



Stability of chilli genotypes for different seasons at terai zone of West Bengal

S Datta & J C Jana

Department of Vegetable and Spice Crops

Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal-736 165, India.

E- mail: suchanddatta@rediffmail.com

Received 19 August 2011; Revised 21 October 2011; Accepted 08 November 2011

Abstract

The stability of 15 chilli (*Capsicum annuum* L.) genotypes, was studied during *rabi* (winter) and *kharif* (rainy) seasons of 2005-06 and 2006-07 at Pundibari, Cooch Behar (West Bengal). Pooled analysis of variance revealed the presence of significant genetic variability among the genotypes. With respect to different growth, yield and quality characters, significant differences were also found in all the characters except ascorbic acid, indicating the effect of environment on the performance of the genotypes. Ulka-686 showed supremacy in yield in both *rabi* and *kharif* seasons but its magnitude of yield for *kharif* season was about half of that of *rabi* season. CA-29 exhibited better performance under *rabi* season and Jwala, Tejaswini and Pusa Sadabahar were adapted for *kharif* season.

Keywords: genetic variability, quality, yield

Phenotypically stable genotypes are of great importance, because environmental conditions vary year to year and genotype-environment interactions are of major consequence as it has masking effect on the performance of genotype and the relative ranking of the genotypes do not remain the same when tested over environments. A significant genotype $\times$ environment ($G \times E$) interaction reduces the usefulness of genotype means for identifying superior cultivars (Magari and Kang 1993). Although a number of improved varieties of chilli (*Capsicum annuum* L.) have been recommended for cultivation, information on stability of genotypes is lacking for the agro-climatic conditions of the terai region of West Bengal. Hence, an investigation was undertaken to study selected chilli genotypes under different seasons for their stability in this region.

15 chilli genotypes (Table 1) namely CA-29, CA-30, CA-39, CA-47, CA-48, Chilli Philhal, Pusa Sadabahar, DKC-8, Pusa Jwala and G-4, Diamond, Tejaswini, NS-1701, Jwala and Ulka-686 were evaluated during *rabi* and *kharif* seasons for two years (2005–06 and 2006–07). The experiment was laid out in factorial randomized complete block design with three replications at the experimental field of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar (West Bengal). The field is located at 26°19'86" N latitude and 89°23'53" E longitude, at an elevation of 43 m MSL. The climatic conditions are sub-tropical, humid, characterized by high rainfall, high relative humidity, moderate temperature, prolonged winter with high residual soil moisture. The experimental soil was sandy clay loam having pH 5.5, 0.91% organic carbon, 133.81 kg ha⁻¹

Table 1. Source and type of genotypes included in the experiment

Genotype	Types	Collection area/ Source
CA-29	Local genotype	Sajerpar, Cooch Behar, West Bengal
CA-30	Local genotype	Dinhata, Cooch Behar, West Bengal
CA-39	Local genotype	Bhubaneswar, Orissa
CA-47	Local genotype	Madhupur, Cooch Behar, West Bengal
CA-48	Local genotype	Madhupur, Cooch Behar, West Bengal
DKC-8	Improved variety	YSPUHF, Solan
Pusa Sadabahar	Improved variety	NSC, Delhi
Chilli Philhal	Improved variety	PAU, Ludhiana, Punjab
Pusa Jwala	Improved variety	NSC, Delhi
G-4	Improved variety	Sungro Seeds Limited, Delhi
Diamond	Hybrid variety	Nickerson Zwang Seeds Pvt. Ltd., Bangalore.
Tejaswini	Hybrid variety	MAHYCO Vegetable Seed Ltd., Mumbai
NS-1701	Hybrid variety	Namdhari Seeds Pvt. Ltd., Bangalore.
Jwala	Hybrid variety	Bharat Nursery Pvt. Ltd., Kolkata.
Ulka-686	Hybrid variety	East West Seeds India Pvt. Ltd., Aurangabad

available nitrogen, 45.62 kg ha⁻¹ available phosphorus and 59.43 kg ha⁻¹ available potash.

Healthy and uniform seedlings were transplanted in plots of 3.6 m × 3.0 m size with a spacing of 30 cm × 45 cm during 15th November for *rabi* season and 20th April for *kharif* season during both the years. Farm yard manure and inorganic fertilizers were applied as per recommendations. Observations on morphological and yield attributing characters were recorded from 10 randomly selected plants from each replication. Different morphological characters were recorded at the time of full bearing stage and fruit characters were recorded from the selected plants at the time of first harvesting of fruits. Total yield in each harvest was combined and converted to t ha⁻¹.

