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Morpho-Phenetic, Biochemical and Storage Characteristics Studies of Chili (*Capsicum annuum* L.) Genotypes Grown under Terai Agro-Ecological Region of West Bengal

Guruprasad, Riman Saha Chowdhury, Suchand Datta

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ABSTRACT

To study the performance of growth, yield, quality and storage behavior of chilli genotypes, an experiment was carried out at the experimental farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, during the consecutive year of 2018-19 and 2019-20. The experiment was laid out in Randomized Block Design with three replications. In this experiment fourteen chilli genotypes were evaluated for various traits. From the analyzed data, it was observed that highest plant height (89.83 cm) was recorded by genotype Local 2 and lowest in genotype IET-8 V3 (39.50 cm). Genotype G-4 took minimum days for 50% flowering (56.13 days) and for 50% fruiting (86.55 days). Longest fruit length (12.95 cm) was observed in genotype IET-8 V8. Genotype Local 1 recorded maximum number of fruits (146.33) per plant followed by IET-8 V4 (133.80). The highest fresh yield (13.69 t/ha) was recorded in genotype IET-8 V8 which was statistically at par with IET-8 V3 (13.15 t/ha). Higher yield was also recorded in IET-8 V5 (12.42 t/ha). Ascorbic acid content was maximum in AVT-II V7 (134.31 mg/ 100 g). Ascorbic acid content in fruits in storage of 15 days it was highest in genotype AVT-II V7 (81.39 mg/100 g), physiological loss in weight (PLW) in 15 days of storage noticed least in genotype Local 2 (47.27 g) and decay loss noticed least in genotype Local-2 (30.42 %). On the basis of the above discussion, it may be concluded that genotype IET-8 V8, IET-8 V3 and IET V5 may be cultivated in the terai zone of West Bengal for their higher yield and moderate ascorbic acid content (more than 100 mg/100 g of fresh). On the basis of storage life Local-2 may be stored from long time with minimum loss of PLW and decay.

Keywords Chilli, Genotypes, Physiological loss, Storage.

Guruprasad, Riman Saha Chowdhury*, Suchand Datta
Senior Assistant director of Horticulture (ZP), Sindhnur, Raichur 584128, India
Assistant Professor, School of Agriculture and Allied Science, The Neotia University, South 24 Parganas 743368, West Bengal, India
Professor, Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar 736165, India
Email: riman.saha03@gmail.com
*Corresponding author

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the unique crop comes under vegetables as well as spice group and widely cultivated all over the world for using

day to day life of mankind. It belongs to the family Solanace with diploid chromosome number 2n =24 and several cultivated species namely *C. annuum*, *C. frutescens*, *C. chinense*, *C. pubescens* and *C. baccatum* (Andrews 1984). Among them most of the cultivar *Capsicum annuum* group is cultivated commercially in India for using both a greens and dry fruit for daily purpose. This genus originated from Mexico as a primary center of origin and Guatemala and Bulgaria is one of the secondary centers where chilli was originated (Salvador 2002).

India is one of the remarkable producer, procurer and chief exporter of chilli in the World, with overall share of 38% to world's production. Andhra Pradesh is foremost in area and production among all the other 23 states of India but all the states are growing chilli actively. A number of scientists also reported the North East region of India as a secondary center of origin of chilli for the reason that, great amount of diversity is present within the states of this region (Datta and Jana 2011). Along with this region the sub Himalayan foot hill of West Bengal particularly Terai zone is the illustrious area of wide genetic base of chilli. The altering and mostly diversified atmosphere prevails in India is the one of the main reason of developing variability among the chilli cultivar, at many places local cultivars are grown due to regional preference and adoption of local varieties in the area Bullet Lanka-6, Bullet Hybrid Lanka, S-8, Laal Lanka, Dhani Lanka-5 are the local varieties in Cooch Behar district of West Bengal (Paul *et al.* 2013) and Akashi, Chita Bhua and Kakla Lanka are the local cultivars of this region. A number of morphological and bio-chemical changes in the chilli by the manipulating environment, which makes chilli, crop more profitable to the farmer's viewpoint and more appetizing in consumer's opinion.

