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Evaluation of chilli genotypes for quality traits

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Abstract

A set of thirty chilli (*Capsicum annuum)* genotypes were evaluated for seven quality parameters (ascorbic acid, moisture content, oleoresin, capsanthin, capsaicin content and TSS) for two consecutive *kharif* seasons of 2005 and 2006. The analysis of variance revealed significant differences for all seven quality parameters studied among the genotypes. Genotypes possessing good quality characteristics can be used for the production of cultivars with outstanding quality attributes.

Key words: Chilli, quality traits, ascorbic acid, capsaicin content, capsanthin, oleoresin and TSS.

Introduction

Chilli (*Capsicum annuum* L.) is one of the most valuable commercial spice crops of India and is grown for domestic as well as for export markets. The green chilli fruits are valuable on account of their richness in ascorbic acid, carotenoids and rutin which are of immense pharmaceutical need (Purseglove, 1977). The green fruits are used in salad and curries. The red fruits are characterized by pungency and colouring matter. The red pigment/capsanthin currently used as natural colour additive in food, drugs and cosmetic industry is rich in bioflavonoids – the most powerful antioxidants that offer protection against oxidation-induced deteriorative changes in the body. Its role in inhibiting the progression of chronic disease conditions such as muscular degeneration, cardiovascular disease and cancer is well documented.

The pungency is due to the presence of a crystalline volatile alkaloid called capsaicin. It helps in relieving nasal congestion and has also emerged as a potent anti-inflammatory and analgesic agent such as balms for external human use, shows antioxidant, anti-tumour and anti-cancerous activities (Kanwar, 2000). Capsaicin as anticoagulant helps in preventing blood clots that can lead to a heart attack or stroke, alleviate the pain of arthritis and mouth pain associated with chemotherapy. Contrary to general misconception, chillies do not cause ulcers or digestive problems (Anonymous, 2004). A non-conventional use of chilli is in the self defence sprays which are gaining popularity in USA. The spray consists of capsicum oleoresin at ultra high emulsion rate which temporarily immobilizes the attacker (Deshpande, 2001).

The chilli can be processed into paste, powder, dry chilli etc., but chilli oleoresin, a processed product is gaining more importance especially from export point of view because it offers uniform quality, longer shelf-life, freedom from micro-organisms and lesser freight charges. Due to

above said reasons, most of the western countries are shifting towards chilli oleoresin rather than exporting whole chilli or chilli powder. Oleoresin of high, medium or low pungency can be produced according to market demand. Chilli oleoresin has vast demand in pharmaceutical and food industry. Based on the afore-mentioned reasons, a detailed study was undertaken and the results are reported in this paper.

Materials and Methods

Thirty chilli genotypes *viz.*,G-4 (Bhagyalakshmi), Anugraha, Ujwala, CO-3, Kadyavallur Local, PKM-1, KCA-190, KCA-171, K-1, Palam Yellow, Surajmukhi, DPCH-1, LCA-357, NCH-162, DCL-352, ACH-201, HCH-9639, BC-25, DCL-520, ACS-2000-2, DCL-524, Pusa Sada Bahar, Ajeet-1, SKAU-SC-304-1, Kashmir Local, SKAU-SC-23-1, SKAU-SC-578-1, SKAU-SC-101, Arka Lohit and Pant C-1 were evaluated during the *Kharif* season for two consecutive years *i.e.* 2005 and 2006 at the research farm of Vegetable Science and Floriculture, CSKHPKV, Palampur (32° 6' N and 76° 3' E at an elevation of 1,290m above mean sea level), in Himachal Pradesh, India. Agro climatically, the location represents the mid-hill zone 2.2 of Himachal Pradesh and is characterized by humid sub-temperate climate with high rainfall (2500 mm), of which 80% is received during June to September. The experiment was laid out in Randomized Block Design with three replications. Normal agronomical and plant protection measures were adopted for proper raising of the crop.

Five plants in each replication were selected at random and the fruits were harvested from all the thirty entries and analysed for their pungency (capsaicin content), capsanthin content, oleoresin, ascorbic acid content, moisture content, and TSS. Data were pooled over the years as Bartlett's test of homogeneity between error variances (Panse and Sukhatme, 1984) was found to be non-significant for these traits. The analysis of variance for different traits over the years is presented in Table 1. The genotypic, phenotypic and environmental coefficients of variation, heritability and genetic advance were estimated as suggested by Burton and De Vane (1953) and Johnson *et al.* (1955).

