial scale under open field condition. Hence, there is a need to evaluate various commercial capsicum hybrids for recommending its cultivation under greenhouse condition.

Different types of structures are being used for improving the productivity and profitability of horticultural crops as well as growing of the crops and planting material throughout the year like green house, shade house, lath house, mist house etc. In modern research, green house technology can be utilized for control of environmental parameters such as temperature, relative humidity, light intensity, light duration, CO_2 level, irrigation, nutrient supply and uptake, spacing, growing medium and root development **(Baghel *et al.*, 2003).**

Materials and Methods

This experiment was carried out during 2023 at Crop Research Farm, Department of Horticulture, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E

longitude and 98 m altitude above the mean sea level. This area situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Prayagraj, city. The climate of this region is typically sub-tropical and semi-arid with monsoon commencing by the third week of June and with drawing by end of September. The temperature reached up to 48^{o}C and in winter it goes down to as low as 2-3^{o}C. During the summer hot scorching winds known as *"Loo"* and frost during winter months are common features. Experimental mechanical analysis of the soil was sand 59.50 (%), silt 24.10 (%), clay 16.40 (%) and textural class silt loam, while chemical analysis of soil was available nitrogen (242 kg/ ha), available phosphorus(24.50 kg/ ha), available potassium(95.00 kg/ ha), organic carbon(0.40 %), pH(7.50) and EC(0.19 dS/ m). The material for the study was comprised of 10Capsicumvariety. The variety were raised in field experiment in randomized block design with three replications. Growth, yield and yield attributing parameters were studied and data were collected from the five randomly selected plants from each plot. The data collected on different parameters was subjected to statistical analysis as per method of analysis prescribed by Panse and Sukhatme (1995).

Results and Discussion

Vegetative parameters

Data presented in Table 1 showed that plant height and Number of branches of Capsicum varied significantly under the influenced by different variety at harvest stage. Plant height increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum plant height and Number of branches (77.47 and 4.60), at harvest was recorded V_4 (Capsicum Varun), followed by V_5 (Sweet Pepper Volante) and minimum plant heightand Number of branches (56.40 and 3.47) was recorded under V_9 (Capsicum Orange). Environment is the aggregate of all external conditions which influence the growth and development of crop, which play dominant role in crop production. Each crop has its own set of environmental conditions under which it grows best. Generally, crops are not profitable unless they are adapted to the region in which they are produced. Raising a crop successfully means the crop must be productive and economical to grow under prevailing conditions (Reddy, 1999).Temperature is the major regulator of development processes. It influences the flower and fruit development. The effect of temperature on net photosynthesis is a vital concern in crop production. The higher temperatures have more adverse influence on net photosynthesis than lower temperatures leading to decreased production of photosynthates above a certain temperature (Reddy,

1999). The temperature can be controlled and regulated under protected condition, therefore healthy and better growth of plants can be expected under protected condition. The differential response of vegetative growth of the different variety may be due to differences in genetic constituents of the varieties and microclimate condition (Bergefurd*et al*., 2011).

Table 1.Vegetative parameters of Different Varieties in Capsicum Varieties in naturally ventilated polyhouse.

Varieties	NAME OF VARIETIES	Height of Plant (cm)	Number of Branches/plant
V1	Sweet Pepper Nemalite	68.20	4.13
V2	Sweet Pepper Cebrail	70.27	4.33
V3	Sweet Pepper Bungi	67.27	4.27
V4	Capsicum Varun	77.47	3.53
V5	Sweet Pepper Volante	72.87	3.47
V6	Shehzadi	58.20	4.53
V7	Alpine 8510	61.00	4.60
V8	Alpine 8248	60.67	4.27
V9	Capsicum Orange	56.40	4.20
V10	Capsicum IMP	57.40	4.07
F - TEST		S	S
S.E.(d)		2.70	0.32
C.D at 5%		5.66	0.66
C.V.		5.08	9.36

Reproductive parameters

Data presented in Table 2 showed that Days to First Flower Initiation of Capsicum varied significantly under the influenced by different variety at harvest stage. Days to First Flower

