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Growth, Yield and Quality of Different Processing Cultivars of Potato (*Solanum tuberosum* L.)

Rajvir Kaur* and D. S. Khurana

Department of Vegetable Science, Punjab Agricultural University, Ludhiana – 141004, India

*Corresponding Author E-mail: rajvir.rozy@gmail.com

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ABSTRACT

The study entitled "Growth, yield and quality of different processing cultivars of potato (Solanum tuberosum L.)" was carried out in the department of Vegetable Science, Punjab Agricultural University, Ludhiana during 2012-14. Different cultivars of potato namely Kufri Pukhraj, Lady Rosetta, Fritolay-1533, Atlantic, Kufri Chipsona-1, Kufri Chipsona-3, Kufri Badshah, Kufri Lauvkar, Kufri Jyoti and Kufri Chandramukhi comprised the plant material. The tubers were analysed for dry matter, starch content, total sugar and reducing sugar at the time of harvest. Present investigation revealed that Kufri Badshah had the luxuriant foliage bearing higher number of leaves, branches, number of tubers and excelled in total tuber yield. Among the various cultivars, Atlantic had maximum dry matter content followed by cultivar Lady Rosetta. The highest starch content was estimated in cultivar Kufri Chipsona-1. This cultivar was also low in total sugars and reducing sugars making it suitable for processing. Among rest of the cultivars studied the cultivars Atlantic, Lady Rosetta and Kufri Chipsona-3 were also considered cultivars for processing.

Key words: *Potato, Yield, Starch Content, Total Sugar, Reducing Sugar.*

INTRODUCTION

Among the various vegetable crops, potato (*Solanum tuberosum* L.) has emerged as a highly profitable crop due to its high yield, starch producing plant and its high demand by the processing companies. It is one of the important vegetable crops grown in North India which is consumed on large scale due to its high nutritive value and widely used in culinary purposes. It is next only to rice, wheat and maize. Next to cereals, potato is the only crop which could supplement the need of the food of the country (Das, 2000). Potato is an economical food and it provides a source of low cost energy to the human diet. It contains about 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% crude fiber and 0.95% ash. It also contains a good amount of essential amino acids like leucine, tryptophan and isoleucine. Being rich in various nutrients, good taste and easy to cook, potato has become popular vegetable in the world with a profitable production potential. Potato being a low calorie food (97 Kcal/g) is a rich source of minerals like potassium, calcium, iron and phosphorus.

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It has high contents of vitamins C, niacin and $B_{6.}$ Besides, potato is largely processed among the various vegetable crops. No other crop can match potato in its production of food energy and food value per unit area[12]. Potato contains about 80% water and thus, is semi-perishable in nature. The high water content makes handling and storage difficult. The good quality of the tuber is greatly influenced by the cultural practices. Though it is an important vegetable crop, yet little attention has been paid to study the processing behaviour of the cultivars. A large number of cultivars have been released by the Central Potato Research Institute and other Institute.

Although, from a grower's point of view, a variety must possess high yield, disease resistance, early maturity to fit in the growing season and have good keeping quality. But for a processor, it must meet the specifications of acceptable qualities of low reducing sugars, high dry matter, proper shape and size for minimum peeling losses, free from mechanical injury and physiological disorders and the finished product should have good texture and flavour (Khurana *et al.,* 2003). The present investigation was thus conducted in different cultivars of potato with a view to study the yielding ability and processing quality.

MATERIAL AND METHODS

The study was carried out at the Vegetable Teaching Farm and Biochemical Laboratory of the Department of Vegetable Science, Punjab Agricultural University, Ludhiana during 2012-14. The crop was planted manually in the first week of October in 2012-13 and 2013-14. The experimental material comprised (*Solanum tuberosum* L.) ten cultivars of potato viz. Kufri Chandramukhi, Kufri Jyoti, Kufri Badshah, Kufri Lauvkar, Kufri Pukhraj, Kufri Chipsona-1, Fritolay-1533, Lady Rosetta, Atlantic and Kufri Chipsona-3. The sources of the various cultivar studied are shown in Table 1. The experiment was conducted in randomized complete block design replicated thrice. The seed tubers were treated with Emisan @ 2.5g per litre of water for 30 minutes. The sowing was done on ridges maintaining a distance 60 cm apart in rows with plant to plant spacing of 20 cm. There were thirty plots and the net plot size was of 4 m × 3 m = $12m^2$. The field was irrigated immediately after planting. Well decomposed farmyard manure @ 50 tonnes per hectare was applied at the time of soil preparation. Recommended dose of fertilizer is 187.5kg of N (412.5 kg of urea), 62.5kg of P_2O_5 (387.5 kg of single superphosphate) and 62.5kg of K_2O (100 kg of muriate of potash) per hectare was applied to the crop. Half dose of nitrogen along with full dose of phosphorus and potassium was applied at the time of sowing while rest of the nitrogen was applied at the time of earthing-up one month after planting. Later on timely irrigations, normal cultural operations and plant protection measures were used to ensure healthy crop. The haulms of the crop were removed with sickle in end January and left in the soil itself for 15 days. The tubers were lifted in mid February. Observations were recorded on plant height , number of leaves per plant, number of branches per plant, number of tubers per plant and total tuber yield (q/ha). For quality analysis, observations were recorded on dry matter, total sugars, reducing sugars and starch content of different cultivars of potato. The starch was estimated as per method of Clegg[3]. The estmations for total sugars from potato tubers was done as per standard procedure suggested by Dubois *et al.*[5] and reducing sugars was done by following the widely used method as given by Nelson[10]. The data were subjected to statistical analysis by the "Analysis of Variance" technique[13].

