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Study of biochemical parameters in potato (*Solanum tuberosum* L.) germplasms under Tarai region of Uttarakhand

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ABSTRACT

A study was conducted in 50 potato genotypes were assessed based on different biochemical parameters including TSS, tuber dry matter content, specific gravity, protein content, ascorbic acid content, reducing sugars and chip colour score. The genotypes were grown at Vegetable Research Centre (VRC) of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India during 2012-13 and 2013-14. The experiment was laid out in Augumented Block Design (ABD). All of these characters showed a high level of variation among all the genotypes. The highest TSS was obtained in Laddy Rosetta (8.820 Brix°) during 2012-13 and TPSK-05-06-98 (8.280 Brix°) during 2013-14. Tuber dry matter content was recorded maximum during 2012-13 and 2013-14 in K. Chipsona-2 i.e. 25.242 and 26.387 and specific gravity was found maximum during 2012-13 and 2013-14 in MS/95-1542 which is about 1.868 and 1.690 respectively. TPSK -05-06-44 showed highest ascorbic acid content and TPSK-05-06-117 showed maximum reducing sugars during 2012-13 and 2013-14 i.e. 2.581& 2.616 and 242.160 & 261.880 respectively. On the other hand Protein Content was found maximum in TPSK-05-06-61 (2.581) during 2012-13 and TPSK-05-06-80 (2.616) during 2013-14. Chip Colour Score in 50 potato genotypes were varies from 2.360 to 7.360 during 2012-13 and 2.60 to 7.360 during 2013-14. The chip colour score was observed highest in TPSK-05-06-105 i.e. 7.360 and AICRP-07-05 i.e. 7.360 during 2012-13 and 2013-14 respectively.

Key words: Biochemical Parameters, *Solanum tuberosum*, Potato, Sugar, Ascorbic acid.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a world food crop, and can be compared only with rice, wheat and maize for its contribution towards securing the food and nutrition, and avoiding the poverty and hunger, especially in developing world where food is perpetually on demand to feed the increasing populations living with inherent social and political conflicts and a variety of socio-economic injustices, and where nutrition is, in reality, a second choice, rather a luxury. Potato is a versatile tuber belongs to family *Solanaceae*. Potato is cheap source of energy and good supplier in relation to requirement of dietary nitrogen of high quality and was pre-eminent as a source of Vitamin C. Valuable minerals is also present in potato. It is widely cultivated over an area of 1990 thousand hectares, with a production of 41555.384 thousand MT (NHB, 2013-14).

Potato processing is gaining importance in our country in view of the rising employment of women in cities leading to growing demand for processed products and the general increase in demand for processed foods in urban areas due to liking of people particularly youngsters for such products. The increase in number of fast food outlets in the metros and even smaller cities is also contributing towards this. Processing helps in reducing demand for storage space and also provides better returns to the growers. The quality of potato chip has been reported to be influenced by pre harvest factors mainly the growing condition and also influenced by variety (Salunkhe et al., 1989), inherent characteristics of potatoes like dry matter and specific gravity (Smith, 1968). Every factor that is part of the environment has the potential to cause differential performance that is associated with genotype environment interaction in potatoes (Feher, 1987).

Keeping in view the above facts and considering the importance of potato as a processing plant, the present study was undertaken with the objective to characterize potato genotypes for quality traits.

MATERIALS AND METHODS

The present investigation was conducted at Vegetable Research Centre (VRC) of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India during 2012-13 and 2013-14. Geographically Pantnagar is situated at 29.50 N latitude, 79.30 E longitudes and at an altitude of 243.84 meters above the mean sea level in sub-mountainous region of Shivalik hills, known as tarai, which have a humid and subtropical climate. Here the frost can be expected from last week of December to the end of January. The experimental material comprised 45 potato genotypes and five checks. The experiment was laid out in Augumented Block Design (ABD) with 50 treatments, using plot size 3m x 2m. The fertilizers were applied as per recommendation for the area. The tubers were sown in ridges, spaced at 60 cm, with plant to plant distance of 20 cm. The observations were recorded on 7 different biochemical parameters *viz.* TSS, tuber dry matter content, specific gravity, protein content, ascorbic acid content, reducing sugars and chip color score from five randomly selected plants and the average was subjected to statistical analysis of variance.

