Evaluation of Paprika Genotypes in Kerala

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Paprika, is the term used by international spice traders for non-pungent red capsicum powder. Paprika is valued most for its colour and mildness of flavour. In India, paprika variety is not yet grown commercially. The work was initiated to study the feasibility of paprika cultivation in Kerala (humid tropical climate). Forty indigenous and exotic genotypes collected from various sources and were evaluated for three seasons. Morphological evaluation was done according to International Plant Genetic Resources Institute descriptor list. Variation was found in morphological and quantitative characters. Genotype Paprika King was found to be superior to other types in yield and colour value, followed by PBC 066, KT-pl-8 and KT-pl-20.

Key Words: Characterization, Evaluation, Paprika, Kerala

International spice traders use the term paprika for non-pungent red *Capsicum* powder. Paprika is the Hungarian word plants in the genus *Capsicum*. This mild powder can be made from any type of *Capsicum annuum* that is non-pungent and has brilliant red colour. Paprika is valued most for its colour and mildness of flavour. The market value of paprika depends largely on its red colour, both surface hue and extractable colour. Its flavour quality is of secondary importance. Oleoresin of paprika, extracted from the ground pods, is used to impart bright red color to meat, sausage products, sauces and to other processed foods, thus, making the product more acceptable.

The pigment content of paprika varies from 0.1-0.8%. The pigments comprise a mixture of closely related carotenoids such as capsorubin, capsanthin, β-carotene, zeaxanthin, violaxanthin and lutene. The most important pigments responsible for red colour are capsanthin and capsorubin. The paprika colours are not metabolised in human body and, hence, it is an ideal natural colour additive for food items. The colour value of paprika is expressed in (ASTA) units American Spice Trade Association. This is the extractable colour present in paprika. Common paprika ASTA colour values preferred in the industry are 85, 100, 120 and 150 (Tainter and Grenis, 1993). According to Govindarajan (1985), the group paprika contains less than 0.1% of capsaicinoids, the best grade of Spanish paprika having 0-0.0003% and for the pungent grades a maximum of 0.5%. Paprika of commerce comes from Hungary, Spain, Morocco, America, Yugoslavia, Czechoslovakia, Chile, Romania, Turkey, Greek and Portugal. Paprika has price advantage over chilli. The weekly International Prices at New York Market as on January, 2000, showed the price of Indian chilli to be 0.62 dollars/pound and that of Spanish paprika (120 ASTA) to be 1.30 dollars/pound (Anon, 2000). In India, as yet, there is no spice paprika variety grown commercially. The Byadagi chillies in Dharward district in Karnataka and Tomato chillies in Warangal district in Andhra Pradesh are near to qualities of paprika types grown in Spain or Hungary. A few selections were made from Byadagi chillies at the Indian Institute of Horticultural Research (IIHR), Bangalore and the selection was released as 'Arka Abir'. In the breeding programme at Indian Agricultural Research Institute (IARI), Regional Stations, Katrain, Kulu valley, Himachal Pradesh, germplasm from abroad were evaluated and a variety 'Kt-pl-19', having high oleoresin and high colour was released. The present study was initiated to study the feasibility of paprika cultivation under the humid conditions of Kerala.

Materials and Methods

Paprika lines were collected through survey and correspondence from centres of cultivation and genebanks like Asian Vegetable Research and Development Centre (AVRDC) Taiwan; Kerala Agricultural University (KAU), Trichur; IIHR, Bangalore IARI, Regional Station, Katrain, Himachal Pradesh; Institute of Plant Genetics and Crop Plant Research (IPGRI), Gaterslaben, Germany; Agricultural Research Station, Lumle, Nepal and Synthite, Kollenchery, Kerala. Field survey of 'Byadagi' chillies of the Dharward district in Karnataka was done. Samples were collected from farmer's field and practices of cultivation and post-harvest operations were studied. Details of genotypes used in this study are given in Table 1.

