

Evaluation of hot pepper germplasm for growth and yield under polyhouse

S. ROY, A. BANDYOPADHYAY, N. CHATTOPADHYAY,
A. MAJUMDER AND M. M. HOSSAIN

Department of Spices and Plantation Crops, Faculty of Horticulture
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal

Received : 07-02-18 ; Revised : 29-08-18 ; Accepted : 05-09-18

ABSTRACT

The present investigation was undertaken during the autumn-winter season of two consecutive years (2013-14 and 2014-15) to study the yield and quality parameters of 12 hot pepper (*Capsicum* spp.) germplasms. The experiment was conducted in randomized block design with three replications. Each plot consisted of 16 plants planted at a spacing of 60 cm × 45 cm. Ten randomly selected plants from each replication were taken to record various quantitative observations like plant height (cm), internodal distance (cm), length (cm), width (cm) and yield of fruits (kg) and some qualitative parameters viz. plant growth habit, branching habit, colour and shape of young and ripe fruits under polyhouse at Gene Bank, the research field of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal. On the basis of mean performance of 12 germplasms three genotypes namely ICPN 20/5 (highest yield plot¹), ICPN 20/6 and ICPN 20/7 (highest yield plant¹) on respect of yield and Dollo, Manas Jolokia and Sukhia Bulet on the basis of growth habit and resistance to biotic and abiotic stresses found promising in West Bengal condition. This work has been done mainly to observe the diversity among themselves in respect to those qualitative and quantitative characters.

Keywords: Germplasm evaluation, hot pepper, polyhouse, qualitative and quantitative

The hot pepper or jolokia is also known as bih jolokia, u-morok, ghost pepper, ghost hot pepper, red nagachilli, and ghost chilli. It is an interspecific hybrid of *C. chinense* and *C. frutescens* (Shu Bin *et al.*, 2007), cultivated in Bangladesh and Indian states of Assam, Nagaland and Manipur. Among the major spices crops hot peppers share about 6.58 percent of the total area under spices cultivation and 6.6 percent of the total production (Salaria and Salaria, 2007). Hot peppers, also known as chilli peppers, owe their “heat” or pungency to a chemical substance called capsaicin. This chemical is concentrated in the cross walls of the fruit and around the developing seeds. Different varieties of hot pepper are Bhut jalokia, Manas Jalokia, Sukhia Bulet, Dollo etc. Germplasm evaluation is an important work in hot pepper using different types of quantitative and qualitative traits. Very meagre work has been done in selection of different type of characters like Fruits plant⁻¹, fruit weight, dry yield plant⁻¹ (Sahoo *et al.*, 1990), fruit plant⁻¹, days to first fruit harvest and fruit weight (Munshi *et al.*, 2000) and (Jose *et al.*, 2004) worked on it. Germplasm evaluation is important step for the improvement of the hot pepper (XueJun *et al.*, 2002). Since it is almost a negligible crop in India, there lies a great scope to increase its acreage. In spite of tremendous use potentiality, good scope for export as spices, high nutritive value, well acceptability among the average Indian farmers and consumers and wide range of available genetic variability, our country is still far behind to attain the required optimum productivity in hot pepper. Evaluation of the potentialities of the existing hot pepper

genetic resources is essential because of its promise for further improvement programme depends on the genetic diversity of the crop. The magnitude of heritable and more particularly its genetic components, is clearly the most important aspect of the genetic constitution of the breeding material which has a close bearing on its response to selection. Again selection of one trait invariably affects a number of associated traits which evokes the necessity in findings out the interrelationship of various yield components both among themselves and with yield. Keeping in view of the above facts, the present experiment was undertaken to evaluate and characterize different growth and yield performance of hot pepper.