Tuber specific gravity was measured using the weight in air and weight in water method (Gould, 1995). To determine dry tuber matter content tubers, ten tubers were taken at random from the harvested plot, washed, chopped and mixed. Two sub-samples 200 g each were taken and pre-dried at a temperature of 60°C for 15 h and further dried for 3 h at 105°C in a drying oven. Dry matter content was calculated as the ratio between dry and fresh mass and expressed as a percentage. The tuber protein content was estimated with the help of Micro-Kjeldhal method and reducing sugar content of tubers was estimated by Nelson-Somogyi's method (Ranganna, 1986a and Ranganna, 1986b).

The juice prepared from tuber was used for reducing sugars analysis. Ten milliliters of the juice were added to 15 ml of 80% ethanol, mixed and heated in boiling water bath for 40 min. After extraction, 1 ml saturated Pb $(CH_3\,COO)_2\,3H_2O$ and 1 ml Na_2HPO_4 were added and the content was mixed by gentle shaking and filtered. The filtered extract was made up to 50 ml with distilled water. An aliquot was diluted to 25 ml with 1 ml copper reagent in a test tube and heated for 20 minutes in a boiling water bath. The heated contents were cooled under running tap water without shaking. Arsenomolybdate color reagent (1 ml) was added to the cooled content made up to 10 ml with distilled water and left for about 10 minutes to allow color development, after which the absorbance was determined by a spectrophotometer at 540 nm. The reducing sugar was calculated using the formulae developed by Somogyi *et al*. (1952).

RESULTS AND DISCUSSION

Varietal differences for total soluble solids (TSS) content were significant. TSS ranged from 2.604 to 8.820 0Brix with the mean value of 5.060 0Brix during first year of experiment However, in second year TSS value ranged from 2.680 to 8.280 0Brix with the average value of 5.472 0Brix. The perusal of data drawn by pooling two years of performance show that the TSS value ranged from 3.09-8.410Brix with an average value of 5.260Brix (Table 3). Data depicted in Table 1clearly indicate that parameter such as TSS content varied with the genotypes. Genotypes Laddy Rossetta (8.8200Brix) and TPSK-0506-98 (8.2560Brix) had higher TSS content as compare to the other genotypes. Minimum TSS content was observed in EM-3 (2.6800Brix) and DPS-07 (2.6040Brix). Pooled analysis of two year data showed that the dry matter content in tuber was varying from 16.81-25.81 per cent with 21.18 per cent as average value. Variations for TSS content had also been reported by Singh and Singh (1988), Mishra (2002) and Dalakoti *et al*. (2003).

Table 1 Average TSS, Tuber Dry Matter Content, Specific Gravity, and Protein Content in different potato varieties/genotypes