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Table 1. Sources of paprika genotypes evaluated for field performance

Sample Number	Genotype	Source
1.	PBC 436	Asian Vegetable Research and Development Centre, Taiwan
2.	PBC 554	Asian Vegetable Research and Development Centre, Taiwan
3.	PBC 1369	Asian Vegetable Research and Development Centre, Taiwan
4.	PBC 066	Asian Vegetable Research and Development Centre, Taiwan
5.	PBC 375	Asian Vegetable Research and Development Centre, Taiwan
6.	PBC 384	Asian Vegetable Research and Development Centre, Taiwan
7.	PBC 384	Asian Vegetable Research and Development Centre, Taiwan
8.	PBC 473	Asian Vegetable Research and Development Centre, Taiwan
9.	PBC 535	Asian Vegetable Research and Development Centre, Taiwan
10.	PBC 717	Asian Vegetable Research and Development Centre, Taiwan
11.	PBC 743	Asian Vegetable Research and Development Centre, Taiwan
12.	PBC 1347	Asian Vegetable Research and Development Centre, Taiwan
13.	PBC 1350	Asian Vegetable Research and Development Centre, Taiwan
14.	PBC 828	Asian Vegetable Research and Development Centre, Taiwan
15.	PBC 999	Asian Vegetable Research and Development Centre, Taiwan
16.	PBC 971	Asian Vegetable Research and Development Centre, Taiwan
17.	CAP 1088/35	Institute of Plant Genetics and Crop Research, Germany
18.	CAP 35/95	Institute of Plant Genetics and Crop Research, Germany
19.	CAP 1036/35	Institute of Plant Genetics and Crop Research, Germany
20.	CAP 1063/35	Institute of Plant Genetics and Crop Research, Germany
21.	Paprika King	Synthite Chemicals, Kollencherry, Cochin, Kerala, India
22.	Cluster chilly	Lumle Agricultural Research Station, Lumle, Nepal
23.	Kt-pl-18	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
24.	Kt-pl-8	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
25.	Kt-pl-19	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
26.	Kt-pl-20	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
27.	Kt-pl-22	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
28.	Kt-pl-23	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
29.	Kt-pl-24	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
30.	Kt-pl-25	Indian Agricultural Research Institute, Regional Station, Katrain, HP, India
31.	Kt-19	Indian Institute of Horticultural Research, Bangalore, India
32.	Arka Abir	Kerala Agricultural University, Thrissur, Kerala, India
33.	CA-219	Kerala Agricultural University, Thrissur, Kerala, India
34.	Modhpur	Kerala Agricultural University, Thrissur, Kerala, India
35.	Paprika type-1	Kerala Agricultural University, Thrissur, Kerala, India
36.	Round ornamental	Kerala Agricultural University, Thrissur, Kerala, India
37.	Small conical	Kerala Agricultural University, Thrissur, Kerala, India
38.	517-1	Kerala Agricultural University, Thrissur, Kerala, India
39.	Jwala	Kerala Agricultural University, Thrissur, Kerala, India
40.	Byadagi	Byadagi thaluk, Karnataka

Three seasons (January to June 1997, January to June 1998 and September 1998 to March 1999) were selected for evaluation of 40 genotypes. Seeds of all genotypes were sown in sterilized sand in plastics cups and transplanted to pots. The potting mixture had a composition of soil:sand:farmyard manure in the ratio of 1:1:1. The mixture was chemically sterilized using formalin. The solution was prepared by mixing formaldehyde with water in the ratio of 1:30. Three litres of solution was applied per m^2 of soil when the soil was moist. The mixture was covered for three days, stirred, covered again for three days and kept in open condition for 15 days.

Six plants were raised for each genotype and observations were recorded from five plants. One plant out of each genotype was kept for selfing to collect selfed seeds for the next generation. Selfing was done by covering the pot with a cage of mesh size 20 x 16 holes/2.5 cm^2 (Bosland, 1993) to prevent insect pollination. The plants were watered daily except during rains. Morphological evaluation of these lines was done according to the IPGRI descriptor list. Biochemical characters like extractable colour (ASTA method, Hort and Fischer, 1971) and percentage of capsaicin (ISO/DIS 7543-1, 1988) were also studied. For estimation of colour, red ripe chillies were dried and the stalk and seeds were removed before powdering. Ground chilli powder (0.1 g) was transferred in to a 250 ml Erlenmeyer flask, and kept overnight at room temperature. The content were filtered through a Whatman No. 42 filter

paper, the first 10 ml was discarded and 25 ml of the filtrate was pipetted into a volumetric flask and diluted to the mark with isopropanol. The absorbance was recorded at 450 nm against isopropanol as blank.

