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Physico-chemical characteristics of some strawberry (*Fragaria* x *ananassa* Duch.) genotypes

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Abstract
A study was conducted during 2013-14 to evaluate 20 strawberry (*Fragaria* x *ananassa* Duch.) genotypes under Lucknow region of Uttar Pradesh. Cultivar 'Winter Dawn' was registered for maximum fruit length (5.35 cm) followed by 'Camarosa' (5.32 cm), whereas; maximum fruit width was observed in 'Camarosa' (4.09 cm). 'Camarosa' was also registered for higher fresh fruit weight (29.71 g), fruit volume (29.60 ml) and dry fruit weight (2.56 g). The highest fruit yield per plant was produced by cultivar 'Sweet Charlie' (139.59 g). Fruit quality in terms of TSS (9.53 ^{0}Brix) and titratable acidity (0.82 %) was observed highest in cultivars 'Sweet Charlie' and IC 318916', respectively. Reducing sugars was higher in 'Addie' (3.63 %) whereas, maximum total sugars content were observed in 'Swiss' (4.55 %). Ascorbic acid (73.60 mg/100 g) was highest in 'IC 318916'.

Key words: Strawberry, *Fragaria* x *ananassa*, *Physico-chemical*

1. Introduction
Strawberry (*Fragaria* x *ananassa* Duch.) is a natural hybrid of two American species, *Fragaria chiloensis* and *Fragaria virginiana* which is a member of the Rosaceae family. This intermingling of genetic characteristics has resulted in a fruit of great variety in taste and color with a cropping ability and season of such versatility that it can be grown from the tropics to the cool temperate regions of the world [1]. Strawberries are also an excellent source of vitamin C, a good source of folate and potassium, and are relatively low in calories. Strawberries have also been credited with cancer-fighting compounds [2]. It is in high demand for table purpose as well as value added products like jam making, canning and ice cream preparations. So, it is very important to select appropriate genotypes of strawberry for production and value addition in a particular region. The production and consumption of strawberry is increasing day by day because of its nutritive value, remunerative prices and other significant importance. It is the most widely distributed fruit crop due to its genotypic diversity, highly heterozygous nature and broad range of environmental adaptations [3]. Therefore, studies were carried out at Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh to find out the variations in physico-chemical characters of fruits of 20 genotypes of strawberry under Lucknow conditions of Uttar Pradesh.

2. Materials and Methods
The experiment was carried out at Horticultural Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India during 2013-14. The experimental site received average rainfall between 0 to 47 mm during the cropping period with average minimum and maximum temperature ranged between 8 °C (December 2013 and January 2014) and 31 °C (October 2013 and March 2014) (Figure 1), respectively.
The soil was slightly saline with a pH of 7.5 and 1.5% of organic matter. Runners of twenty strawberry genotypes *viz*. Sweet Charlie, Winter Dawn, Camarosa, Chandler, Red Coat, Addie, Swiss, Jeolikote Local, Gorella, Jucunda, IC 318915, Sweet Heart, Mecharenj, Fern, Red Ground, Pusa Early Dwarf, IC 319153, CH III- 40, Belruby and IC 318916 were collected from National Bureau of Plant Genetic Resources Regional Station (NBPGR-RS), Nainital, Uttarakhand, India. The experiment was laid out under randomized block design and replicated thrice. The experimental area was prepared by ploughing 30 cm deep, disk harrowing and proper leveling. The runners were planted in open field condition at distance of 30 × 20 cm during last week of October, 2013, consisted of 90 plants in each treatment. Uniform cultural practices were adopted during the course of investigation. The fruits of Strawberry were harvested at commercial maturity at an interval of 3-4 days. Fruits of uniform size and colour were selected for physico-chemical analysis. Data were recorded on different attributes on fruit length (cm),

fruit diameter (cm), fresh fruit weight (g), fruit volume (ml), dry fruit weight (g), fruit yield per plant (g), total soluble solids (0Brix), titratable acidity(%), reducing sugar (%), total sugars (%) and ascorbic acid (vitamin c) (mg/100 g fruit). Fruit length and fruit diameter were recorded with the help of digital vernier caliper whereas, fresh fruit weight and fruit yield per plant were recorded with the help of analytical balance. For determination of dry fruit weight, the weighed fruit samples were kept in Petry plates and placed in hot air oven at 70±2°C temperature. The weight of the samples was recorded at regular intervals till it became constant. Total soluble solids (TSS) of the fruits were determined by the Erma hand refractrometer. Fruit volume, titratable acidity, reducing sugar, total sugars and ascorbic acid were computed as per the method suggested by Ranganna [4]. Statistical analysis of the data was carried out by the method of analysis of variance as outlined by Gomez and Gomez [5].