MATERIALS AND METHODS

The present investigation was undertaken during the autumn-winter season of two years 2013-14 and 2014-15 to evaluate different qualitative and quantitative characters of 12 hot pepper germplasms. Twelve germplasms were grown in randomized block design replicated thrice. Each plot consisted of 16 plants planted at a spacing of 60 cm x 45 cm. Standard crop management practices (Akinci and Akinci, 2004) and plant protection measures were taken time to time as and when required. Ten randomly selected plants from each replication were taken to record the following quantitative observations at Gene Bank, the research field of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal. Recommended doses of inorganic fertilizers (N, P₂O₅ and K₂O @ 120, 60 and 60 kg ha⁻¹) were applied along with FYM 15t ha⁻¹. One third of the nitrogen and full doses of phosphorus and potash were

applied at the time of planting. Rest amount of nitrogen was top dressed at 30 DAP and 60 DAP in equal amount. At first seeds were sown in poly trays. The seeds germinated within 8-12 days of sowing. The 30 days old seedlings were ready for transplanting, when they were about 12- 15 cm in height. A light irrigation was given just after transplanting for better establishment of the seedling in the soil. Gap filling was done during the second irrigation, 10-12 days after transplanting. Latter on irrigation was given as and when required depending upon the climatic and soil moisture condition. The stage of maturity at which hot pepper are picked depend on the purpose for which it is grown. For vegetable purpose hot peppers were harvested at fully grown green stage, whereas for dry hot pepper which is used as spice, it is harvested at red ripe stage. The hot pepper fruits mature in 155 to 170 days after transplanting. The ripe fruits were picked 1-2 weeks intervals after first harvest. Harvesting was done 3 times over a period of 3 months. Primary processing of hot pepper essentially consists of sun drying. Depending upon the weather condition the ripe hot peppers were dried in the sun for 7-10 days. The moisture content of the fruits was lowered to 10 %. Data were analyzed using analysis of variance (ANOVA) to evaluate the differences among treatments while the means were separated using the least significant difference (LSD) test at the 5% level of significance.

The grouping of the populations in clusters as done by using Tocher's method as described Rao (1952). The criterion used in clustering by this method was that any two entries belonging to the same cluster at least, on an average have shown a smaller D^2 value than those belonging to different clusters.

Subsequently hierarchical cluster analysis has been done with those same genotypes in order to observe the degree of association according to their characteristics that was expressed in dendrogram following Ward's (1963) method.

RESULTS AND DISCUSSION

Eleven morphological and twenty physical characters were recorded include Plant growth habit, Branching habit, Pigment at node, Leaf shape, Leaf colour, Corolla colour, Fruit shape, Blossom end fruit shape, Mature fruit colour, ripe fruit colour, dried fruit colour in accordance with earlier work conducted by (Karak *et al.* 2015) under saline belt of West Bengal . The frequency distribution of the morphological, physical and yield attributing characters are shown in table 1, 2 and 3, respectively.

Qualitative parameters

The germplasms showed three plant growth habits. It was observed that out of twelve germplasms, 11

germplasms showed intermediate plant growth habit, 1 showed erect habit and none was with spreading habit (Table 1). The predominant branching habits observed were dense and sparse with 9 and 3 number of germplasm respectively. All 12 germplasms had pigment at nodes. Among 12 germplasms, 7 germplasms under investigation had lanceolate leaf shape, 2 had Elliptic leaf shape, 2 had linear leaf shape and only 1 had cordate leaf shape. Leaf colour was observed mostly to be deep green with number of 7 followed by light green with 3 and only 1 with just green leaf. Leaf pubescence was absent in all the hot pepper germplasms studied. In hot pepper the flowers are borne in the leaf axil singly or in clusters of 2 or 3. All had only one flower axil⁻¹ and in 10 of the germplasms the corolla colour was white, 1 was off white and 1 was greenish white. Six types of fruit shape were observed. One germplasm had long fruit type, 3 were of medium long, 3 were very long, 1 was long with cylindrical shape, 2 were small, 1 was small and round and 1 was with short and stout fruit type. Three types of blossom end shape had been recorded of which pointed and blunt types were found to be predominant with 5 both and only 2 showed round type blossom end fruit shape. Mature fruit colour have to be taken at mature marketable fruit stage. In hot pepper generally eight mature fruit colour can be observed.

In the present experiment only four mature fruit colour was observed *i.e.* seven reddish brown, 2 orange red, 2 deep red and 1 orange at fully ripe fruit stage. A total of 8 ripe fruit colour was observed in hot pepper (reddish brown with 58.33%, orange red and deep red both with 16.66 % each and only orange with 8.33%). It was undoubtedly established that most of the germplasms belong to *capsicum frutescence* as they have white to greenish white corolla and bear both terminal and axillary flower bud. The study of 12 germplasms of hot pepper showed wide range of variation in days to first flowering, days to 50 % flowering, green fruit weight, green fruit length, green fruit girth, weight of red ripe fruit, weight of dry fruit, green fruit yield plant⁻¹, dry fruit yield plant⁻¹, number of seeds fruit⁻¹ and number of fruits per plant.