For determination of capsaicin content, whole chillies were dried and powdered. Ten gram of the powder was quantitatively transferred to a soxhlet apparatus and extracted using 100 ml tetrahydrofuran for eight hours. The solvent was then evaporated to the maximum extent possible in the rotary vacuum evaporator under reduced pressure in a 250 ml round bottomed flask one water bath. 0.05 to 0.1g of carbon black was added to the extract so as to maintain a ratio of the order of 10 between the extract and carbon black. A volume of 90 ml of methanol was added to this and agitated in magnetic stirrer for 30 minutes. The solution was allowed to stand for 5 minutes and filtered through a membrane filter into a 100 ml volumetric flask and made up to the mark with methanol solution (70 parts methanol and 30 parts water). Using this filtrate, six dilutions were prepared for spectrophotometric measurements. Zero was adjusted with methanolic solution and absorbances measured at 248 nm and 296 nm.

Results and Discussion

The morphological characters of the paprika lines are given in Table 2. Quantitative characters of the paprika lines were recorded for three seasons and are presented in Tables 3-5. Plant height ranged from 32.3 cm to 92.0 cm (Table 3). Days to flowering ranged from 29.0-64.6 (Table 4). Kt-19 (64.60) and Dokomlasi 640 (55.6) were late flowering lines and the remaining lines showed intermediate days to flowering. Days to fruiting ranged from 42-80 (Table 4). Fruit length ranged from 1.65cm to 13.6cm (Table 5). Genotypes with short fruits were round ornamental (1.65 cm), PBC 1369, PBC 436, CAP 1086/35, PBC 743, PBC 717 and Paprika type-1 (4.10). Lines with long fruit were Paprika King (13.6 cm), PBC 828, PBC 999, Kt-pl-24, PBC 385, PBC 066, and PBC 375 (10.06). The remaining lines had fruits of intermediate length. Variation in fruit length is shown in Fig. 1. Fruit width ranged from 0.60 cm to 3.83cm (Table 5). Fruit width was high in PBC 1369 (3.83cm), PBC 436, PBC 066, Kt-pl-19, Kt-pl-24, Kt-pl-23, PBC 828, PBC 999 and Paprika King (2.26 cm). PBC 743 (0.60 cm), PBC 717 and Jwala (0.77) were narrow fruited lines. Colour value ranged from 70.3 to 268 ASTA (Table 7). Percentage of capsaicin ranged from 0.05 to 0.63 (Table 8). Capsaicin content was high in 517-1 (0.63%), CAP 1086/35(0.60%) and Jwala (0.52%) and low in PBC 436 (0.05%), PBC 1369 (0.106%), Kt-pl-18 (0.14%) and Kt-pl-25 (0.16%).

Evaluation of morphological characters showed that there was significant difference among the lines in several characters (Table 2). There was significant difference among the lines in plant growth habit. The growth habit ranged from erect, intermediate to compact. The genotypes varied in stem pubescence also. Most of the lines had no pubescence at all. CAP 1086/35 has dense stem pubescence. Significant difference was also found in other morphological characters like leaf colour (varying from light green to dark green), leaf shape, number of flowers/axil, flower position, corolla colour, anther colour, stigma exertion, fruit colour at mature and intermediate stage, fruit shape, fruit shape at blossom end fruit surface. Variation in growth habit, stem pubescence, stem colour, leaf pubescence, flower position, fruit shape and fruit length were reported by Mohammed (1994) and variation in morphological characters like plant height, number of branches and number of leaves among sweet pepper varieties was reported by Aliyu and Olerawaju (1994). Variation in quantitative characters was also found among the genotypes (Tables 3 -8). There was significant variation among the lines for characters like plant height, days to flower and days to fruit. Lines Kt-19 and Dokomlasi 640 were the latest to flower. They were also late to fruit. Significant difference was found in fruit length among the lines. A few lines had fruits ten times as long as some other lines. Round ornamental, had small cherry like fruit, PBC 1369 and PBC 436 had round blocky fruits. PBC 743 and PBC 717 had narrow small fruits. Paprika king had the longest fruit. There was also considerable variation in fruit width among the lines. PBC 743 and PBC 717 had narrow fruit width whereas, PBC 1369 and PBC 436 had broad fruits. Fresh fruit weight is an important character in determining the amount of paprika powder obtained because paprika powder is made from dried powdered fruit wall. Fruit weight was highest in CAP 1088/35 (18.2 g). Low yield being the limiting factor in paprika production (Bosland *et al.*, 1991), yield/plant is also a crucial character in paprika breeding. Among the 40 lines evaluated, Paprika King had the highest yield (255.6 g), followed by PBC 066 (227.3 g) and Kt-pl-8 (190.3 g). Seed size and seed number also varied among the lines. Paprika types with fleshy fruits generally had large seeds and highly pungent types had small seeds.