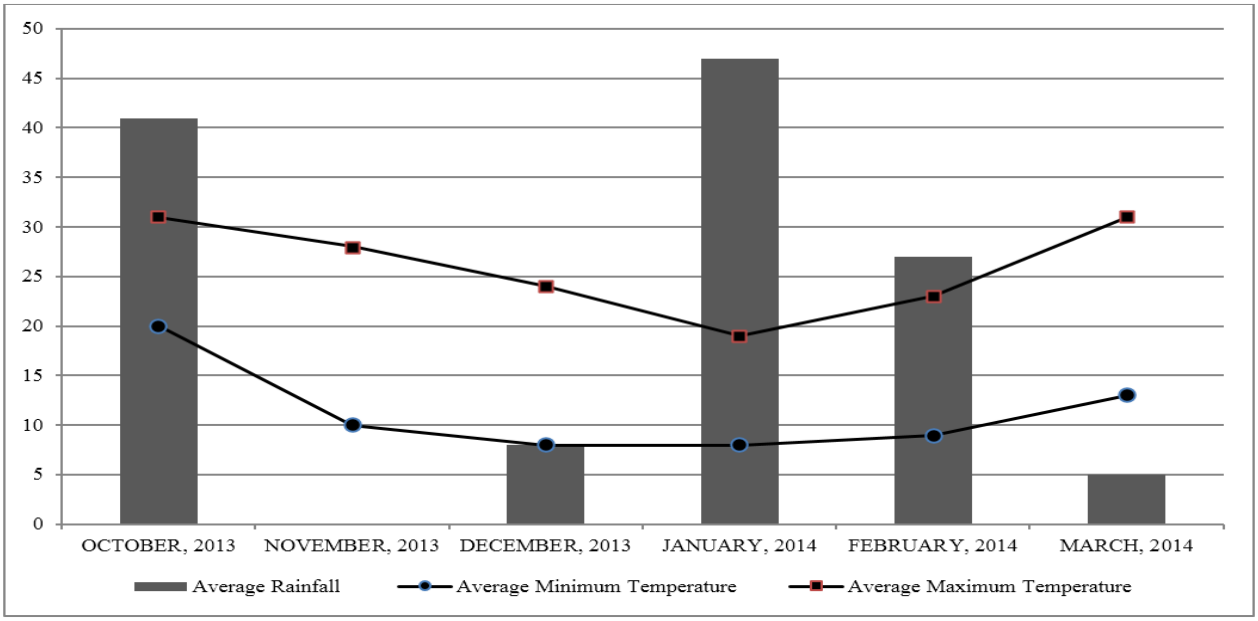

Table 1: Physico-chemiccal characteristics of fruits of strawberry (*Fragaria x ananssa* Duch.) genotypes.

Genotypes	Fruit length (cm)	Fruit width (cm)	Fresh Fruit weight (g)	Fruit volume (ml)	Dry fruit weight (g)	Yield per plant (g)	TSS (^{0}Brix)	Titratable acidity (%)	Reducing sugar (%)	Total sugars (%)	Ascorbic acid (mg/100 g)
Sweet Charlie	5.31	4.00	25.57	25.50	2.40	139.59	9.45	0.73	3.56	4.46	65.87
Winter Dawn	5.35	4.08	27.92	27.77	2.44	138.62	9.37	0.74	3.52	4.45	67.47
Camarosa	5.32	4.09	29.71	29.60	2.56	136.49	9.43	0.73	3.55	4.45	67.60
Chandler	4.35	3.08	16.57	16.50	1.36	121.76	8.55	0.73	3.59	4.49	64.13
Red Coat	4.16	2.97	14.80	14.77	1.05	127.65	8.41	0.73	3.58	4.49	66.13
Addie	4.20	2.92	16.69	16.67	1.45	123.48	8.65	0.73	3.63	4.48	63.73
Swiss	4.20	2.95	20.98	20.97	1.70	123.12	7.92	0.71	3.56	4.55	66.27
Jeolikote Local	4.04	2.81	14.35	14.33	1.14	124.48	7.37	0.72	3.54	4.48	68.93
Gorella	4.19	2.82	17.57	17.57	1.25	121.49	8.29	0.74	3.59	4.51	64.27
Jucunda	4.42	3.17	14.63	14.70	1.08	122.17	8.24	0.74	3.54	4.53	65.87
IC 318915	3.38	2.03	4.00	3.83	0.39	23.27	6.48	0.80	3.29	4.20	72.00
Sweet Heart	4.21	3.05	16.75	16.77	1.36	119.19	7.89	0.73	3.55	4.49	65.73
Mecharanj	4.33	3.04	15.75	15.73	1.22	119.98	7.94	0.72	3.55	4.49	67.73
Fern	4.41	3.11	15.17	15.17	1.08	123.55	7.85	0.70	3.59	4.47	62.67
Red Ground	4.31	3.04	17.54	17.47	1.18	122.27	8.13	0.71	3.56	4.47	65.20
Pusa Early Dwarf	4.13	2.86	12.15	12.10	0.99	112.90	8.67	0.74	3.58	4.46	66.00
IC 319153	3.39	2.08	4.31	4.33	0.38	24.61	6.58	0.81	3.27	4.20	72.27
CH III 40	4.41	3.14	17.66	17.63	1.30	125.48	8.07	0.70	3.57	4.50	66.27
Belruby	4.26	2.99	16.52	16.60	1.32	114.92	7.80	0.71	3.53	4.49	66.27
IC 318916	3.42	2.18	3.66	3.57	0.30	26.10	6.56	0.82	3.24	4.19	73.60
CD (P=0.05)	0.167	0.015	4.636	4.661	0.505	7.750	0.346	0.199	0.072	0.067	2.495