Chilli has occupied a unique temperament in the day to day food pattern all over the world's people by using chilli in different curry preparation or preparation of sauces, chutneys, pickles, salads, soups for its upstanding pungency, color, flavor and taste. A bunch of useful chemicals likely, fatty oils, capsaicinoids, carotenoids, steam volatile oils, vitamins (vitamin A, E, C and P in green chilli), proteins, fibers and mineral elements are found in chilli (Hosmani 1993). Chilli is well-known all over the world for its medicinal properties, which include the flavonoid rutin, which is used in pharmaceuticals, as well as the fact that it improves blood circulation, improves digestion, accelerates metabolic rate, contains a high amount of antioxidants, strengthens the immune system, and is a source of bactericidal agent. Gargling with peppers relieves pharyngitis and soothes a sore throat. Green chillies also have anti-cancer characteristics due to the presence of the L-asperginase enzyme (anti-tumour element) that is employed in the treatment of acute lymphatic leukaemia, a kind of cancer (Khan *et al.* 2014).

Many limiting factors contribute to low production, productivity and decay loss, including a lack of superior genotypes/improved cultivars for use in breeding programs to develop potential hybrids, and a high incidence of insect pests (thrips, mites, and borers) and diseases (anthracnose, leaf spots, and viral diseases), all of which result in a significant reduction in yield and quality. As a result, chilli genotypes must be evaluated under these conditions for exceptional quality, yield, and growth performance, as well as their storage behavior. For better growth, development and quality of chilli production and breeding work for trait improvement, the terai agro-ecological region of West Bengal have appropriated environment and soil. Taking into consideration this, present research was undertaken in chilli to gather information on yield and yield components and identification of appropriate storable cultivars for this region. By reason of the moderately perishable nature of green chillies, it is likely to fast quality changes and spoilage (through decaying, shrivelling, wilting, water loss, pathogenic disorders) after harvest under inappropriate post-harvest management. Hence, the present investigation was undertaken to study the performance of collected genotypes with respect to yield, quality and storage behavior.

MATERIALS AND METHODS

The present experiment on chilli genotypes was conducted at horticulture experimental farm of Uttar Banga Krishi Viswavidyalaya during two consecutive *rabi* (winter) season of 2018-19 and 2019-20. The soil of the planting site was sandy loam in nature

Table 1. Growth parameters of different chilli genotypes. cm= centimeter, m= meter, mm=millimeter..

Genotypes	Plant height (cm)	Number branches per plant	Stem girth (mm)	Days for 50% flowering	Days for 50% fruiting	Fruit length (cm)	Fruit diameter (mm)
IET-8 V1	63.87	12.03	9.95	73.00	102.00	7.69	12.42
IET-8 V3	39.50	9.93	9.45	66.50	92.83	9.34	11.63
IET-8 V4	67.87	10.87	9.85	70.67	101.83	9.60	13.52
IET-8 V5	58.30	10.90	10.93	60.83	90.00	11.74	11.39
IET-8 V7	68.13	10.27	10.81	68.67	92.50	8.35	12.13
IET-8 V8	56.27	11.10	10.83	67.17	96.83	12.95	12.76
AVT-II V2	59.97	10.43	10.79	68.50	98.33	7.10	7.36
AVT-II V3	59.83	9.50	8.08	67.33	91.50	8.18	8.32
AVT-II V6	53.90	9.13	9.33	69.50	94.33	7.68	7.43
AVT-II V7	56.33	10.23	10.17	59.50	89.67	11.08	11.51
Local 1	67.43	9.27	9.83	69.33	104.50	7.66	12.71
Local 2	89.83	11.20	10.22	94.00	124.17	3.97	6.84
Local 3	64.07	10.07	10.12	72.17	103.50	6.20	10.84
G-4	52.47	10.74	8.14	56.17	87.17	7.08	7.13
SEm (±)	2.22	0.42	0.46	1.53	1.65	0.24	0.30
CD (5%)	6.30	1.19	1.31	4.35	4.69	0.68	0.85

with course structure, poor water holding capacity with low pH. The temperature range was varying from 9°C to 32°C and the humidity ranges from 42% to 100% throughout the crop growing period of the respective years under the experiment. Fourteen genotypes were selected for the present study with three replications and the statistical analysis done through Randomized Block Design (RBD). The seeds are treated with Bavistin @1g/kg of seed and sowing to the nursery bed at the time of last week of October in respective years. After 35 days of sowing the seedlings are collected from the nursery bed at evening hours and planted into the main field where 42 numbers of beds were prepared with 2.5 m × 1.8 m size. The seedlings of the chilli genotypes were planted randomly among the beds with thee replication with the spacing of 45 cm plant to plant and 30 cm row to row. The recoded douse of organic (well rotten farm yard manure at the rate of 20 t/ha) and inorganic fertilizer (N:P:K @ 100:50:0 kg /ha) were applied for better growth and development of the chilli genotypes. Inter culture operations weeding and irrigation was done at every 15 days interval. Observations on various parameters were recorded namely days to 50% flowering and fruiting, plant height, fruit length, fruit diameter, number of brunches, stem girth, number of fruit, fruit weight, fruit yield and among the bio-chemical and post harvest character ascorbic acid content, physiological loss of weight percentage {(Initial weight-final weight)/ fruit weight x100} and decay loss percentage (Quantity of chilli spoiled / total quantity of chilli ×100) were measured with different time interval from 5 days to 30 days. For analysing all the morphological and biochemical parameters, the statistical analysis methods by Panse and Sukhatme (1967) were adopted.