Genotypes	TSS (°Brix) 2012-13	TSS (°Brix) 2013-14	Pooled	Tuber Dry Matter Content (%) 2012-13	Tuber Dry Matter Content (%) 2013-14	Pooled	Specific Gravity (g/cm^3) 2012-13	Specific Gravity (g/cm^3) 2013-14	Pooled	Protein Content (%) 2012-13	Protein Content (%) 2013-14	Pooled
K. Arun	4.556	5.480	5.018	20.970	22.707	21.838	1.038	1.240	1.139	2.119	2.042	2.080
K. Jawahar	7.036	6.080	6.558	19.880	18.797	19.338	1.028	1.340	1.184	2.419	2.342	2.380
AICRP-07-1	4.896	3.980	4.438	18.740	20.897	19.818	1.778	1.440	1.609	1.369	1.492	1.430
TPSK-05-06-110	5.056	4.580	4.818	22.940	24.707	23.823	1.278	1.340	1.309	2.219	2.392	2.305
TPSK-05-06-79	5.956	6.280	6.118	22.040	22.807	22.423	1.678	1.590	1.634	2.369	2.192	2.280
MS/95-1542	4.196	4.280	4.238	20.740	22.957	21.848	1.868	1.690	1.779	1.269	1.292	1.28
EM-2	5.556	4.680	5.118	21.040	19.807	20.423	1.028	1.340	1.184	1.219	1.292	1.255
TPSK-0506-98	8.256	8.280	8.268	23.890	24.907	24.398	1.038	1.440	1.239	2.219	2.342	2.280
DPS-19	4.036	4.580	4.308	20.740	20.207	20.473	1.678	1.220	1.449	1.819	1.192	1.505
M-3	6.420	6.900	6.660	19.422	21.447	20.434	1.070	1.468	1.269	1.269	1.510	1.389
TPSK-05-06-95	4.620	4.000	4.310	18.422	20.447	19.434	1.100	1.248	1.174	1.869	1.710	1.789
Laddy Rossetta	8.820	8.000	8.410	22.422	23.947	23.184	1.740	1.548	1.644	2.219	2.510	2.364
EM-5	3.760	4.800	4.280	20.272	23.247	21.759	1.640	1.518	1.579	1.519	1.410	1.464
EM-3	2.680	3.500	3.090	20.422	22.617	21.519	1.120	1.248	1.184	1.669	1.610	1.639
K. Giriraj	7.040	7.000	7.020	18.772	20.447	19.609	1.270	1.128	1.199	1.369	1.360	1.364
Atlanta	5.020	3.900	4.460	19.772	22.947	21.359	1.490	1.248	1.369	1.819	1.810	1.814
K. Sadabahar	4.580	4.800	4.690	20.372	18.947	19.659	1.120	1.128	1.124	1.919	2.120	2.019
AICRP-07-05	3.840	4.500	4.170	20.572	18.947	19.759	1.440	1.518	1.479	1.969	2.160	2.064
TPSK-05-06-117	6.084	6.680	6.382	19.802	18.887	19.344	1.322	1.202	1.262	2.413	2.516	2.464
K. Chipsona-2	7.404	7.880	7.642	25.242	26.387	25.814	1.172	1.052	1.112	2.163	2.366	2.264
MS/93-1344	3.184	4.580	3.882	18.952	20.287	19.619	1.032	0.992	1.012	2.063	2.216	2.139
TPSK-05-06-105	6.864	7.080	6.972	16.952	19.387	18.169	1.272	1.202	1.237	1.713	2.116	1.914
K. Badsah	5.064	5.880	5.472	18.252	20.557	19.404	1.042	1.222	1.132	2.463	2.416	2.439
TPSK-05-06-80	5.664	5.480	5.572	19.802	22.737	21.269	1.202	1.322	1.262	2.413	2.616	2.514
K. Pushkar	3.544	2.680	3.112	18.862	19.887	19.374	1.422	1.202	1.312	1.513	1.766	1.639