3. Results and Discussion

There was significant difference observed among different strawberry genotypes with respect to fruit length, fruit width, fresh fruit weight, fruit volume, dry fruit weight and fruit yield per plant (Table 1). Maximum fruit length was observed in 'Winter Dawn' (5.35 cm) followed by 'Camarosa' (5.32 cm) and 'Sweet Charlie' (5.31 cm) whereas, minimum fruit length was found in 'IC 318915' (3.38 cm). Maximum fruits width was recorded in Camarosa' (4.09 cm) followed by 'Winter Dawn' (4.08 cm) and 'Sweet Charlie' (4.00 cm). 'IC 318915' also registered for minimum fruit width (2.03 cm). Lal and Rao [6] also reported sufficient variations in fruit size while testing 17 strawberry genotypes under Garhwal region of Uttarakhand. The variations in fruit size are mainly due to plant vigour, competition among fruits in the inflorescence, number of developed achenes, size of developed achenes, differences in activity among the achenes in the production of growth material, climatic conditions, irrigation and plant nutrients. Fresh fruit weight varied from 3.66 g in IC 319916 to 29.71 g in 'Camarosa'. 'Camarosa' produced heavier fruits among all tested cultivars followed by 'Winter Dawn' (27.92 g) and 'Sweet Charlie' (25.57 g). Similarly, highest fruit volume (29.60 ml) and dry fruit weight (2.56 g) was also recorded in 'Camarosa'. These variations in fresh fruit weight might be due to the genetic makeup of the cultivars [7] and adaptation to climatic conditions [8]. Maximum yield per plant was recorded in 'Sweet Charlie' (139.59 g) followed by 'Winter Dawn' (138.62 g) and 'Camarosa' (136.49 g) whereas, minimum was recorded for 'IC 318915' (23.27 g) (Table 1). These variations in the yielding potential might be due to the fact that strawberry yields are markedly influenced by environmental parameters like photoperiod, temperature and light intensities [9].

Fruits had also showed significant variation among qualitative characters (Table 1). TSS was recorded between 6.48- 9.45 ^{0}B with highest in 'Sweet Charlie' (9.45 ^{0}B) followed by 'Camarosa' (9.43 ^{0}B) and lowest in 'IC 318915' (6.48 ^{0}B). The difference in TSS occurs due to different cultivars, cultivation system and climatic conditions [10]. Various workers also reported total soluble solids content from 5.2 to 11.6 ^{0}B in different cultivars [11, 12]. Highest titratable acidity was recorded in 'IC 318916' (0.82 %) followed by 'IC 319153' (0.81 %) and lowest was registered in 'Fern' (0.70 %) and CH III 40 (0.70 %) which were at par with each other. The lower acidity might be due to the narrow difference in the day and night temperature during the cropping period, as the cooler nights and warmer day are helpful in synthesizing more acidity [13]. Highest reducing sugar was observed in 'Addie' (3.63 %) followed by 'Chandler' (3.59 %), 'Gorella' (3.59 %) and 'Fern' (3.59 %). These cultivars are statistically at par with each others in terms of reducing sugar. Total sugars content ranged from 4.19 to 4.55 %. Genotype 'Swiss' (4.55 %) showed significantly higher levels of total sugars than all other genotypes, whereas, lowest total sugars were observed in 'IC 318916' (4.19%). The variations in titratable acidity and sugar contents in different strawberry genotypes were also reported earlier by other workers [14, 6]. Ascorbic acid varied from 62.67 mg per 100 g of fresh mass in genotype 'Fern' to 73.60 mg per 100 g of fresh mass in 'IC 318916'. Variations in ascorbic acid content in different strawberry cultivars also reported earlier [15].

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