Results and Discussion

The analysis of variance revealed significant differences for all seven quality parameters (Table1). In case of ascorbic acid in green fruits, the variation ranged from 83.81mg/100g in Palam Yellow to 134.59mg/100g in Pant C-1 with an overall average of 105.05mg/100g, whereas moisture content was highest in HCH-9639 (87.85%) and lowest in KCA-190 (80.46%) with average value of 83.35% (Table2). TSS in green and red fruits was highest in Pusa Sada Bahar and lowest in NCH-162.

Capsaicin, Capsanthin and Oleoresin contents were computed on dry weight basis from red ripe fruits. The variation observed for oleoresin content varied from 22.00 ASTA Units in DPCH-1 to 78.42 ASTA Units in G-4. The average value was 52.18 ASTA Units. The perusal of mean values in Table 2 revealed highly significant differences among genotypes in case of capsanthin and capsaicin content. The Capsanthin values ranged from 71.71 ASTA Units in PKM-1 to 111.46 ASTA Units in KCA-190 with mean value of 96.10 ASTA Units.

Palam Yellow was the minimum pungent

Table 1. Analysis of variance for quality traits over the years

Traits	2005			2006			Pooled over years			χ^2 (Bartlett's test)
	Replication	Genotypes	Error	Replication	Genotypes	Error	Replication	Genotypes	Error	
df	2	29	58	2	29	58	2	29	116	
Quality traits										
Ascorbic acid (mg/100 g)	0.22	394.59*	2.19	1.53	396.59*	2.05	1.31	790.79*	2.13	0.06
Oleoresin (ASTA Units)	1.63	609.52*	1.44	1.11	609.52*	1.46	2.63	1219.05*	1.45	0.00
Capsanthin (ASTA Units)	1.09	613.99*	1.11	1.09	613.99*	1.11	2.25	1227.98*	1.12	0.00
Capsaicin content (%)	0.00	0.08*	0.00	0.00	0.08*	0.00	0.00	0.16*	0.00	0.03
TSS (%) (Green)	0.00	0.41*	0.00	0.00	0.41*	0.00	0.00	0.82*	0.00	0.00
TSS (%) (Red)	0.00	0.50*	0.00	0.00	0.50*	0.00	0.00	1.01*	0.00	0.00
Moisture content (%)	0.09	11.27*	0.10	0.09	11.27*	0.10	0.13	22.54*	0.11	0.00

* Significant at P=0.05 χ^2 Non-significant

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Table 2. Mean performance of chilli genotypes in relation to different quality traits

Genotypes	Quality Traits						
	Ascorbic acid (mg/100 g)	Oleoresin (ASTA Units)	Capsanthin (ASTA Units)	Capsaicin content (%)	TSS (%) (Green)	TSS (%) (Red)	Moisture content (%)
G-4	99.43	**78.42**	108.63	0.53	5.22	8.24	84.08
HCH-9639	107.02	63.96	103.58	0.54	5.32	8.30	**87.85**
Anugraha	104.15	66.65	92.31	0.49	5.24	8.27	83.94
CO-3	97.23	68.07	88.48	0.58	5.08	8.14	83.64
P. Yellow	**83.81**	62.65	107.49	**0.19**	5.21	8.24	83.65
PKM-1	107.24	64.12	**71.71**	0.48	5.18	8.22	85.40
DPCH-1	88.62	**22.00**	47.56	0.22	5.04	8.06	81.42
LCA-357	101.27	71.04	107.43	0.51	5.08	8.11	87.38
SKAU-SC-304-1	100.80	54.53	79.43	0.43	5.32	8.29	83.39
NCH-162	89.81	44.59	108.37	0.60	**4.98**	**8.01**	84.37
DCL-352	123.29	33.77	104.76	0.60	6.15	9.05	86.38
ACH-201	123.05	44.28	108.37	0.37	5.04	8.11	84.32
Kadyavallur Local	92.81	60.68	94.09	0.48	5.10	8.17	83.97
Arka Lohit	119.70	63.25	72.61	0.52	5.30	8.24	82.82
BC-25	104.37	54.15	84.18	0.36	5.23	8.19	81.67
KCA-190	107.71	35.77	**111.46**	0.49	5.16	8.19	**80.46**
Kashmir local	109.37	49.48	103.57	0.51	5.03	8.07	81.32
KCA-171	101.67	47.64	96.65	0.59	5.13	8.06	81.28
K-1	92.31	35.24	78.01	0.35	5.11	8.21	83.49
DCL-520	93.34	53.75	107.41	0.41	5.21	8.34	86.79
SKAU-SC-23-1	98.07	77.08	108.75	0.45	5.00	8.03	81.70
ACS-2000-2	108.03	33.25	101.25	0.39	5.09	8.19	81.87
SKAU-SC-57[illegible]1	112.24	31.19	103.91	0.61	5.24	8.21	83.03
SKAU-SC-101	119.57	51.20	101.11	0.62	5.48	8.88	83.71
DCL-524	104.45	49.31	97.18	0.50	5.23	8.43	80.98
Ujwala	99.20	40.97	103.32	0.86	6.03	9.14	83.38
Pusa Sada Bahar	104.08	65.29	98.80	0.87	**6.21**	**9.41**	81.14
Surajmukhi	107.08	42.00	98.29	**0.90**	6.05	9.25	81.39
Ajeet-1	117.03	50.53	96.24	0.39	5.68	8.88	83.06
Pant C-1	**134.59**	50.61	98.07	0.56	5.97	9.05	82.59
Mean	105.05	52.18	96.10	0.51	5.34	8.40	83.35