TPSK -05-06-44	5.564	4.580	5.072	20.952	22.887	21.919	1.322	1.542	1.432	2.413	2.516	2.464
K. Khyati	4.364	4.680	4.522	19.802	19.487	19.644	1.472	1.672	1.572	1.913	2.166	2.039
K. Jyoti	6.604	7.520	7.062	18.914	19.809	19.361	1.662	1.446	1.554	2.431	2.462	2.446
TPSK-05-06-61	5.264	5.820	5.542	20.604	21.809	21.206	1.042	1.056	1.049	2.581	2.512	2.546
EM-1	3.124	4.720	3.922	19.904	18.809	19.356	1.062	1.076	1.069	1.201	1.212	1.206
TPSK-05-06-85	5.404	5.320	5.362	23.844	23.809	23.826	1.072	1.276	1.174	1.881	1.862	1.871
C-11	7.144	8.220	7.682	20.954	22.559	21.756	1.242	1.396	1.319	2.131	1.512	1.821
DPS-07	2.604	4.220	3.412	19.944	21.499	20.721	1.262	1.346	1.304	1.881	1.512	1.696
TPSK-05-06-86	5.104	6.020	5.562	24.844	24.809	24.826	1.242	1.276	1.259	2.201	2.192	2.196
MS/99-1871	4.684	6.220	5.452	23.944	23.944	23.876	1.062	1.062	1.079	1.881	1.881	1.571
MS/0-3740	2.844	4.820	3.832	22.254	22.254	23.281	1.242	1.242	1.269	2.081	2.081	2.046
TPSK-05-06-83	4.654	5.520	5.087	24.874	24.874	25.306	1.336	1.336	1.439	1.819	1.819	1.720
TPSK-05-06-007	3.654	4.520	4.087	23.284	23.284	21.716	1.446	1.446	1.384	2.469	2.469	2.495
K. Himalini	4.694	3.920	4.307	20.784	20.784	22.341	1.156	1.156	1.214	2.369	2.369	2.295
K. Surya	3.394	3.220	3.307	23.284	23.284	23.916	1.266	1.266	1.334	2.069	2.069	1.995
MS/0-9808	2.814	3.420	3.117	20.884	20.884	21.891	1.246	1.246	1.384	1.539	1.539	1.395
PH-3	6.154	7.220	6.687	20.284	20.284	19.716	1.346	1.346	1.324	1.669	1.669	1.720
P-11	4.454	5.520	4.987	17.874	17.874	18.886	1.226	1.226	1.324	2.069	2.069	1.995
C-1	6.034	7.820	6.927	16.784	16.784	16.816	1.446	1.446	1.549	1.419	1.419	1.265
C-10	4.994	6.320	5.657	17.784	17.784	18.841	1.146	1.146	1.224	1.149	1.149	1.185
K. Frysona ©	5.500	6.040	5.770	20.958	20.958	21.813	1.362	1.362	1.236	1.386	1.386	1.446
K. Chipsona-1 ©	4.820	6.020	5.420	24.280	24.280	22.978	1.404	1.404	1.412	2.088	2.088	2.179
K. Bahar ©	4.980	5.420	5.200	20.930	20.930	21.555	1.424	1.424	1.362	1.486	1.486	1.456
K. Guarav ©	5.894	5.340	5.617	20.156	20.156	20.478	1.098	1.098	1.130	2.134	2.134	2.140
K. Ashoka ©	4.128	5.280	4.704	18.684	18.684	19.128	1.094	1.094	1.172	1.750	1.750	1.645
Mean	**5.060**	**5.472**	**5.266**	**20.722**	**20.722**	**21.185**	**1.291**	**1.291**	**1.308**	**1.908**	**1.908**	**1.898**
CV	**3.15**	**6.889**	**12.081**	**7.671**	**3.135**	**5.871**	**6.09**	**5.844**	**9.992**	**7.74**	**5.702**	**8.396**
CD (5%)	**0.784**	**0.956**	**0.894**	**1.658**	**1.729**	**1.749**	**0.252**	**0.199**	**0.184**	**0.379**	**0.276**	**0.224**