RESULTS AND DISCUSSION

Pooled data of two years having significant variation were summarised. The plant height was noticed highest in Local 2 (89.83 cm) and the lowest height was observed in genotype IET-8 V3 (39.50 cm and the maximum number of branches were noted in genotype IET-8 V1 (12.03) and minimum in genotype AVT-II V_6 (9.13) the more stem girth was recorded in genotype IET-8 V_5 (10.93 mm) and less is observed in genotype AVT-II V_3 (8.08 mm), the genetic makeup of the different variety and environmental condition may cause of the such type of variation in different genotypes under study (Table 1). Sreenivas *et al.* (2019) and Purad *et al.* (2019) was found similar types of finding among their germplasm and they also predict the same cause of such type of variation. Genotype G-4 (56.13 days) took less time for 50% flowering and Local 2 (94.00 days) took maximum time (Table 1).

Table 2. Yield and bio-chemical parameters of different chilli genotypes. g=Gram, mg=milligram, ha= Hectare, m=meter.

Genotypes	Number of fruits per plant	Individual fruit weight (g)	Individual plant yield (g/plant)	Plot yield (kg/4.05 m^2)	Yield per hectare (Ton/ha)	Ascorbic acid (mg 100 g fresh fruit)	Ascorbic acid after 5 days (mg/ 100 g)
IET-8 V1	97.93	3.04	196.92	5.39	10.64	108.13	94.80
IET-8 V3	127.80	2.86	243.46	6.66	13.15	107.24	91.42
IET-8 V4	133.80	2.43	203.45	5.61	11.08	112.37	98.86
IET-8 V5	124.57	2.67	231.31	6.29	12.42	112.60	96.28
IET-8 V7	111.17	2.53	182.75	4.98	9.84	106.85	96.08
IET-8 V8	115.43	3.21	255.30	6.93	13.69	107.00	92.37
AVT-II V2	119.33	2.06	159.15	4.38	8.66	105.57	90.67
AVT-II V3	103.57	2.45	162.86	4.44	8.77	114.03	98.01
AVT-II V6	93.87	2.42	147.07	4.03	7.97	115.11	99.87
AVT-II V7	106.03	2.70	179.21	4.94	9.76	134.31	115.89
Local 1	144.17	2.67	141.98	3.92	7.73	111.79	95.40
Local 2	124.83	1.74	180.33	4.95	9.79	108.89	96.38
Local 3	131.07	2.48	201.21	5.51	10.89	106.25	96.05
G-4	95.00	2.08	135.83	3.71	7.33	87.87	64.22
SEm (±)	1.42	0.05	2.47	0.13	0.25	1.58	1.27
CD (5%)	4.03	0.14	7.03	0.37	0.72	4.47	3.61

Bundela *et al.* (2019) and Jogi *et al.* (2017) previously reported minimum 50 days required for 50% flower production and it varies from variety to variety. Genotype G-4 (86.55 days) took minimum time for 50% fruiting and maximum for Local 2 (124.17 days.). Fruit length was recorded longest in genotype IET-8 V_8 (12.95 cm) and shortest in genotype Local 2 (3.97 cm). Fruit diameter noticed highest in genotype IET-8 V_8 (12.76 mm) and the lowest in genotype Local 2 (6.84 mm) (Table 1). Arora *et al.* (2015) and Quresh *et al.* (2015) was conclude similar variations in fruit characteristics among the chilies belong to different genotypes.

Number of fruits per plants recorded highest in genotype Local 1 (146.33) and lowest in genotype G-4 (95.00), individual weight of fruit was registered more in genotype IET-8 V_8 (3.21 g) and less in genotype (1.74 g) per plant yield observed more in genotype IET-8 V_8 (255.30 g) and recorded less in genotype G-4 (135.83 g), yield per plot was noticed highest in genotype IET-8 V_8 (6.93 kg) and lowest in genotype G-4 (3.71 kg) (Table 2). Similarly, fresh yield per hectare registered maximum in genotype IET-8 V8 (13.69 t/ha) followed by IET-8 V3 (13.15 t/ha) and IET V5 (12.42 t/ha) and minimum in genotype G-4 (7.33 t/ha) (Table 2). Datta and Jana (2012) and Yatagiri *et al.* (2017) were also reported similar trend in the yield of the different genotypes under study.