variety with capsaicin content of 0.19%, whereas Surajmukhi was the most pungent variety (0.9%). Ujwala (0.86%) and Pusa Sada Bahar (0.87%) were the other pungent varieties. Genotypes with the desirable quality parameters thus identified can be utilized further in the breeding programme to

Table 3. Estimates of variability parameters for quality traits in chilli

Traits	Range	General mean ± SE (m)	Variance			Coefficient of variation			Heritability (h^2) (%)	Genetic advance (K=2.06)	Genetic advance (% of mean)
			Phenotypic	Genotypic	Environmental	Phenotypic (PCV)	Genotypic (GCV)	Environmental (ECV)			
Quality traits											
Ascorbic acid (mg/100 g)	83.81-134.59	105.05±0.84	133.77	119.13	2.13	11.01	10.39	1.39	88.40	23.46	22.33
Oleoresin (ASTA Units)	22.00-78.42	52.18±0.70	204.51	196.29	1.45	27.41	26.85	2.31	90.30	29.26	56.07
Capsanthin (ASTA Units)	71.71-111.46	96.10±0.61	205.86	178.18	1.12	14.93	13.89	1.10	89.40	29.39	30.58
Capsaicin content (%)	0.19-0.90	0.51±0.01	0.03	0.02	0.00	31.73	30.64	2.45	87.45	0.33	64.28
TSS (%) (Green)	4.98-6.21	5.34±0.02	0.14	0.08	0.00	6.95	5.39	0.64	88.40	0.76	14.24
TSS (%) (Red)	8.01-9.41	8.40±0.02	0.17	0.11	0.00	4.90	3.88	0.43	87.59	0.84	10.00
Moisture content (%)	80.46-87.85	83.35±0.19	3.87	3.74	0.11	2.36	2.32	0.39	90.20	3.94	4.73

develop new cultivars having outstanding quality attributes.

The estimates of PCV and GCV (Table 3) were high for capsaicin content and oleoresin, thus indicating the presence of substantial variability ensuring ample scope for improvement through selection for these traits whereas, PCV and GCV were moderate for capsanthin and ascorbic acid suggesting that these traits have less potential for direct selection. Estimates of PCV and GCV were low for moisture content, TSS at green stage and red stage which indicated that genotypes possessed comparatively low genetic variation for this trait. All quality traits exhibited high heritability (Table 3), indicating that these traits were less influenced by the environment. This suggested that large proportion of phenotypic variance has been attributed to genotypic variance and hence, reliable selection could be made for these traits on the basis of phenotypic variation.

Johnson *et al.* (1955) stressed that for estimating the real effects of selection, heritability alone is not sufficient and genetic advance alongwith heritability is more useful.

High heritability alongwith high genetic advance was recorded for capsanthin. The results revealed that the inheritance of this character is under the control of additive gene action (Panse, 1957). So, selection will be more effective for the improvement of this trait.

High heritability for ascorbic acid, TSS at green and red stage and moisture content were found to be associated with low genetic advance. The association of high heritability with low genetic advance reveals that inheritance of these characters is under the control of non-additive gene effects. Improvement of these traits through simple selection might not give desirable results and need to be improved through hybridization (Panse, 1957).

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