Quantitative parameters

Among the quantitative parameters, days to first flowering ranged from 109.33 days to 195.66 days after transplanting. The germplasm Dollo was late in flowering (195.66 days) and the germplasm ICPN-20/5 showed earliest flowering taking only 109.33 days. This was followed by germplasm ICPN-20/2, ICPN-20/6 and ICPN-20/7 with 111.33, 121.67 and 126.33 days respectively. In case of days to 50% flowering, pooled data showed a wide range of 122.66 days to 203.66 days after transplanting. The minimum days to 50% flowering

Table 1: Studies on morphological growth parameters of different hot pepper germplasms

Germplasm	Characters										
	Plant growth habit	Branching habit	Pigment at node	Leaf shape	Leaf colour	Corolla colour	Fruit shape	Blossom end fruit shape	Mature fruit colour	Ripe fruit colour	Dried fruit colour
Dollo	Erect	Sparse	Present	Cordate	Green	White	Small, round	Round	Green	Deep red	Blackish brown
Manas Jolokia	Intermediate	Dense	Present	Elliptic	Light green	Greenish white	Short, stout	Pointed	Greenish yellow	Orange	Blackish brown
Sukhia Bulet	Intermediate	Dense	Present	Elliptic	Green	Off white	Small	pointed	Green	Deep red	Blackish brown
ICPN 20/1	Intermediate	Dense	Present	Lanceolate	Deep green	white	Small	Pointed	Deep green	Reddish brown	Blackish brown
ICPN 20/2	Intermediate	Dense	Present	Lanceolate	Deep green	white	Long, cylindrical	Blunt	Light green	Reddish brown	Blackish brown
ICPN 20/3	Intermediate	Dense	Present	Lanceolate	Deep green	white	Medium long	Blunt	Green	Reddish brown	Blackish brown
ICPN 20/4	Intermediate	Dense	Present	Lanceolate	Deep green	white	Medium long	Blunt	Green	Reddish brown	Blackish brown
ICPN 20/5	Intermediate	Dense	Present	Lanceolate	Deep green	white	Very long	Blunt	Greenish brown	Reddish brown	Blackish brown
ICPN 20/6	Intermediate	Dense	Present	Lanceolate	Deep green	white	Very long	Blunt	Greenish brown	Reddish brown	Blackish brown
ICPN 20/7	Intermediate	Sparse	Present	Linear	Light green	white	Very long	Pointed	Pale green	Orange red	Blackish brown
ICPN 20/9	Intermediate	Dense	Present	Lanceolate	Deep green	white	Medium long	Round	Brown	Reddish brown	Blackish brown
ICPN 20/10	Intermediate	Sparse	Present	Linear	Light green	white	Long	Pointed	yellow	Orange red	Blackish brown

Table 2: Studies on physical growth parameters of different hot pepper germplasms (pooled)

Germplasm	No. of germinated seedlings/49 seeds	Seedling height after 1 month (cm)	Final plant height (cm)	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)	Days to first flowering	Days to 50% flowering	Internodal distance (cm)	No. of primary branches Plant ⁻¹	No. of secondary branches Plant ⁻¹	Canopy diameter (cm)	
												E-W	N-S
Dollo	34.00	12.40	208.33	17.17	13.00	6.00	195.67	203.67	25.33	6.33	25.00	71.33	60.66
Manas Jolokia	38.33	12.17	160.00	15.00	7.40	2.50	168.33	178.33	19.33	5.33	22.33	56.33	59.33
Sukhia Bulet	27.00	9.93	148.67	11.00	5.40	3.20	181.00	189.00	17.33	5.67	27.33	84.00	85.66
ICPN 1	37.00	13.67	81.67	9.17	3.60	3.20	164.00	174.33	14.00	3.33	22.33	49.00	50.33
ICPN 2	36.67	13.50	91.67	13.20	7.00	5.73	111.33	123.67	11.33	4.00	24.33	52.33	43.66
ICPN 3	31.67	11.73	83.67	13.6	6.80	5.00	142.33	155.67	16.50	2.00	14.00	51.00	60.66
ICPN 4	37.00	12.17	83.33	12.00	7.86	5.60	150.67	163.33	14.00	3.00	22.00	48.33	59.33
ICPN 5	40.33	12.40	96.00	12.80	6.40	4.13	109.33	122.67	11.50	2.00	19.67	34.66	42.00
ICPN 6	41.33	13.43	90.67	14.20	6.50	3.70	121.67	135.00	9.66	3.00	25.00	52.33	54.66
ICPN 7	37.67	13.03	113.00	9.80	3.93	3.50	126.33	137.00	11.83	8.33	37.33	54.33	48.66
ICPN 9	35.00	12.23	92.00	13.50	7.86	6.00	140.33	151.67	10.33	5.00	25.00	54.66	42.66
ICPN 10	39.33	10.83	123.00	10.73	4.20	7.00	131.33	145.00	9.73	7.33	37.67	47.00	43.00
SEm (±)	3.64	0.78	4.42	0.48	0.16	0.40	3.84	3.83	0.575	0.55	1.42	1.09	1.09
LSD (0.05)	NS	NS	13.06	1.41	0.474	1.19	11.34	11.31	1.698	1.62	4.20	3.23	3.23