Table 2. Morphological characters of 40 paprika genotypes

Character	Expression	Genotypes
Stem shape	Cylindrical	All
Stem pubescence	Dense	CAP 1086/35
	Intermediate	PBC 385, PBC 473, PBC 535, Byadagi.
	Sparse/nil	CA 219, PBC 066, PBC 1369, PBC 375, PBC 384, PBC 554, PBC 436, Small conical, Round ornamental, Arka Abir, Modhpur, CAP 1088/35, Kt-pl-19, CAP 1063/35, PBC 1350, PBC 1347, PBC 743, PBC 717, Paprika type-1, Dokomlasi 640, Kt-19, Cluster chilli, 517-1, PBC 828, PBC 971, Kt-pl-22, Kt-pl-24, Kt-pl-25, Kt-pl-18, Kt-pl-23, Kt-pl-8, Kt-pl-20, PBC 999, Jwala, Paprika king.
Plant growth habit	Erect	PBC 385, PBC 473, PBC 535, Byadagi, CA 219, PBC 1347, PBC 743, Paprika type – 1, Dokomlasi 640, Kt-19, PBC 828, PBC 999, Jwala, Paprika king, Arka Abir.
	Intermediate	CAP 1086/35, PBC 066, PBC 1369, PBC 375, PBC 384, PBC 554, Kt-pl-19, PBC 1350, PBC 717, 517-1, Kt-pl-22, Kt-pl-25, Kt-pl-18, Kt-pl-23, Kt-pl-8, Kt-pl-20, PBC 971, Modhpur.
	Compact	PBC 436, Small Concial, Round Ornamental, CAP 1088/35,AP 1063/35, Cluster chilli, Kt-pt-l24.
Branching habit	High	Cluster chilli
	Intermediate	PBC 385, PBC 473, PBC 1347, PBC 743, Paprika type–1, Dokomlasi 640, PBC 828, PBC 999, Jwala, CAP 1086/35, PBC 066, PBC 1369, PBC 375, PBC 384, PBC544, Kt-pl-19, PBC 1350, PBC 717, 517-1, Kt-pl-22, Kt-pl-25, Kt-pl-23, Kt-pl-8, PBC 436, Small conical, CAP 1088/35, CAP 1063/35, Kt-pl-24, PBC 971, PBC 535, Modhpur, Arka Abir.
	Sparse	Byadagi, CA 291, Kt-19, Paprika king, Kt-pl-18, Kt-pl-20, Round ornamental
Leaf colour	Light green	Jwala, Byadagi.
	Green	PBC 385, PBC 473, PBC 1347, Paprika type–1, Dokomlasi 640, PBC 066, PBC 1369, PBC 384, PBC 554, Kt-pl-19, PBC 1350, PBC 717, 517-1, Kt-pl-22, Kt-pl-25, Kt-pl-23, Kt-pl-8, PBC 436, Smallconical, CAP 1063/35, Kt-pl-24, CA 219, Paprika king, Kt-pl-18, Kt-pl-20, Round ornamental, PBC 971, PBC 535, PBC 743, Arka Abir, Modhpur.
	Dark green	Cluster chilli, PBC 828, PBC 999, CAP 1086/35, PBC 375, CAP 1088/35, Kt-19.
Leaf shape	Ovate	Jwala, Byadagi, PBC 385, PBC 473, PBC 1347, Paprika type –1, Dokomlasi 640, PBC 066, PBC 1369, PBC 384, PBC 554, Kt-pl-19, PBC 1350, PBC 717, Kt-pl-22, Kt-pl-25, Kt-pl-23, Kt-pl-8, PBC 436, Small conical, CAP 1063/35, Kt-pl-24, CA 219, Paprika king, Kt-pl-18, Kt-pl-20, Round ornamental, Cluster chilli, PBC 828, PBC 999, CAP 1086/35, PBC 375, Kt-19, PBC 535, Arka Abir, Modhpur, PBC 743.
	Lanceolate	517-1, CAP 1088/35, PBC 971.