Ascorbic acid in fruit was determined by colorimetric method (Ranganna 2001). Capsaicin content of green fruits was measured with a Spectrophotometer (Sadasivam & Manickam 1996). Leaf chlorophyll content was measured by non destructive method using Cholorophyll Meter (Konica Minolta Sensing, Osaka) at first harvest. Stability analysis was done as per Eberhat & Russell (1966). To test homogeneity of experimental errors, Bartlett's

'T' test of homogeneity was followed. It was found that the calculated values were non-significant for plant height, primary branches, days to 50% flowering, days to 1st harvest, fruit length, fruit number, leaf chlorophyll content, fruit yield, ascorbic acid content in fruits and capsaicin content in green fruit (at 3 d.f.). Hence, the experimental errors of individual trial were considered homogeneous, suggesting thereby the possibility of pooled analysis of variance.

Pooled analysis of variance indicated the presence of significant genetic variability among the genotypes for all the characters (Table 2). Significant differences were found for all characters except ascorbic acid indicating the differential effect of environment on genotype performance. Wani *et al.* (2003) reported that planting season affected all characters except ascorbic acid content at Kashmir.

The genotype × environment (G × E) interaction affected all characters and indicated that the genotype exhibited a differential response due to planting season. Similar observations were also reported by Sooch *et al.* (1981) and Lohithaswa *et al.* (2000) in chilli. Partitioning of E + (G × E) means square showed that planting season (linear) varied significantly

Table 2. Analysis of variance of growth, yield and fruit characters of chilli

Source	DF	Plant height (cm)	Primary branches	Days for 50% flowering	Days taken for 1 st harvest	Fruit length (cm)	Fruit number	Fresh green fruit yield (t ha ⁻¹)	Leaf chloro -phyll (SPAD-502)	Ascorbic acid (mg 100 g ⁻¹ fresh)	Capsaicin content in green fruit (%)
Genotype	14	490.57**	2.18**	371.57**	1704.42**	5.2**	3667.94**	32.92**	72.09**	836.7**	0.142**
Environment	3	170.84**	8.78**	8.66*	960.20**	0.16*	13806.1**	146.14**	664.35**	7.79	0.023**
G × E interaction	42	55.75**	0.43**	28.73**	44.45**	0.02**	3667.94**	3.96**	18.50**	36.08**	0.0004**
Environment +(G × E)	45	63.43	0.98**	27.40*	105.50**	0.03*	1519.05**	13.44**	61.56**	34.20	0.001**
Environment (linear)	1	512.51	26.34**	26.00**	2880.59**	0.48**	41418.33**	438.71**	1993.1**	23.50	0.070**
(G × E) linear	14	64.08*	0.92**	48.36*	60.53	0.03*	1438.18**	9.32**	33.82**	44.42	0.0008**
Pooled deviation	30	48.15**	0.17**	17.66**	33.98**	0.02*	226.82**	1.20**	10.12**	29.78**	0.002**
Pooled error	120	3.12	0.04	1.48	2.19	0.01	5.81	0.06	2.26	4.25	0.0001

* **, Significant at 5% and 1%, respectively

for plant height, fruit diameter and ascorbic acid. Pooled deviation was significant for characters. However, linear components were greater than non-linear components for traits which could be predicted over planting season with greater precision.

Plant height varied from 49.57 to 90.31 cm with a mean of 62.01 cm. Eleven genotypes had significant S^2d_i values indicating that these genotypes were unstable with respect to season (Table 3). Genotype NS-1701 was stable to planting season. Pusa Jwala, CA-30 and CA-48 performed well in *kharif* season. The genotypes CA-29 and Jwala were stable in *rabi* season and Pusa Sadabahar and Tejaswini were suitable for *kharif* season with respect to primary branches plant⁻¹.

Early flowering is desirable in chilli. Five genotypes had mean values less than the grand mean and four genotypes had mean values very nearer to the grand mean (Table 2). No genotype had absolute stability with respect to planting date. Like days to 50% flowering early harvest of fruit is important (Table 3). CA-29, CA-3, CA-39, CA-47, CA-48, Chilli Philhal and NS-1701 required less time to first harvest. No genotype had stable performance at both planting seasons with respect to this trait.

Fruit length of most genotypes were stable with regard to planting season. The genotype CA-47 was stable for both seasons with respect to fruit length. Genotypes Tejaswini and Pusa Jwala were specifically adapted to *rabi* season where as NS-1701, Diamond and Ulka-686 were suitable for *kharif* season. Responses of genotype with respect to fruit length were similar to findings of Reddy & Sadashiva (2003).