Initiation increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Days to First Flower Initiation (20.07), at harvest was recorded V_9 (Capsicum Orange), followed by V_6 (Shehzadi) and minimum Days to First Flower Initiation (9.13) was recorded under V_2 (Sweet Pepper Cebrail). This might be due to genetic constitution of the different hybrids that leads to differ in flower initiation. Similar findings were noticed by Rajender and Shukla (2013) and Ahmed *et al*. (2015) in capsicum. In case of Fruit Length increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Fruit Length (8.83), at harvest was recorded V_5 (Sweet Pepper Volante), followed by V_2(Sweet Pepper Cebrail) and minimum Fruit Length (4.90) was recorded under V_9 (Capsicum Orange). This could be due to higher uptake of nutrients and higher leaf area which enables higher build up of sufficient photosynthates enabling the increase in length of fruit in that hybrid. This is in concordance to the results of Biwalker*et al*. (2015), Yellava and Patil (2009) in capsicum. Similarly in Fruit Diameter increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Fruit Diameter (6.40), at harvest was recorded V_5 (Sweet Pepper Volante), followed by V_3 (Sweet Pepper Bungi) and minimum Fruit Diameter (4.50) was recorded under V_{10} (Capsicum IMP). The least Fruit Diameter (6.40) were recorded by V_5 (Sweet Pepper Volante). This could be attributed to the increased Fruit Diameter. These results are in conformity with Bhatt and Rao (1993) and Kurubetta (2008) in capsicum. However in Number of fruits per plant increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Number of fruits per plant (9.40), at harvest was recorded V_5 (Sweet Pepper Volante), followed by V_4 (Capsicum Varun) and minimum Number of fruits per plant (3.67) was recorded under V_{10} (Capsicum IMP). Higher fruit yield plant-1 in V_5 (Sweet Pepper Volante) was due to more number of flowers and fruits plant-1, high average fruit weight and maximum sized fruits with higher values of fruit length and fruit width. This is in consonance with the findings of Zende (2008), Kurubetta and Patil (2009) and Aruna and Sudagar (2010) in capsicum. Also in Average fruit weight (g) increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Average fruit weight (g) (154.20), at harvest was recorded V_5 (Capsicum Varun), followed by V_1 (Sweet Pepper Nemalite) and minimum Average fruit weight (g) (138.27) was recorded under V_9 (Capsicum Orange). V_5 (Sweet Pepper Volante) recorded maximum Maximum Average fruit weight (g) (154.20) which was significantly superior over all the variety. The

minimum Average fruit weight (g) (138.27) was recorded by V_9 (Capsicum Orange). This might be due to good vegetative growth besides effective pollination and fertilization and lower abscission rate of flowers. Similar results were recorded by Backer (1989) in sweet pepper.Among the Fruit yield per plant (kg) increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Fruit yield per plant (kg) (1.47), at harvest was recorded V_5 (Sweet Pepper Volante), followed by V_1 (Sweet Pepper Nemalite) and minimum Fruit yield per plant (kg) (0.29) was recorded under V_{10} (Capsicum IMP). Similarly V_5 (Sweet Pepper Volante) recorded maximum number of fruits per plant (1.47) which was significantly superior over the other variety. The least number of fruits per plant (0.29) were recorded by V_{10} (Capsicum IMP), might be due to more number of flowers and high value of per cent fruit set because of vigorous and healthy plants. These results are line with Backer (1989) in sweet pepper.Number of fruits per plant second harvest increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Number of fruits per plant second harvest (3.27), at harvest was recorded V_2 (Sweet Pepper Cebrail), followed by V_5 (Sweet Pepper Volante) and minimum Number of fruits per plant second harvest (0.47) was recorded under V_9 (Capsicum Orange). And Total yield increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum Total yield (17.72), at harvest was recorded V_5 (Sweet Pepper Volante), followed by V_1 (Sweet Pepper Nemalite) and minimum Total yield (9.27) was recorded under V_{10} (Capsicum IMP).Atmospheric moisture also plays a significant role in crop growth and development. The relative humidity increases the availability of net energy for crop growth and prolong the survival of crops under moisture stress conditions. Relative humidity reduces the evaporation losses from the plants which lead to optimum utilization of nutrients. It also maintains the turgidity of the cells, which is useful in enzyme activity leading to a higher yield (Reddy, 1999). Higher values of fruit length, fruit diameter and no. of fruit/plant contributed for maximum average fruit weight in the variety, V_5 (Sweet Pepper Volante). Similar observations were recorded by Valsikova and Belko (2004), Zende (2008) and Kurubetta and Patil (2009) in capsicum.

Table 2.Reproductive parameters of Different Varieties in Capsicum varieties in naturally ventilated polyhouse.