Table 2 Average Ascorbic Acid Content, Reducing Sugars Chip Colour Score and in different potato varieties/genotypes

Genotypes	Ascorbic Acid Content (mg/100g) 2012-13	Ascorbic Acid Content (mg/100g) 2013-14	Pooled	Reducing Sugars (mg/100g) 2012-13	Reducing Sugars (mg/100g) 2013-14	Pooled	Chip Colour Score 2012-13	Chip Colour Score 2013-14	Pooled
K. Arun	20.399	19.861	20.130	126.160	129.080	127.620	5.760	5.760	5.760
K. Jawahar	20.949	22.711	21.830	135.160	142.080	138.620	6.760	4.760	5.760
AICRP-07-1	19.549	21.961	20.755	140.160	131.080	135.620	4.760	3.760	4.260
TPSK-05-06-110	20.649	21.211	20.930	175.160	194.080	184.620	5.760	6.760	6.260
TPSK-05-06-79	19.149	18.961	19.055	190.160	209.080	199.620	5.760	5.760	5.760
MS/95-1542	18.649	17.861	18.255	139.160	149.080	144.120	4.760	4.760	4.760
EM-2	18.899	18.211	18.555	143.160	134.080	138.620	5.760	4.760	5.260
TPSK-0506-98	17.499	19.661	18.580	195.160	204.080	199.620	6.760	6.760	6.760
DPS-19	16.649	17.811	17.230	146.160	129.080	137.620	5.760	5.760	5.760
M-3	17.555	19.617	18.586	136.360	150.280	143.320	5.160	6.360	5.760
TPSK-05-06-95	20.555	21.517	21.036	211.360	196.280	203.820	7.160	5.360	6.260
Laddy Rossetta	19.555	18.567	19.061	194.360	128.280	161.320	6.160	6.360	6.260
EM-5	17.555	18.517	18.036	156.360	139.280	147.820	5.160	5.360	5.260
EM-3	16.405	17.997	17.201	161.360	179.280	170.3200	5.160	5.360	5.2600
K. Giriraj	20.405	19.367	19.886	179.360	144.280	161.8200	5.160	5.360	5.2600
Atlanta	20.705	19.397	20.051	180.360	174.280	177.3200	6.160	6.360	6.2600
K. Sadabahar	20.285	21.237	20.761	186.360	161.280	173.8200	6.160	5.360	5.7600
AICRP-07-05	19.555	17.467	18.511	211.360	219.280	215.3200	6.160	7.360	6.7600
TPSK-05-06-117	20.615	22.037	21.326	242.160	261.880	252.0200	4.360	3.760	4.0600
K. Chipsona-2	20.715	21.907	21.311	207.160	219.880	213.5200	2.360	3.760	3.0600
MS/93-1344	19.625	18.807	19.216	212.160	230.880	221.5200	6.360	6.760	6.5600
TPSK-05-06-105	21.425	20.957	21.191	187.160	184.880	186.0200	7.360	6.760	7.0600
K. Badsah	19.625	20.857	20.241	151.160	134.880	143.0200	5.360	4.760	5.0600
TPSK-05-06-80	20.475	19.537	20.006	191.160	184.880	188.0200	5.360	5.760	5.5600
K. Pushkar	20.205	21.207	20.706	182.160	178.880	180.5200	6.360	4.760	5.5600
TPSK -05-06-44	25.225	25.057	25.141	237.160	242.880	240.0200	6.360	5.760	6.0600
K. Khyati	20.475	19.957	20.216	187.160	219.880	203.5200	5.360	5.760	5.5600
K. Jyoti	23.145	22.197	22.671	146.360	133.680	140.0200	3.960	3.360	3.6600
TPSK-05-06-61	22.295	20.397	21.346	196.360	216.680	206.5200	4.960	5.360	5.1600
EM-1	19.995	16.947	18.471	136.360	125.680	131.0200	5.960	6.360	6.1600
TPSK-05-06-85	20.995	19.647	20.321	221.360	194.680	208.0200	4.960	6.360	5.6600
C-11	20.145	20.047	20.096	146.360	131.680	139.0200	6.960	7.360	7.1600
DPS-07	18.895	19.617	19.256	131.360	144.680	138.0200	6.960	6.360	6.6600
TPSK-05-06-86	21.145	21.407	21.276	200.360	218.680	209.5200	4.960	5.360	5.1600
MS/99-1871	18.095	18.095	18.496	206.360	206.360	213.02	5.960	5.960	6.160
MS/0-3740	18.895	18.895	19.366	202.360	202.360	193.020	6.960	6.960	7.16
TPSK-05-06-83	21.475	21.475	20.836	219.960	219.960	207.520	4.760	4.760	4.260
TPSK-05-06-007	17.575	17.575	18.486	208.960	208.960	205.520	5.760	5.760	5.760
K. Himalini	20.025	20.025	19.566	120.960	120.960	133.020	5.760	5.760	5.260
K. Surya	19.115	19.115	19.906	113.960	113.960	117.020	3.760	3.760	3.260
MS/0-9808	17.475	17.475	19.036	148.960	148.960	142.520	5.760	5.760	5.760
PH-3	19.765	19.765	20.006	194.960	194.960	207.020	4.760	4.760	4.760
P-11	20.505	20.505	20.856	169.960	169.960	179.020	5.760	5.760	5.260
C-1	19.215	19.215	19.766	114.960	114.960	120.520	6.760	6.760	6.260
C-10	18.575	18.575	18.096	119.960	119.960	126.020	4.760	4.760	5.260
K. Frysona ©	21.180	21.180	20.920	186.400	186.400	189.600	3.400	3.400	3.000
K. Chipsona-1 ©	20.680	20.680	20.594	127.600	127.600	132.700	2.600	2.600	2.500
K. Bahar ©	19.690	19.690	19.795	158.000	158.000	175.900	5.800	5.800	6.200
K. Guarav ©	21.186	21.186	20.992	185.400	185.400	189.400	6.600	6.600	6.600
K. Ashoka ©	20.740	20.740	20.705	178.400	178.400	181.000	3.400	3.400	3.500
Mean	19.883	19.883	19.973	172.816	172.816	173.482	5.496	5.496	5.446
CV	**2.39**	**2.980**	**4.556**	**1.56**	**1.496**	**4.426**	**9.15**	**8.889**	**10.296**
CD (5%)	**0.570**	**1.517**	**1.280**	**6.904**	**6.601**	**10.802**	**1.310**	**1.246**	**0.788**