None of the genotype had absolute stability (Table 4) with respect to number of fruits plant⁻¹. Ulka-686 produced highest number of fruits but there was low predictability for this trait. Genotypes CA-29, Pusa Sadabahar and Jwala were specifically adapted for *rabi* season. The genotypes Pusa Sadabahar and Tejaswini were specifically adapted to the *kharif* season. Senapati & Sarkar (2002) found that G × E

Table 3. Stability parameters for plant height, primary branches and days for 50% flowering, first harvest and fruit length of chilli

Genotype	Plant height (cm)			Primary branches			Days for 50% flowering			Days to 1 st harvest			Fruit length (cm)		
	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i
CA-29	53.24	-0.40	27.91**	7.73	1.52	0.12	39.34	-1.83	-0.61	74.25	0.84	15.96	5.90	2.18	0.01
CA-30	62.06	0.85	7.17	6.90	2.19	0.16**	44.59	-4.71	2.48	82.92	1.28	8.43	5.95	0.18	-0.002
CA-39	60.17	1.48	61.15**	5.93	1.13	-0.03	51.34	4.12	4.59	97.50	2.07	49.71**	5.01	1.13	0.00
CA-47	64.80	1.47	81.57**	6.49	2.11	0.24**	50.92	-5.77*	48.82**	91.00	1.46	30.31**	5.93	1.01	-0.002
CA-48	49.57	0.50	30.63**	6.35	1.63	0.03	54.75	-1.76	-0.45	99.58	1.61	6.01	5.68	2.05	0.04**
DKC-8	59.48	-0.18	30.23**	6.31	0.55	0.01	67.25	5.89	12.39**	136.75	0.79	72.29**	5.84	-0.15	0.001
Pusa Sadabahar	63.95	0.66	46.65**	6.76	-0.42	-0.01	62.50	5.45*	-0.45	124.00	0.64	2.55	6.30	1.20	-0.002
Chilli Philhal	57.37	3.25	146.25**	5.46	1.47	0.04	63.42	-6.44	66.84**	99.75	0.11	109.06*	5.10	-0.22	0.05
Pusa Jwala	52.10	0.78	10.76	5.63	0.88	0.13	62.92	4.91	22.71**	129.42	1.34	6.34**	7.90	2.93	0.01
G-4	76.30	3.70	49.49**	5.99	0.91	0.23**	74.08	-5.29	29.08**	137.25	1.60	10.29**	6.75	0.88	0.01**
Diamond	52.87	0.78	7.58	6.95	0.45	0.60**	59.75	-0.82	1.87	119.00	0.57	9.89	7.65	1.48	0.01
Tejaswini	90.31	-0.25	96.08**	6.79	0.29	-0.01	68.00	9.59	15.15**	134.75	1.26	6.98*	6.80	1.16	-0.01
NS-1701	53.54	1.05	0.17	6.57	0.20	0.31**	67.84	-0.28	28.73**	106.75	0.43	63.90**	8.97	-1.05	0.03*
Jwala	58.66	2.65	59.11**	7.29	1.30	0.15	61.92	7.55	15.86**	124.00	0.36	23.04**	4.83	1.83	0.02*
Ulka-686	75.29	-1.32	20.72*	7.80	0.97	0.002	63.75	4.39	1.23	129.50	0.47	62.11**	6.39	0.83	-0.01
Mean	62.01			6.63			59.69			112.43			6.33		

*,** Significant at 5% and 1%, respectively

Table 4. Stability parameters for fruit number, yield and quality of chilli

Genotype	Total fruit no. plant ⁻¹			Fresh green fruit yield (t ha ⁻¹)			Leaf chlorophyll (SPAD-502)			Ascorbic acid (mg ⁻¹ 100 g fresh)			Capsaicin content in green fruit (%)		
	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i	Mean	b _i	S ² d _i
CA-29	140.59	1.31	5.15	12.21	1.24	0.15	59.97	1.49	8.91	142.29	3.30	18.84**	0.53	0.62	0.00
CA-30	104.99	1.68	497.25**	8.97	1.67	2.63**	58.23	1.66	2.94	133.83	2.83	-0.49	0.36	1.06	0.00
CA-39	96.27	1.55	97.81**	8.36	1.56	0.56**	60.60	0.44	9.65	136.21	-2.70	-1.02	0.48	1.09	0.00**
CA-47	111.14	1.88	3.16	9.62	1.76	1.19**	49.75	0.21	6.05*	126.70	-1.62	-0.73	0.33	1.39	0.00**
CA-48	109.49	1.50	4.83	9.44	1.50	0.55**	51.25	0.59	2.45	117.44	-5.16	-0.94**	0.61	1.65**	0.00
DKC-8	107.19	1.19	-3.86	7.92	1.04	0.24	54.55	0.77	-2.08	126.24	-3.80	-0.92**	0.37	0.94*	0.00
Pusa Sadabahar	123.59	-0.18	1.41	9.67	0.09	0.76	59.84	0.52	8.32	143.97	-5.77	-2.68	0.48	0.95	0.00
Chilli Philhal	93.82	0.89	327.88**	6.93	0.69	1.92**	49.63	1.56	3.73	122.47	3.05	0.40*	0.57	1.50	0.00
Pusa Jwala	80.25	0.66	360.45**	5.89	0.51	0.13	53.27	0.30	4.69*	135.55	2.04	0.69	0.54	0.53	0.00
G-4	76.94	0.50	447.95**	5.84	0.75	2.80**	51.33	1.14	20.87**	145.05	-1.55	0.70	0.84	0.82	0.00
Diamond	91.65	0.29	1020.58**	8.38	0.64	2.39**	52.37	1.22	14.52**	139.02	2.78	1.19	0.46	0.70	0.00
Tejaswini	126.69	0.37	210.84	10.02	0.40	0.14	59.03	1.13	1.06	104.68	2.33	0.38	0.94	0.98	0.00
NS-1701	100.12	-0.15	122.88*	8.79	0.46	1.89**	58.13	1.71	24.56**	98.00	10.39	1.38**	0.69	0.13	0.00
Jwala	172.74	1.41	134.98	14.16	0.82	0.15	52.64	0.97	7.48	132.30	0.23	-0.16*	0.71	1.00	0.00
Ulka-686	179.93	2.11*	49.85**	16.14	1.89	1.50**	61.32	1.33	4.72	110.93	-2.40	-0.95	0.82	1.70**	0.00
Mean	114.36			9.49			55.46			127.64			0.55		