Name of Varieties	Days to First Flower Initiation	Fruit Length in (cm)	Fruit Diameter (cm)	Number of fruits /plant	Average fruit weight (g)	Fruit yield /plant (kg)	No. of fruits /plant 2nd harvest	Total yield (q)/200sq. m
V1	14.27	8.19	5.78	8.07	138.27	1.11	2.33	15.15
V2	9.13	8.79	5.88	8.00	130.13	1.05	3.27	15
V3	15.87	6.14	6.35	7.87	96.27	0.74	2.53	12.75
V4	11.4	7.71	4.67	8.6	114.2	0.97	2.6	14.7
V5	9.67	8.83	6.4	9.4	154.2	1.47	3.13	17.72
V6	18.33	5.5	6.36	4.4	91	0.37	2	9.69
V7	11.8	5.65	4.59	4.6	88.47	0.39	1.33	9.91
V8	15.07	5.67	5.8	4.6	92.53	0.43	1.67	10.06
V9	20.07	4.9	4.56	4.53	87.13	0.4	0.47	10.09
V10	13.73	5.97	4.5	3.67	87.53	0.29	0.87	9.27
F - TEST	S	S	NS	S	S	S	S	S
S.E.(d)	0.57	0.29	0.85	0.45	6.27	0.09	0.77	1.052
C.D at 5%	1.19	0.61	1.79	0.95	13.16	0.18	1.63	2.172
C.V.	4.98	5.3	2.24	8.68	7.11	14.67	46.9	18.227

Quality parameters

Data presented in Table 3 showed that TSS (^{o}brix) and Vitamin C (mg/100g) of Capsicum varied significantly under the influenced by different variety at harvest stage. TSS (^{o}brix)and Vitamin C (mg/100g) increased continuously with advancement of crop age and attained its maximum value at the maturity stage irrespective of variety. Maximum TSSand Vitamin C (mg/100g) (obrix) (9.03 and 154.66), at harvest was recorded V_1 (Sweet Pepper Nemalite), followed by V_3 (Sweet Pepper Bungi) and minimum TSS (obrix) and Vitamin C (mg/100g) (7.23 and 56.40) was recorded under V_4(Capsicum Varun).

Higher Vitamin-C content was recorded in V_4 (Capsicum Varun) (154.66 mg/100 g) variety which was superior over all variety evaluated. Generally, the higher ascorbic acid content would increase the nutritive value of capsicum, which would help better retention of colour and flavour. Capsicum varieties and hybrids possessing high ascorbic acid content are of great demand in export markets as opined by Sweta Rani (2003), Banaras *et al*. (2005) and Choudhary *et al*. (2011) in capsicum.Pevicharova*et al.* (2007) also recorded lower amount of vitamin-C content under higher temperature and stated that in bell pepper fruits high day

temperature decreased the total vitamin-C of fruits.Higher TSS content was recorded in Inspiration (9.03°Brix) which was found to be superior over all other treatments. Since capsicum is used for salad making, fruits with high TSS are highly preferred. TSS is an important quality attribute of capsicum fruit which increases the palatability and also it determines the varieties for processing industries. Similar findings were recorded by Hajarica and Phookan (2005) in tomato and Sood *et al.* (2007) in capsicum.

Table 3Quality parameters of Different Varieties of Capsicum in naturally ventilated polyhouse condition.

Varieties	NAME OF VARIETIES	TSS (^{0}brix)	Vitamin C (mg/100g)
V1	Sweet Pepper Nemalite	9.03	154.10
V2	Sweet Pepper Cebrail	8.63	154.48
V3	Sweet Pepper Bungi	8.87	152.56
V4	Capsicum Varun	7.23	154.66
V5	Sweet Pepper Volante	8.00	154.05
V6	Shehzadi	8.60	152.00
V7	Alpine 8510	8.70	153.22
V8	Alpine 8248	8.43	152.03
V9	Capsicum Orange	8.43	152.15
V10	Capsicum IMP	7.90	152.56
F - TEST		S	NS
S.E.(d)		0.38	1.19
C.D at 5%		0.80	2.50
C.V.		5.55	0.95

Conclusion

The result from the present investigation concluded that in terms of Growth parameters Sweet pepper volante was recorded with maximum Plant height (72.87 cm), Number of branches (3.47), Days to first flower initiation (9.67). In terms of Yield parameters Sweet pepper volante was recorded with maximum (fruit weight (154.20 g), Fruit length (8.83cm), Fruit yield per plant (1.47 kg), Fruit yield (17.72(q)/200sq.m.). In terms of Yield parameters Sweet Pepper Volante was recorded with maximum TSS (8.00),Vitamin C (154.05 mg).

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