Ascorbic acid content was found highest in genotype AVT-II V7 (134.31 mg/ 100 g fresh) and found lowest in G-4 (87.87 mg/ 100 g fresh) (Table 2). Ascorbic acid content after 5 days was observed maximum in genotype AVT-II V_7 (115.89 mg/100g) and less in genotype G-4 (64.22 mg/100 g fresh) after 10 days of storage ascorbic acid content found highest in genotype AVT-II V_7 (96.48 mg/100 g) and lowest in genotype G-4 (53.76 mg/100 g) and after 15 days of storage maximum found in genotype AVT-II V_7 (81.39 mg/100 g) and found less in genotype G-4 (44.03 mg/100 g) (Table 2). The ascorbic acid content at different days' interval was showed a clear concept of the quality loss in terms of ascorbic acid content due to increase of respiration. Arora *et al.* (2015) was successfully conducted an experiment on ascorbic acid losses from the days of harvesting and conclude similar types of findings.

Physiological loss of weight was found maximum in cultivar Local 3 (24.03 g) and less in genotype Local 2 (15.23 g) after 5 days of ambient storage, after

Table 3. Bio-chemical and storage parameters of different chilli genotypes. PLW= Physiological loss of weight, g=Gram, mg=milligram.

Genotypes	Ascorbic acid after 10 days (mg/ 100 g)	Ascorbic acid after 15 days (mg/ 100 g)	PLW after 5 days (g)	PLW after 10 days (g)	PLW after 15 days (g)	Decay loss after 5 days	Decay loss after 10 days	Decay loss after 15 days
IET-8 V_1	78.01	64.47	17.30	34.25	50.47	10.56	31.47	67.82
IET-8 V_3	74.85	61.34	18.45	34.20	51.71	11.15	35.69	71.76
IET-8 V_4	81.10	67.58	19.68	35.70	51.89	9.80	29.92	62.05
IET-8 V_5	75.29	65.62	18.35	36.36	53.17	10.75	31.99	65.79
IET-8 V_7	78.00	64.26	17.83	33.84	47.92	9.07	28.66	63.47
IET-8 V_8	76.64	62.74	19.96	40.20	57.03	11.98	36.42	75.48
AVT-II V_2	74.68	62.70	18.95	35.51	51.09	7.83	26.35	54.04
AVT-II V_3	80.69	67.13	20.09	36.46	51.63	11.50	35.67	72.82
AVT-II V_6	81.87	67.48	21.08	39.53	53.47	9.79	30.32	64.18
AVT-II V_7	96.48	81.39	19.61	34.64	51.20	9.33	28.84	59.67
Local 1	81.70	67.16	20.29	37.48	52.27	8.96	27.93	60.20
Local 2	76.56	61.90	15.23	30.08	47.27	4.19	13.42	30.42
Local 3	77.50	62.29	24.03	42.56	57.92	11.54	36.87	63.84
G-4	53.76	44.03	21.43	41.13	55.65	9.13	28.33	57.40
SEm (±)	0.99	0.75	0.92	1.87	2.044	0.61	1.47	2.09
CD (5%)	2.81	2.14	2.61	5.32	5.79	1.73	4.16	5.92

10 days of storage the maximum PLW was found in genotype Local 3 (42.568 g) and minimum in genotype Local 2 (30.088 g) and after 15 days PLW was registered highest in genotype Local 3 (57.92 g) and lowest in genotype Local 2 (47.27 g) (Table 3). Decay loss of green fruits after 5 days of storage recorded maximum in genotype IET- 8 V8 (11.98 %) and found minimum in genotype Local 2 (4.19 %) after 10 days of storage more decay loss found in genotype IET-8 V_8 (36.42 %) and less observed in genotype Local 2 (13.42 %) and after 15 days of storage the highest decay loss was registered in genotype IET- 8 V_8 (75.48 %) and the lowest was recorded in genotype Local-2 (30.42 %) (Table 3). Physiological loss and decay loss both were showed variation among different genotypes under the present study, it may be due to the genetic constitution along with the environment influence on the specific genotypes. Arora *et al.* (2015) recorded similar type of decay loss among the genotypes studied by them.

CONCLUSION

After conducting the present experiment, it may be established that genotype IET-8 V_8, IET-8 V_3 and IET V_5 may be cultivated in the terai agro-ecological zone of West Bengal for their higher yield and moderate ascorbic acid content (more than 100 mg/100 g of fresh). On the basis of storage life Local-2 may be stored from long time with minimum loss of physiological loss of weight and decay.

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