RESULTS AND DISCUSSION

Growth and Yield Contributing Parameters

It is evident from the data given in Table 2 that plants of Kufri Badshah gained maximum height of 67.40 cm and 66.33 cm respectively during 2013 and 2014. It was followed by cultivars Kufri Chipsona-3 and Lady Rosetta while the plant height was the lowest in cultivar Atlantic. It was further revealed that Kufri Badshah and Kufri Chipsona-3 being

taller in length also bore maximum number of leaves numbering 47.64 and 45.14 leaves, however latter did not record significant difference with cultivar Fritolay-1533 bearing 45.77 leaves per plant. During both the years maximum branches were borne by the cultivar Kufri Badshah where on the average of two years, it had 6.53 branches per plant followed by Kufri Chipsona-3, Kufri Jyoti and Kufri Lauvkar, respectively while minimum branches were borne by Kufri Chipsona-1 (Table 2).

It was noticed that during the year 2013 maximum tubers were borne by the cultivar Kufri Badshah (Table 3). It bore a total number of 12.07 tubers. Likewise during 2014 each plant bore 11.86 tubers. Among rest of the cultivars it was seen that during both the year Lady Rosetta, Kufri Jyoti and Kufri Lauvkar being statistically at par among themselves followed by the cultivar Kufri Badshah. The higher number of tubers by these cultivars is due to the reason that the plants were more vigorous in terms of height and foliage which synthesized more food ultimately leading to higher number of tubers. It was further noticed that during both the years cultivar Kufri Badshah bore more number of A and B grade tubers as compared to C grade tubers. Maximum A grade tubers were borne by Kufri Badshah where it numbered 3.10 and 2.92 during 2013 and 2014, respectively while B grade tubers were again maximum in Kufri Badshah where it numbered 5.77 and 5.63 during 2013 and 2014. Higher number of A and B grade tubers in Kufri Badshah was depicted in terms of higher yield of this cultivar (Table 3).

The highest tuber yield of potato was recorded in cultivar Kufri Badshah during both the years of investigation. On the basis of average of two years, it recorded a yield potential of 391.50q/ha which was followed by Kufri Pukhraj which recorded average total yield of 354.50q/ha (Table 3). The cultivars Kufri Chandramukhi, Atlantic and Kufri Chipsona-3 recorded the lower yield during both the years with average yield of 232.83, 247.67 and 249.67q/ha, respectively. As per recommendations of Punjab Agricultural University with the cultivar Kufri Badshah has been reported to be high yielding one as compare to Kufri Chandramukhi[2]. The variation is attributed to the genetic variation existing among the genotypes.

Quality Parameters

Among the different cultivars, the cultivar Atlantic had the highest dry matter during both the year with dry matter of 24.27g and 24.36g per 100 gram of fresh weight (Table 4). The higher dry matter content in Atlantic, Lady Rosetta, Kufri Chipsona-3 and Kufri Chandramukhi is because of these cultivars suitable for processing recorded high dry matter as compare to Kufri Pukhraj, being early bulking cultivar witnessed low dry matter content. In a previous study conducted by Marwaha and his associates in 2009, it was revealed that among five cultivars were Atlantic, Fritolay-1533 and Kufri Chipsona-1 recorded a higher dry matter content of 22.6, 22.1 and 22.1 per cent, respectively being statistically at par among themselves. While Kufri Jyoti had the lowest dry matter content of 17.2 per cent. They were of the opinion that possessing high in dry matter content the cultivar Atlantic, Fritolay-1533 and Kufri Chipsona-1 may be considered suitable for processing.