No. of flowers/axil	1	Jwala, Byadagi, PBC 385, PBC 473, Paprika type–1, PBC 1347, Dokomlasi 640, PBC 066, Kt-pl-19, PBC 1350, Kt-pl-22, Kt-pl-25, Kt-pl-23, Kt-pl-8, PBC 436, Small conical, Kt-pl-24, Paprika king, Kt-pl-18, Kt-pl-20, Round ornamental, PBC 828, PBC 999, PBC 375, Kt-19, 517-1, CAP 1088/35, PBC 971, PBC 535, Arka Abir, Modhpur, PBC 743.
	>2	PBC 1369, PBC 384, PBC 554, PBC 717, CAP 1063/35, CA 291, Cluster chilli, CAP 1086/35.
Flower position	Pendent	Byadagi, PBC 385, PBC 473, PBC 1347, Dokomlasi 640, PBC 066, Kt-pl-19, PBC 1350, Kt-pl-22, Kt-pl-25, Kt-pl-24, Paprika king, Kt-pl-18, Kt-pl-20, PBC 828, PBC 999, PBC 375, Kt-19, 517-1, CAP 1088/35, PBC 971, PBC 535, Modhpur, PBC 1369.
	Intermediate	Jwala, Kt-pl-23, Kt-pl-8, PBC 436, Arka Abir, PBC 554.
	Erect	Paprika type–1, Small conical, Round Ornamental, PBC 743, PBC 384, CAP 1063/35, CA 219, Cluster chilli, CAP 1086/35, PBC 717.
Corolla colour	White	Byadagi, PBC 385, PBC 473, PBC 1347, Dokomlasi 640, PBC 066, Kt-pl-19, Kt-pl-22, Kt-pl-25, Kt-pl-23, Kt-pl-24, Kt-pl-18, Kt-pl-20, PBC 828, PBC 999, PBC 375, Kt-19, 517-1, CAP 1088/35, PBC 971, PBC 535, Modhpur, Jwala, PBC 436, Arka Abir, Paprika type–1, Round ornamental, PBC 384, CA 219, Cluster chilli, CAP 1086/35, PBC 717.
	Light yellow	PBC 1350, Paprika king, PBC 1369, Kt-pl-8, PBC 554, Small conical, PBC 743, CAP 1063/35.
Anther colour	Blue	Byadagi, PBC 473, Kt-pl-22, Kt-pl-25, Kt-pl-20, PBC 828, 517-1, PBC 971, Modhpur, Jwala, Arka Abir, Round ornamental, Paprika king, Small conical, PBC 743, CAP 1063/35.
	Purple	PBC 385, PBC 1347, Dokomlasi 640, PBC 066, Kt-pl-19, Kt-pl-24, Kt-pl-18, PBC 999, PBC 375, Kt-19, CAP 1088/35, PBC 535, PBC 436, Paprika type–1, PBC 384, CA 219, Cluster chilli, CAP 1086/35, PBC 717, PBC 1350, PBC 1350, PBC 1369, Kt-pl-8, PBC 554.
Fruit shape	Elongate	PBC 554, PBC 473, PBC 535, PBC 717, PBC 1347, PBC 1350, PBC 971, PBC 384, CAP 1063/35, Arka Abir, CA-219, Byadagi, Kt-pl-22, Kt-pl-23, PBC 385, PBC 743, 517-1, Dokomlasi 640, Kt-19, Modhpur, Jwala, PBC 066, Paprika King, Kt-pl-18, Kt-pl-20, PBC 375, Kt-pl-24.
	Triangular	PBC 999, PBC 828, CAP 1086/35, CAP 1088/35, Paprika type–1, Small conical, Kt-pl-8, Kt-pl-25, Cluster chilli, Kt-pl-19
	Round	Round ornamental
	Blocky	PBC 1369, PBC 436.
Fruit shape at blossom end	Pointed	PBC 473, PBC 535, PBC 717, PbC 1347, PBC 971, PBC 384, CAP 1063/35, CA-219, Byadagi, Arka Abir, PBC 385, 517-1, PBC 743, Dokomlasi 640, Kt-19, Modhpur, Jwala, PBC 066, Paprika King, Kt-pl-18, Kt-pl-20, PBC 375, Kt-pl-24, PBC 999, CAP 1086/35, CAP 1088/35, Kt-pl-8, Cluster chilli.
	Blunt	PBC 554, PBC 1350, Kt-pl-22, Kt-pl-23, PBC 828, Paprika type–1, Small conical, Kt-pl-19.
	Sunken	Round ornamental PBC 1369, PBC 436.
	Sunken and Pointed	Kt-pl-25.