were noticed in germplasm ICPN-5 (122.66 days) followed by ICPN-20/2 (123.66 days) and ICPN-20/6 (135.00 days) (Table 2). Most late 50% flowering was recorded in Dollo (203.66 days). The fresh fruit weight ranged between 2.18 g to 42.46 g. Considering the ripe fruit weight of germplasm ICPN-20/6 had maximum weight of 42.467g was followed by ICPN-20/5 (29.83g) and lowest in Manas Jolokia (2.62 g), , 25.53, 22.86, 19.28, 12.88, 10.01, 3.80, 3.58 and 2.62 g respectively. On the other hand, germplasm Sukhia Bulet recorded lowest weight of 2.18 g only.

In case of fruit length, the range was 2.20 cm to 18.20 cm. ICPN-20/6 was the longest with 18.20 cm fruit length and genotype Dollo was the shortest with 2.2 cm fruit length. Germplasm like ICPN 5, ICPN 3, ICPN 2, ICPN 4, ICPN 7, ICPN 10, ICPN 9, ICPN 1, Manas Jolokia, and Sukhia Bulet showed intermediate fruit length of 15.20, 14.66, 13.20, 11.20, 11.03, 10.20, 8.93, 5.20, 4.00, 3.36 cm respectively (Table 2). From pooled data girth of the fruit ranged between 1.06 cm to 3.8 cm. ICPN-20/6 had the highest fruit girth of 3.8 cm whereas ICPN-20/1 had the least fruit girth of 1.06 cm.

Yield attributing characters

Among the yield attributes the weight of dry fruit (pooled data) was found between 0.8 g to 13.8 g. The weight of dry fruit of ICPN-20/6 was highest 13.80 g (Table 3). This germplasm also showed the highest weight of ripe fruit. The lowest weight of dry fruit was recorded in the ICPN-20/1 with only 0.8 g. significant variation in the weight of fruits among the chilli cultivars was also noticed by Karak *et al.* (2015). Different germplasms showed different values of ripe fruit yield plant⁻¹ ranging between 11.83 g to 28.81 g. The germplasm ICPN-20/5 produced highest red fruit yield plant⁻¹. These germplasms gave ripe fruit yields of 28.81 kg plot⁻¹. On the other hand germplasms ICPN-20/4, ICPN-20/10, ICPN-20/1 and ICPN-20/2 produced low yield of 14.09, 15.83, 16, 16.16 kg ripe fruit plot⁻¹ respectively. Highest yield was produced by the germplasm ICPN-20/5 pointed with 28.81 kg ripe fruit plot⁻¹ and lowest by the germplasm ICPN-20/9 with 11.83 kg ripe fruit plot⁻¹ (Table 3). Similar variations in respect of yield was recorded by Sarkar *et al.* (2009). In respect of leaf shape 58.33% plants showed lanceolate leaves, both elliptic and linear had formed 16.66% each and remaining 8.33 % were of cordate types. On the basis of pigmentation 100% of the plants had shown pigments in their nodes and all their dried fruits had shown the same blackish brown colour. Out of each 49 planted seeds of each germplasm highest germination was found in ICPN-20/6 with 40.33 and lowest germination was found in Sukhia Bulet with 27 germinated seedlings. In case of seedling height highest length of seedling was