Table 3: General mean and range of variation of potato germplasm (2012-13, 2013-14 and pooled)

S. No.		Mean sum of squares					
		First Year (2012-13)		Second Year (2013-14)		Pooled	
		General mean	Range	General mean	Range	General mean	Range
1.	Tuber Dry Matter Content (%)	20.72	16.78-25.24	21.649	16.84-26.38	21.18	16.81-25.81
2.	Specific Gravity (g/cm^3)	1.29	1.02-1.86	1.327	0.99-1.69	1.30	1.01-1.77
3.	TSS Brix°	5.06	2.60-8.82	5.472	2.68-8.28	5.26	3.09-8.41
4.	Protein Content (%)	1.90	1.14-2.58	1.889	1.11-2.61	1.89	1.18-2.54
5.	Ascorbic Acid Content (mg/100g)	19.88	16.40-25.22	20.064	16.94-25.05	19.97	17.20-25.14
6.	Reducing Sugars (mg/100g)	172.81	113.96-242.16	174.148	120.08-261.88	173.48	117.02-252.02
7.	Chip Colour Score	5.49	2.36-7.36	5.396	2.40-7.36	5.44	2.50-7.16

Table 4: Mean, range and least significant difference for potato germplasm during 2012-13

S. No.		General mean	Range	Checks					CV%	CM
				K. Frysona	K. Chipsona-1	K. Bahar	K. Guarav	K. Ashoka		
1.	Tuber Dry Matter Content (%)	20.72	16.78-25.24	20.958	24.280	20.930	20.156	18.684	3.15	0.412
2.	Specific Gravity (g/cm^3)	1.29	1.02-1.86	1.362	1.404	1.424	1.098	1.094	7.671	0.063
3.	TSS Brix°	5.06	2.60-8.82	5.500	4.820	4.980	5.894	4.128	6.09	0.195
4.	Protein Content (%)	1.90	1.14-2.58	1.386	2.088	1.486	2.134	1.750	7.74	0.094
5.	Ascorbic Acid Content (mg/100g)	19.88	16.40-25.22	21.180	20.680	19.690	21.186	20.740	2.39	0.300
6.	Reducing Sugars (mg/100g)	172.81	113.96-242.16	186.400	127.600	158.000	185.400	178.400	1.56	1.716
7.	Chip Colour Score	5.49	2.36-7.36	3.400	2.600	5.800	6.600	3.400	9.15	0.326

Table 5: Mean, range and least significant difference for potato germplasm during 2013-14

S. No.		General mean	Range	Checks					CV %	CM
				K. Frysona	K. Chipsona-1	K. Bahar	K. Guarav	K. Ashoka		
1.	Tuber Dry Matter Content (%)	21.649	16.84-26.38	22.668	21.676	22.180	20.800	19.572	3.13	0.430
2.	Specific Gravity (g/cm^3)	1.327	0.99-1.69	1.110	1.420	1.300	1.162	1.250	5.84	0.049
3.	TSS Brix°	5.472	2.68-8.28	6.040	6.020	5.420	5.340	5.280	6.88	0.238
4.	Protein Content (%)	1.889	1.11-2.61	1.506	2.270	1.426	2.146	1.540	5.70	0.069
5.	Ascorbic Acid Content (mg/100g)	20.064	16.94-25.05	20.660	20.508	19.900	20.798	20.670	2.98	0.377
6.	Reducing Sugars (mg/100g)	174.148	120.08-261.88	192.800	137.800	193.800	193.400	183.600	1.49	1.641
7.	Chip Colour Score	5.396	2.40-7.36	2.600	2.400	6.600	6.600	3.600	8.88	0.310

Table 6: Mean, range and least significant difference for potato germplasm during pooled analysis

S. No.		General mean	Range	Checks					CV%
				K. Frysona	K. Chipsona-1	K. Bahar	K. Guarav	K. Ashoka	
1.	Tuber Dry Matter Content (%)	21.18	16.81-25.81	21.81	22.97	21.55	20.47	19.12	5.47
2.	Specific Gravity (g/cm^3)	1.30	1.01-1.77	1.23	1.41	1.36	1.13	1.17	9.99
3.	TSS Brix°	5.26	3.09-8.41	5.77	5.42	5.20	5.61	4.70	12.08
4.	Protein Content (%)	1.89	1.18-2.54	1.44	2.17	1.45	2.14	1.64	8.39
5.	Ascorbic Acid Content (mg/100g)	19.97	17.20-25.14	20.92	20.59	19.79	20.99	20.70	4.55
6.	Reducing Sugars (mg/100g)	173.97	117.02-252.02	189.60	132.70	175.90	189.40	181.00	4.42
7.	Chip Colour Score	5.44	2.50-7.16	3.00	2.50	6.20	6.60	3.50	10.29