Contd.

Character	Expression	Genotypes
Fruit blossom end appendage	Absent	PBC 473, PBC 535, PBC 717, PBC 1347, PBC 971, PBC, 384, CAP 1063/35, CA–219, Byadagi, Arka Abir, PBC 385, PBC 535, PBC 743, Dokomlasi 640, Kt-19, Modhpur, Jwala, PBC 066, Paprika King, Kt-pl-18, Kt-pl-20.
	Present	PBC 375, Kt-pl-24, PBC 999, CAP 1086/35, CAP 1088/35, Kt-pl-8 Cluster chilli, PBC 554, PBC 1350, Kt-pl-22, Kt-pl-23, PBC 828, Paprika type–1, Kt-pl-19, Round ornamental PBC 1369, Kt-pl-25, 517-1.
Fruit surface	Smooth	Small conical, PBC 436
	Semi-wrinkled	PBC 535, PBC 717, PBC 971, PBC 384, CAP 1063/35, CA-219, Arka Abir, Modhpur, Jwala, Paprika King, Kt-pl-20, PBC 375, Kt-pl-24, PBC 999, CAP 1086/35, CAP 1088/35, Cluster chilli, PBC 554, PBC 1350, Kt-pl-22, Kt-pl-23, PBC 828, Paprika type–1, Kt-pl-19, Round ornamental, PBC 1369, Kt-pl-25, PBC 436, PBC 1347, Small conical, 517-1.
	Wrinkled	PBC 473, PBC 385, PBC 743, Kt-19, PBC 066, Kt-pl-18, Kt-pl-8, Dokomlasi 640, Kt-19
Placenta length	>1/2	Byadagi
Seed colour	Straw	All genotypes

Table 3. Variability of paprika genotypes in plant height, days to flower, days to fruit, fruit length and fruit width

S. No.	Accession No.	Plant height	Days to flower	Days to fruit	Fruit length (cm)	Fruit width (cm)
1.	PBC 436	32.3	43.6	56.6	4.5	3.8
2.	PBC 385	65.3	39.6	52.6	8.73	1.5
3.	PBC 384	68.6	41.3	54.6	10.5	2.1
4.	PBC 375	59.3	40.3	53.0	10.6	1.86
5.	PBC 1369	44.6	35.6	47.7	3.56	3.83
6.	PBC 066	58.3	36.0	49.3	11.03	3.16
7.	CA 219	62.0	37.0	49.6	6.0	1.6
8.	PBC 473	52.0	41.3	53.6	9.76	1.96
9.	PBC 535	48.6	42.3	55.0	9.5	1.96
10.	PBC 554	41.3	44.3	56.3	9.6	1.83
11.	Kt-pl-18	44.0	31.6	43.0	7.5	1.66
12.	Cluster chilly	45.0	52.6	64.6	5.53	1.80
13.	Small conical	45.3	.45.6	57.3	4.90	1.93
14.	Round ornamental	45.6	46.6	60.3	1.65	1.90
15.	Arka Abir	82.6	45.0	57.6	8.5	1.87
16.	Byadagi	92.0	48.0	63.0	9.32	1.64
17.	Modhpur	49.0	44.0	57.3	7.86	1.63
18.	CAP 1088/35	43.6	41.3	56.0	7.53	1.36
19	CAP 1086/35	55.0	41.0	53.6	3.04	1.13
20.	Kt-pl-19	50.3	40.6	54.0	6.33	2.56
21.	CAP 1063/35	47.7	38.6	50.6	5.8	2.0
22.	PBC 1350	51.0	41.0	54.3	5.96	2.2
23.	PBC 1347	45.6	43.0	55.6	8.03	1.66
24.	PBC 743	70.6	43.6	56.0	5.2	0.60
25.	PBC 717	84.0	45.0	57.3	5.06	0.89
26.	Paprika type–1	68.0	43.0	56.6	4.10	2.43
27.	Dokomlasi–640	43.3	55.6	68.3	7.23	1.46
28.	Kt-pl-22	53.0	36.3	50.3	9.13	2.1
29.	Kt-19	86.0	64.6	80.0	9.6	1.36
30.	Kt-pl-24	36.6	34.3	48.3	10.26	1.56
31.	Kt-pl-25	49.0	33.6	46.3	8.0	1.96
32.	Kt-pl-23	47.3	31.6	42.0	8.05	2.96
33.	Kt-pl-8	44.6	34.6	46.6	7.1	2.36
34.	Kt-pl-20	44.6	29.0	42.0	9.43	2.10
35.	PBC 828	68.0	34.6	46.6	10.0	3.10
36.	PBC 971	66.6	41.6	53.6	12.4	1.76
37.	PBC 999	61.6	41.3	54.6	13.23	3.30
38.	Jwala	44.6	32.0	44.0	7.5	0.77
39.	517–1	71.3	31.0	45.0	3.63	1.30
40.	Paprika King	68.3	32.0	47.3	13.6	2.26
	Mean	55.45	40.5	53.5	7.8	1.98
	SD	14.12	6.88	7.29	2.94	0.72
	CV%	25.4	16.9	13.6	37.6	36.3