It was revealed from the data that cultivar Kufri Chipsona-1 contained maximum starch content where it contained the starch content of 74.37% and 74.44% during 2013 and 2014, respectively. It was followed by the cultivars Kufri Chandramukhi, Lady Rosetta, Atlantic and Kufri Chipsona-3. The cultivars which have high starch content can be used for processing purposes. The lowest starch content was estimated in cultivar Kufri Jyoti with average starch content of 51.62% on dry weight basis. These results are in line with Kaur and Aggarwal (2014) who estimated higher starch content of 18.50 % in cultivar Kufri Chipsona-1 and 18.10% in Kufri Chandramukhi, and both of them were statistically at par with each other. The difference in starch content might be due to difference in dry matter content among various cultivars as starch and dry matter content of

potato are directly related to each other. In a study conducted on two cultivars namely Kufri Chandramukhi and Kufri Sindhuri. Kufri Chandramukhi contained more starch than Kufri Sindhuri thus considered suitable for processing[7].

The highest total sugar content was recorded in cultivar Kufri Pukhraj which had 3.29 g per 100 gram dry weight on average of both years (Table 4). It was followed by cultivars Kufri Badshah, Kufri Jyoti and Kufri Chandramukhi. Sugar content of potato tuber is a heritable character and may be influenced by cultivar, maturity, production site and storage conditions[1]. Minimum content of total sugars was estimated in cultivar Kufri Chipsona-1 followed by Atlantic and Lady Rosetta which contained 0.56g, 0.63g and 0.82g per100 gram of total sugar on average of both the years. A study was conducted by Kaur and Aggarwal in 2014 on total sugar content of the potato who also reported the similar results. They reported maximum total sugars in Kufri Pukhraj (0.77% fresh weight basis) followed by Kufri Badshah (0.46% fresh weight basis) and minimum in Kufri Chipsona-1 and Atlantic (0.12% fresh weight basis).

During both the years (Table 4) maximum reducing sugars was reported in cultivars Kufri Jyoti followed by Kufri Lauvkar which contained 0.87g and 0.84g/100 gram of reducing sugar on average of both years. These cultivars were at par with each other. The cultivar Kufri Chipsona-1 had minimum reducing sugar content and followed by Kufri chipsona-3 and Lady Rosetta which contained 0.09g, 0.11g and 0.13g/100 gram of reducing sugar, respectively on the average of both the years. These cultivars were statistically at par among themselves. In a previous study conducted by Pandey *et al.*, maximum reducing sugars were in Kufri Jyoti (168.0 mg/100 gram fresh weight), among the five cultivars (Kufri Chipsona-1, Kufri Chipsona-2, Kufri Jyoti, Atlantic and Fritolay-1533) of potato, which are similar to current research[11].

Table 1: Source of planting material studied during 2012-14

Sr. No.	Cultivars	Sources
1	Kufri Pukhraj	Central Potato Reseach Institute, Shimla
2	Fritolay-1533	Pepsi Foods Pvt. Ltd. Channo, Sangrur
3	Lady Rosetta	Pepsi Foods Pvt. Ltd. Channo, Sangrur
4	Kufri Chipsona-1	Central Potato Reseach Institute, Shimla
5	Kufri Chipsona-3	Central Potato Reseach Institute, Shimla
6	Atlantic	Pepsi Foods Pvt. Ltd. Channo, Sangrur
7	Kufri Jyoti	Central Potato Reseach Institute, Shimla
8	Kufri Badshah	Central Potato Reseach Institute, Shimla
9	Kufri Lauvkar	Central Potato Reseach Institute, Shimla
10	Kufri Chandramukhi	Central Potato Reseach Institute, Shimla

Table 2: Height of plants, number of leaves per plant and number of branches per plant in different cultivars of potato during 2012-13 and 2013-14

Sr. No.	Cultivars	Plant Height (cm)		Mean	No. of leaves/plant		Mean	No. of branches/plant		Mean
		2013	2014		2013	2014		2013	2014	
1	Kufri Pukhraj	51.07	53.43	52.25	34.50	35.22	34.86	4.73	4.67	4.70
2	Fritolay-1533	55.27	52.67	53.97	46.71	44.83	45.77	3.93	5.00	4.47
3	Lady Rosetta	55.87	58.33	57.10	43.44	43.94	43.69	4.33	5.33	4.83
4	Kufri Chipsona-1	49.67	51.00	50.33	34.73	35.29	35.01	3.93	3.33	3.63
5	Kufri Chipsona-3	56.07	62.00	59.03	45.84	44.44	45.14	5.87	6.00	5.93
6	Atlantic	45.53	45.00	45.27	33.48	32.90	33.19	4.47	4.67	4.57
7	Kufri Jyoti	49.80	48.67	49.23	37.99	37.53	37.76	5.73	6.00	5.87
8	Kufri Badshah	67.40	66.33	66.87	48.40	46.88	47.64	6.73	6.33	6.53
9	Kufri Lauvkar	48.73	50.33	49.53	35.96	34.69	35.33	5.27	6.33	5.80
10	Kufri Chandramukhi	47.40	44.33	45.87	39.84	37.15	38.50	4.73	5.00	4.87
L.S.D. (P=0.05)		9.66	12.74	10.92	2.79	2.69	2.65	NS	NS	2.50