*,**Significant at 5% and 1%, respectively

interaction was significant for number of fruits plant⁻¹.

No genotype had absolute stability for yield. The highest yield was obtained in Ulka-686 (16.14 ha⁻¹) which exhibited high yielding ability for both planting seasons but the magnitude of yield in *kharif* season was about half that of *rabi* season. Genotype CA-29 performed better during *rabi* season and Jwala, Tejaswini and Pusa Sadabahar were better adapted for *kharif* season.

Leaf chlorophyll content varied from 49.75 to 61.32 SPAD-502 (Table 4). Genotype Jwala had low chlorophyll but was stable in nature. Genotypes CA-29, CA-30, Tejaswini and Ulka 686 had chlorophyll content that were stable in *rabi* season and CA-39 and Pusa Sadabahar had stable leaf chlorophyll content in *kharif* season.

The highest ascorbic acid was obtained in G-4 (145.04 mg 100 g⁻¹ fresh) and was lowest in NS-1701 (97.99 mg⁻¹ 100 g fresh). No genotype showed stability for planting season. However, CA-30, Pusa Jwala, Diamond F₁ and Tejaswini performed well during *rabi* season and CA-39, CA-47, Pusa Sadabahar, G-4, and Ulka 686 were under *kharif* season.

Except for CA-47, all genotypes were suitable with respect to capsaicin content (Table 4) in green fruit. The genotypes Jwala, Tejaswini and Pusa Sadabahar were stable at all planting seasons.

It may be concluded that the genotype Ulka-686 is suitable for cultivation in both *rabi* and *kharif* season in the terai zone of West Bengal. CA-29 exhibited better performance during *rabi*

season and Jwala, Tejaswini and Pusa Sadabahar were adapted for *kharif* season.

References

- Eberhart S A & Russel W L 1966 Stability parameters for comparing varieties. *Crop Sci.* 6: 36–40.
- Lohithaswa H C, Kulkarni R S & Manjunath A 2000 Combining ability analysis for fruit yield, capsaicin and other quantitative traits in chillies (*Capsicum annuum* L.) over environments. *Indian J. Gen. Plant Breed.* 60: 511–518.
- Magari R & Kang M S 1993 Genotype selection via a new yield-stability statistic in maize yield trials. *Euphytica* 70: 105–111.
- Ranganna S 2001 Analysis and Quality Control for Fruits and Vegetable Products. Tata McGraw Hill (2nd Edn), New Delhi.
- Reddy K M & Sadashiva A T 2003 Studies on yield stability in chilli (*Capsicum annuum* L.). *Indian J. Hort.* 60: 183–187.
- Sadasivam S & Manickam A 1996 Biochemical Methods. New Age International Publishers (2nd Edn.), Kolkata.
- Senapati B K & Sarkar G 2002 Genotype-environment interaction and stability for yield and yield components in chilli (*Capsicum annuum* L.). *Veg. Sci.* 29: 146–148.
- Sooch B S, Thakur M R & Gupta V P 1981 Stability analysis for some characters in chilli (*Capsicum annuum* L.). *Indian J. Hort.* 39: 83–88.
- Wani P K, Ahmed N, Tanki M I & Raj N. 2003. Stability analysis for yield and quality characters in hot pepper (*Capsicum annuum* L.). *Capsicum Eggplant Newslett.* 22: 75–78.