Table 4. Variability of paprika genotypes in fruit weight, yield/plant, seed size and seed number

S. No.	Accession no.	Fruit weight	Yield/ plant	Seed size(cm)	Seed number
1.	PBC 436	13.3	60.3	0.44	76
2.	PBC 385	2.13	125.3	0.28	119
3.	PBC 384	2.90	155.3	0.33	92.6
4.	PBC 375	2.30	169.6	0.31	122.3
5.	PBC 1369	16.6	53.3	0.48	77
6.	PBC 066	11.4	227.3	0.38	101
7.	CA 219	1.11	92.3	0.30	114
8.	PBC 473	2.28	110.3	0.31	114
9.	PBC 535	1.83	128.0	0.34	129.6
10.	PBC 554	4.20	113.6	0.45	86.3
11.	Kt-pl-18	3.60	157.3	0.46	86.0
12.	Cluster Chilli	3.40	95.0	0.32	140.6
13.	Small Conical	4.70	123.3	0.30	132.0
14.	Round oranmental	1.80	174.3	0.32	79.3
15.	Arka Abir	2.12	117.0	0.42	100.3
16.	Byadagi	2.63	115.0	0.41	104.0
17.	Modhpur	2.13	113.6	0.32	110.3
18.	CAP 1088/35	18.2	141.6	0.44	67.0
19.	CAP 1086/35	0.57	56.0	0.27	89.3
20.	Kt-pl-19	8.53	120.3	0.45	76.3
21.	CAP 1063/35	0.68	71.3	0.24	62
22.	PBC 1350	3.03	162.6	0.35	108
23.	PBC 1347	2.26	173.3	0.35	135.0
24.	PBC 743	0.16	62.0	0.26	109.3
25.	PBC 717	0.53	75.6	0.24	90.6
26.	Paprika type-1	1.85	101.3	0.34	98.3
27.	Dokomlasi-640	2.02	99.66	0.33	99.6
28.	Kt-pl-22	5.99	135.0	0.38	90.0
29.	Kt-19	1.79	93.33	0.29	100.6
30.	Kt-pl-24	5.2	113.3	0.38	100.3
31.	Kt-pl-25	8.1	167.0	0.46	70.6
32.	Kt-pl-23	4.73	144.3	0.47	95.0
33.	Kt-pl-8	7.40	190.3	0.45	85.6
34.	Kt-pl-20	13.16	155.0	0.46	90.6
35.	PBC 828	5.56	108.6	0.40	89.6
36.	PBC 971	8.50	107.3.	0.42	96.0
37.	PBC 999	7.63	103.5	0.50	90.6
38.	Jwala	1.56	78.3	0.35	104.6
39.	517-1	1.20	119.6	0.32	105.0
40.	Paprika King	16.9	255.6	0.45	61.0
	Mean	5.1	124.1	0.36	96.5
	SD	4.85	44.4	0.07	19.2
	CV%	95	35.8	19.4	19.8