Dry matter content varied with genotypes. Processing cultivar Kufri Chipsona-2 had highest dry matter content i.e. 25.242% followed by TPSK-05-06-86 (24.844%) and Kufri Chipsona-1 (24.280%). The range of variation for dry matter content was from 16.78-25.24 per cent with mean value of 20.722 per cent during 2012-13. Whereas, in 2013-14 it ranged from 16.849-26.387 per cent, with an average of 21.649 per cent. This could be due to the difference in crop maturity, which is known to have a strong influence on the dry matter content (Singh *et al*., 2003).

Least dry matter content was observed in C-1, TPSK-05-06-105, C-10 and P-11. Cultivars Kufri Chipsona-1 and Kufri Chipsona-2 developed for processing are reported to have higher dry matter content.

Among 50 genotypes specific gravity was found maximum in MS/95-1542 (1.868 g/cm^3) followed by AICRP-07-1 (1.778 g/cm^3) and Laddy Rossetta (1.740 g/cm^3) and minimum was found in Kufri Jawahar (1.028 g/cm^3), EM-2 (1.028 g/cm^3) and Kufri Arun (1.038 g/cm^3). In first year, specific gravity was found to vary from 1.028-1.868 g/cm^3. The mean value was calculated to be 1.291 g/cm^3. Second year, the range of variation for specific gravity was from 0.992-1.690 g/cm^3 with mean value of 1.327 g/cm3. Pooled performance revealed that the specific gravity of genotypes ranged from 1.01-1.77 g/cm3 with 1.30 g/cm3 as average value. These results are in concurrence to the findings of Dalakoti *et al*. (2003) evaluated 19 genotypes for their dry matter, total soluble solids and found that Kufri Chipsona-2 had highest dry matter (24.39%) succeeded by Kufri Chipsona-1 (23.20%), SM/92-168 (23.07%) and SM/91-1515 (21.98%). Kufri Chipsona-2 reflected maximum T.S.S. of 8.35^0 Brix followed by Kufri Chipsona-1 (8.20^0 Brix), SM/92-168 (7.26^0 Brix) and SM/91-1515 (7.00^0 Brix). Dry matter content is subjected to the influence of both the environment and genotypes (Miller *et al*., 1975; Tai and Coleman, 1999). Elfnesh *et al* (2011) studied the dray matter content and specific gravity of five improved cultivars of potato and concluded that dry matter content and specific gravity of tubers were significantly influenced by the interaction effect of growing environment and cultivars. Burton (1996) who reported that the dry matter content of early maturing cultivars is usually lower than that of the later maturing varieties. Variation in tuber dry matter content may be attributed to cultivars inherent difference in the production of total solids and he was also reported that genetic differences among varieties play a role in their ability to produce high solids when grown on the same test plot.

Data depicted in Table 1 clearly indicate that protein content was significantly influenced by different potato genotypes. Amongst 50 genotypes protein content was highest in genotype TPSK-05-06-61 (2.581%) but from statistical point of view this was not much different from TPSK-05-06-007 (2.469%) and Kufri Badsah (2.463%) and lowest was found in C-10 (1.149%) followed by EM-1 (1.201%) , EM-2 (1.219%) and MS/95-1542 (1.269%). Ascorbic acid content of 50 potato genotypes was also observed. Table -1 clearly shows that the potato genotypes were significantly different from each other with respect to ascorbic acid content. The highest amount (25.225 mg/100g of fresh weight) of ascorbic acid was recorded in genotype TPSK -05-06-44 and the lowest amount of ascorbic acid content (16.405 mg/100g of fresh weight) was found in genotypes EM-3. In 2012-13, the ascorbic acid content of genotypes ranged from 16.40-25.22 mg/100g with 19.88 mg/100g as a mean value. In 2013-14, the ascorbic acid content of fresh tuber varies from 16.94-25.05 mg/100g with an average value of 20.06 mg/100g. Pooled analysis calculated the ascorbic acid content from 17.20-25.14 mg/100g as mean value of 19.97 mg/100g. Ascorbic acid content of tubers have been studied and their high quality verified by several investigations (Kapoor *et al*., 1975). Significant variation for ascorbic acid and vitamin A in tuber among the potato genotypes have also been reported by Dalakoti *et al*. (2003).