Table 3: Studies on yield and yield attributing characters of different hot pepper germplasms (pooled)

Germplasm	Fruit length (cm)	Fruit girth (cm)	Pedicle length (cm)	Fresh Fruit weight(g)	Dry fruit weight(g)	Total yield (kg plot ⁻¹)	Yield (kg Plant ⁻¹)
Dollo	2.20	2.20	3.50	3.58	1.58	16.83	0.22
Manas Jolokia	4.00	2.30	3.10	2.62	0.96	18.32	0.21
Sukhia Bulet	3.36	1.50	2.80	2.18	0.84	14.96	0.21
ICPN 1	5.20	1.06	3.16	3.80	0.80	16.00	0.34
ICPN 2	13.20	3.20	3.20	25.53	8.19	21.00	0.97
ICPN 3	14.66	3.00	3.13	19.28	8.28	16.16	0.98
ICPN 4	11.20	2.90	3.03	22.86	8.19	14.09	0.88
ICPN 5	15.20	3.40	3.30	29.87	10.20	28.81	1.13
ICPN 6	18.20	3.80	3.63	42.46	13.80	21.50	0.73
ICPN 7	11.03	2.60	3.00	12.88	3.21	24.50	1.36
ICPN 9	8.93	3.28	2.93	25.72	7.05	11.50	0.80
ICPN 10	10.20	1.50	4.16	10.01	3.01	15.83	1.10
SEm (±)	0.756	0.105	0.093	2.426	0.675	1.083	0.089
LSD (0.05)	2.230	0.310	0.274	7.161	1.992	3.196	0.262

found in ICPN-20/1 with 13.66 cm and lowest length was found in Sukhia Bulet with 9.93 cm.

Thirteen qualitative characters have been recorded which include plant growth habits, branching habit leaf length, width etc. It was undoubtedly established that the most genotypes belong to *Capsicum* spp. So as far all the characters are concerned wide range of variation was evident in days to first flowering, fruit weight, yield plant⁻¹ and fruits plant⁻¹ etc. on the basis of mean performance, three genotypes namely ICPN 20/5 (highest yield plot⁻¹), ICPN 20/6 and ICPN 20/7 (highest yield plant⁻¹) on respect of yield.

REFERENCES

- Akinci, S. and Akinci, I.E. 2004. Evaluation of red pepper for spice (*Capsicum annum* L.) germplasm resource of Kahramanmaras Region (Turkey). *Pakistan J. Bio. Sci.*, **7**: 703-10.
- Jose, L., Khader, K.M.A. and Jose, L. 2002. Correlation and path coefficient analysis in chilli. *Capsicum and Egg plant Newslet.*, **21**: 56-59.
- Karak, P.K., Pariari, A. and Karak, C. 2015. Varietal evaluation of chilli in the saline belt of West Bengal. *J. Crop and Weed*, **11**: 86-89.
- Munshi, A.D., Behra, T.K. and Singh, G. 2000. Varietal evaluation of 24 hot pepper. *Karnataka J. Agril. Sci.*, **13**: 784-87.
- Rao, C.R. 1952. *Advance Statistical Methods in Biometrics*. John Willey and Sons Pvt. Ltd., New York.
- Sahoo, S.C., Miahra, S.N. and Mishra, R.S. 1990. Genetic variation in F₂ generation of chilli varieties in two locations in Mauritius. *Revue Agricole et Sucriere delle Maurice*, **80/81**: 252-57.
- Sarkar, S., Murmu, D., Chattopadhyay, A. and Hazra, P. 2009. Genetic variability, correlation and path analysis of some morphological characters in chilli. *J. Crop and Weed*, **5**: 162-66.
- ShuBin, W., JinBing, L. and BaoGui, P. 2007. A new hot pepper hybrid, Sujiao 12. *Acta Hort.*, **34**: 532.
- Ward, J. H. R. 1963. Hierarchical Grouping to Optimize an Objective Function. *J. American Stat. Asso.*, **58**: 236-44.
- XueJun, C., Rong, F., JinJian, W. and YuSheng, M. 2002. Selection of a new hot pepper F₁ hybrid, Ganfeng 5. *China Veg.*, **2**: 29.