Table 5. Variability of paprika genotypes in colour value and capsaicin content

S. No.	Accession No.	Colour value (ASTA)	Capsaicin (%)
1.	PBC 436	121	0.05
2.	PBC 385	172	0.47
3.	PBC 384	143.8	0.53
4.	PBC 375	100.6	0.37
5.	PBC 1369	70.3	0.106
6.	PBC 066	128.6	0.226
7.	CA 219	116.6	0.526
8.	PBC 473	112.3	0.47
9.	PBC 535	86.3	0.22
10.	PBC 554	132.6	0.41
11.	Kt-pl-18	133.6	0.14
12.	Cluster Chilly	137.0	0.57
13.	Small Conical	106.3	0.50
14.	Round Ornamental	105.0	0.39
15.	Arka Abir	173.3	0.28
16.	Byadagi	216.0	0.286
17.	Modhpur	110.3	0.42
18.	CAP 1088/35	93.0	0.31
19.	CAP 1086/35	89.3	0.60
20.	Kt-pl-19	225.0	0.21
21.	CAP 1063/35	188	0.30
22.	PBC 1350	105.6	0.263
23.	PBC 1347	120.0	0.426
24.	PBC 743	88.66	0.403
25.	PBC 717	94.0	0.426
26.	Paprika type–1	115.6	0.26
27.	Dokomlasi-640	104	0.316
28.	Kt-pl-22	107	0.293
29.	Kt–19	140.6	0.383
30.	Kt-pl-24	148.3	0.063
31.	Kt-pl-25	223.0	0.16
32.	Kt-pl-23	158.6	0.30
33.	Kt-pl-8	102	0.283
34.	Kt-pl-20	137	0.386
35.	PBC 828	258	0.253
36.	PBC 971	118.9	0.24
37.	PBC 999	114.0	0.226
38.	Jwala	78.86	0.52
39.	517-1	134.3	0.63
40.	Paprika King	268.3	0.36
	Mean	136.5	0.34
	S.D	49.1	0.14
	CV%	35.9	41.1

Paprika is valued most for its colour and mildness of flavour. Hence, biochemical analysis for colour and pungency were done for all the lines. Genotypes with ASTA colour values in the range of 101-105 are classified under high colour groups those with 70-100 ASTA units under medium colour group and those below 70 ASTA units under low colour groups. Among the 40 geno-types, Paprika King has the highest colour value (268 ASTA), followed by PBC 828 (258 ASTA) and Kt-pl-19 (225 ASTA). There were quite a few genotypes under the high colour group. Paprika as a group entertains a pungency value less than 0.1%. Among the lines studied, PBC 436 had the lowest capsaicin percentage (0.05) and the highest was in 517-1 (0.63%).

It was found that Paprika King had high fresh fruit weight (16.9 g), high yield (225 g), high colour value (268 ASTA) and low capsaicin percentage (0.34). PBC 066 also had high fruit weight (11.4 g), yield (227 g), high colour value (128.6 ASTA) and low capsaicin (0.23%). PBC 1347 gave good yield (173.3 g) and high colour value (120 ASTA), but had high percentage of capsaicin (0.42). Round ornamental also

gave high yield (174.3g) and high colour value (105 ASTA), but the percentage of capsaicin was high. With the technology to separate colour and pungency compounds already available using super critical CO_2 as solvent (Skerget, 1998), the high capsaicin lines can also be used to prepare paprika oleoresin with low pungency. Byadagi, a well-known paprika type from Dharwad, Karnataka, was low yielding (115 g) under Calicut (North Kerala) conditions. Kt-pl-19 was low yielding (120.3 g), but Kt-pl-8 was high yielding (190.3 g) and has high colour value (102 ASTA) and capsaicin (0.28%). Kt-pl-20 was moderate in yield (155 g), but had high colour value (137 ASTA) and capsaicin content of 0.38%. Seasonal variation in the expression of both quantitative and qualitative characters was also found in the present study. It could be due to the difference in adaptability and response to changes in the environment. Future line of work includes the evaluation of the promising lines like Paprika King, PBC 066, Kt-pl-8 and Kt-pl-20 for several seasons at several locations, to release a paprika cultivar suitable for Kerala.

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