Perusal of data in Table-2 also reveals that potato genotypes differed in their reducing sugar content. The reducing sugar content depending on the genotypes in present investigation, varied from 113.960 to 242.160 mg/100g fresh weight in potatoes. TPSK-05-06-117 and TPSK-05-06-85 showed higher reducing sugars content i.e. 242.160 mg/100gram fresh weight of potato tubers and 221.360 mg/100g fresh weight of potato tubers respectively. The pattern of reducing sugars level varied with the genotypes. Minimum reducing sugar was obtained in Kufri Surya (113.960 mg/100gram fresh weight of potato tubers) followed by C-1 (114.960 mg/100gram fresh weight of potato tubers). During 2012-13, the protein content of tuber ranged from 1.14-2.58 per cent with an average of 1.908 per cent. However, during 2013-14, the protein content of tuber was found to be 1.889 per cent which ranged from 1.11-2.61 per cent. Protein content of tuber was calculated in pooled analysis, and it was found that variation ranged from 1.18-2.54 per cent with average value of 1.89 per cent. These results are in concurrence to the findings of Elfnesh *et al* (2011). They studied the reducing sugar content of five improved potato cultivars (Chiro, Zemen, Bedassa, Gabissa and Harchassa) and found that the reducing sugar content varied from 0.036 to 0.051g /100 g of fresh weight. In present experiment, the range of variation for reducing sugar was from 113.96-242.16 mg/100g with mean value of 172.81 mg/100g during 2012-13 whereas, in 2013-14 it ranged from 120.08-261.88 mg/100g, with an average of 174.148 mg/100g. Pooled analysis of two year data showed that the dry matter content in tuber was varying from 117.02-252.02 mg/100g with 173.48 mg/100g as average value. Stevenson *et al* (1964) showed that the presence of low reducing sugar content makes the cultivars suitable for chips processing. This is in agreement with the findings of Moreira *et al* (1999) who reported that low reducing sugar content (below 0.25% and preferably below 0.10%) is desired for the production of potato chips. According to Cargill *et al.* 1986, Forbush 1989, Uppal and Verma 1990 the reducing sugar content of the potato is affected by several factors, including variety, growing conditions, maturity at harvest, post harvest handling stress and the storage environment.

A chip colour score above 4 is considered unacceptable. The chip colour was acceptable with a colour score of 4 and less in some of the genotypes. Table 2 clearly indicates that amongst 50 genotypes the chip colour score varies from 2.6 to 6.96. In present investigation the potato genotypes i.e. Kufri Chipsona-2, Kufri Jyoti, Kufri Chipsona-1, Kufri Frysona and Kufri Ashoka produced good quality chips (Table-2). In 2012-13, the chip colour score ranged from 2.36-7.36 with an average of 5.49. However, in 2013-14, the chip colour score ranged from 2.40-7.36 with an average of 5.39. The average chip colour score observed in pooled analysis was 5.44 and range of variation was recorded to be 2.50-7.16. Similar kind of experiment was conducted by Singh *et al* (2008) and reported that Kufri Chipsona-1 grown at Modipuram, Kufri Lauvkar at Gwalior, and Kufri Chipsona-1and Kufri Chipsona-2 at Patna produced good quality chips with a colour score of 2. Kufri Chipsona-1 and Kufri Chipsona-2 are known to produce acceptable chip colour.

CONCLUSION

Based on the findings of present investigation, it could be concluded that under the prevalent climatic cultivation conditions in plains, potato cultivation is most profitable enterprise but keeping in view of quality traits Kufri Chipsona 1 and Kufri Chipsona 2 having highest dry matter content and produced acceptable chips. On the other hand keeping in view of nutritional quality the new genotypes TPSK-05-06-61 and TPSK-05-06-007 having highest protein content and genotype TPSK -05-06-44 having highest ascorbic acid content and these genotypes are good for consumption.

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