Table 3: Number of tubers per plant and total tuber yield in different cultivars of potato during 2012-13 and 2013-14

Sr. No.	Cultivars	No. of tubers/plant (2013)			Total no. of tubers	No. of tubers/plant (2014)			Total no. of tubers	Total Tuber Yield (q/ha)		Mean
		A grade	B grade	C grade		A grade	B grade	C grade		2013	2014	
1	Kufri Pukhraj	2.33	4.67	3.27	10.27	2.41	4.56	3.41	10.38	347.00	362.00	354.50
2	Fritolay-1533	1.67	3.46	2.30	7.42	1.73	3.51	2.24	7.47	255.67	262.33	259.00
3	Lady Rosetta	2.30	4.62	4.96	11.88	2.72	4.57	4.54	11.83	273.33	284.33	278.83
4	Kufri Chipsona-1	2.70	3.43	3.20	9.34	2.57	3.39	3.26	9.22	278.67	287.33	283.00
5	Kufri Chipsona-3	2.67	4.87	3.13	10.68	2.50	4.75	3.26	10.50	250.67	248.67	249.67
6	Atlantic	1.96	3.85	3.69	9.51	2.09	3.54	3.56	9.19	246.67	248.67	247.67
7	Kufri Jyoti	2.40	5.03	4.14	11.56	2.38	5.28	4.18	11.84	305.33	313.33	309.33
8	Kufri Badshah	3.10	5.77	3.20	12.07	2.92	5.63	3.32	11.86	391.67	391.33	391.50
9	Kufri Lauvkar	2.60	4.83	4.30	11.73	2.19	4.67	3.92	10.78	272.00	275.67	273.83
10	Kufri Chandramukhi	2.22	4.83	3.68	10.73	2.13	4.80	3.43	10.36	227.33	238.33	232.83
L.S.D. (P=0.05)		0.11	0.05	0.09	0.15	0.10	0.07	0.12	0.16	3.66	10.66	7.70

Table 4: Dry matter content, starch content, total sugars and reducing sugars after harvesting in different cultivars of potato during 2012-13 and 2013-14

Sr. No.	Cultivars	Dry Matter (g/100g)			Starch Content (%)			Total Sugars (g/100g)			Reducing Sugars (g/100g)		
		2013	2014	Mean	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
1	Kufri Pukhraj	16.21	17.24	16.72	58.30	59.68	58.99	3.17	3.41	3.29	0.68	0.66	0.67
2	Fritolay-1533	21.33	22.18	21.75	55.40	54.80	55.10	1.59	1.80	1.70	0.13	0.13	0.13
3	Lady Rosetta	23.67	23.72	23.69	64.29	65.07	64.68	0.85	0.79	0.82	0.27	0.24	0.25
4	Kufri Chipsona-1	21.58	21.55	21.56	74.37	74.44	74.41	0.55	0.57	0.56	0.09	0.09	0.09
5	Kufri Chipsona-3	22.30	22.66	22.48	61.27	61.73	61.50	1.27	1.28	1.27	0.11	0.11	0.11
6	Atlantic	24.27	24.36	24.32	63.68	62.56	63.12	0.62	0.64	0.63	0.35	0.34	0.35
7	Kufri Jyoti	17.57	17.37	17.47	51.23	52.02	51.62	1.96	2.01	1.98	0.88	0.87	0.87
8	Kufri Badshah	18.30	18.45	18.38	53.06	52.23	52.64	2.27	2.44	2.36	0.67	0.65	0.66
9	Kufri Lauvkar	20.79	20.38	20.58	56.53	54.79	55.66	1.45	1.59	1.52	0.84	0.85	0.84
10	Kufri Chandramukhi	22.17	22.54	22.35	72.86	72.37	72.61	1.95	1.99	1.97	0.68	0.69	0.69
L.S.D. (P=0.05)		0.18	0.86	0.60	0.22	2.27	1.56	0.12	0.30	0.22	0.01	0.01	0.01

CONCLUSION

The present study thus concludes that cultivars Kufri Chipsona-1, Kufri Chipsona-3, Atlantic and Lady Rosetta being low in reducing and total sugars are the most suitable cultivars for processing.

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