International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)
'A Bridge Between Laboratory and Reader'

www.ijbpas.com

ASSESSMENT OF FIFTEEN SELECTED POTATO (*SOLANUM TUBEROSUM* L.) GENOTYPES ON THE BASIS OF BIOCHEMICAL CHARACTERISTICS

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ABSTRACT

The present study was conducted to assess the industrial quality of fifteen promising genotypes of potato during the year 2014 at Plant Genetic Resources Institute, National Agricultural Research Centre, Islamabad Pakistan. Seed of fifteen potato genotypes namely 17-19, Potato-II, 393574-72, Kuroda, 51-60, 2002-1, Sarpomira, NARC-Potato-III, 394012-96, Cardinal, Romeo, Desiree, Zia-I, Zia-II and Zia-III was used as planting material in this research work.

The experiment was laid out in a Randomized Complete Block Design. Biochemical quality assessment test was used to determine specific gravity and dry matter contents of these potato

genotypes by employing Potato Hydrometer. The highest level of specific gravity (1.091) and dry matter contents (22.5%) were recorded in Romeo followed by Cardinal that produced 1.082 specific gravity and 20.6% dry matter contents. Zia-III is the lowest (1.06, 16.1%) specific gravity and dry matter contents, respectively. This screening study would have significant importance in the continuing struggle for the selection of the most excellent genotype of potato for emerging Chips Industries of Pakistan.

Key Words: Alcohol, Dry matter, Industrial traits, Romeo, Specific gravity

INTRODUCTION

Potato is considered as one of the most important vegetable crops in family Solanaceae. Globally, it is grown on large area and is known as a king of vegetable (Mustafa 1997).Potato has been consumed as a staple food by its native people of South America for about eight thousand years (Pavlista et al. 1997). Then it spread throughout South America continent and became an economical and sufficient food source for the supports of industrial revolution. The annual production of potato estimated to 307.8 million tones and it became a significant part of daily food consumption all over the world. It provides sufficient energy to its consumers as it possesses high quality protein, vitamins and also minerals (Mehdi et al. 2008).

The world leading countries of potato production are China (20%) USSR (12%), India (8%) and USA (8%) (Lin et al. 2001). It is accumulated to large quantities in European countries and is highly consumed in Asian countries (Brown, 2005). It is an annual crop and requires cool season for efficient growth of tubers. The optimum temperature range is 16 ℃ - 20 ℃ throughout its growing season (Mathur, 2003). In Pakistan, potato is the 4th food crop after wheat, rice and maize with respect to production. It is utilized worldwide for both human and animals due to its multipurpose usage and also acts as a raw material for the production of starch and alcohol (Hassanpanah et al. 2006).

It is important to know the needs of the consumers and to recognize the cultivars that possess traits to fill the gaps between changing market and production conditions (Connor *et al.,* 2001). Tuber quality of potato is a key characteristic that fulfills the needs of industries with regard to dry matter contents, specific gravity, tuber shape and starch (FAO, 2008). Keeping in view the industrial needs of potato, the present study was carried out to

screen out the best potato genotype possessing the highest values of specific gravity, dry matter contents and the best tuber characteristics.

MATERIALS AND METHODS

In order to evaluate the promising genotypes of potato for industrial quality, the research work was conducted at Plant Genetic Resources Institute and field of Potato Program, Horticultural Research Institute, NARC Islamabad-Pakistan during the year 2014. Seed of fifteen potato genotypes was obtained from different sources (Table 1) and used as planting material for the selection of desirable characteristics in this research work. Planting was carried out by following Randomized Complete Block Design in 15 m^2 plots with 3 replications keeping plant to plant distance of 15 cm and row to row distance of 75 cm. Seed bed preparation was done by applying fertilizer at the rate of 125 -125 - 125 NPK kg/hectare. The second dose of N (125 kg/hectare) was applied in two splits and applied at first and second earthening up. The regular visits of the crop were done throughout the growing season. Evaluation considerations of quality traits were ready after harvesting the crop. Data were recorded for processing

quality such as specific gravity, dry matter contents and tuber shape.

Processing Aspects

Specific gravity and dry matter contents

The data were recorded by Potato Hydrometer developed by SFA (Snack Food Association, Virginia) as per standard procedure. Comparing the specific gravity to chart, dry matter percentage was calculated.

Tuber Characteristics

Tuber shape

Tuber shape was scored as oval, round, oblong and long by visual observation following a key devised by Wooster and Farooq (1995).

Tuber eye depth

The tuber eye depth was visualized as described by Wooster and Farooq (1995).

1 = Very deep 2 = Very deep to deep 3 = Deep   4 = Deep to medium
5 = Medium   6 = Medium to shallow 7 = Shallow 8 = Shallow to very shallow
9 = Very shallow

Flesh color

The 12 tubers from each plot were cut into 2 parts and flesh color was assessed as mentioned by Wooster and Farooq (1995).

1 = White 2 = Cream 3 = Yellow

Calibration of Potato Hydrometer

A steal rod of 10 ½" long and ½" in diameter was placed in the hydrometer basket of 8 pound; basket along with rod was attached to hydrometer bulb and placed into the container of the water. The hydrometer was adjusted on

1.07. After calibration, specific gravity was calculated by placing 3630 grams of potato in the hydrometer basket and dipping that sample into the water tank. Then specific gravity was noted as the hydrometer comes to rest floating.

Statistical analysis

The experiment was laid out according to Randomized Complete Block Design (RCBD) and the statistical analysis was done by subjecting the replication-wise data of each parameter to Analysis of Variance (ANOVA) in Statistix 8.1.

RESULTS AND DISCUSSION

The massive scope for fast development of processing industry is due to improved demand of fast foods in Pakistan. The excellence of processed foodstuffs based on tubers is mainly subjected by quality characters like dry matter, specific gravity and tuber shape. Appropriateness of these parameters is indispensable for evaluation of potato genotypes for processing industries that are being discussed in the present research study. The material evaluated in this experiment was of fifteen potato genotypes. These genotypes were examined for the benefits of chips making potato industries.

Biochemical characterization

Specific gravity

The specific gravity of fifteen potato genotypes was determined and the data are presented in Table 2; Figure 1 & 2. The specific gravity of fifteen potato genotypes showed significant difference (t=667.92, P=0.000) but most of the genotypes showed similarity in value of this parameter. However, higher specific gravity (1.091) was observed in case of potato genotype 'Romeo". Our findings were consistent with the findings of Hafiz et al. (2011) in which the highest specific gravity (1.091) was recorded in genotype NARC 1-2006/3. (Amoros et al. 2000) calculated six clones of potato and reported that specific gravity ranged between 1.121 and 1.141. Our findings were also in concurrence with those of (Hassanpanah et al. 2006) who conducted a research study on twenty potato cultivars and calculated tuber yield, specific gravity, sugar contents and flesh color and ascertained that tuber yield was positively correlated with specific gravity and also dry matter percentage but no significant correlated were noticed with sugar contents. During our study 'Cardinal' ranked second with specific gravity of 1.082, while the lowest specific gravity (1.060) was recorded in case of genotype Zia-III. A petty relationship between dry matter and specific gravity was also found in earlier report (Rastovski et al. 1981). Conclusively, a tuber

with high specific gravity is favorable for processing of potato (Adams, 2004).

Dry matter percentage (%)

The potato tuber dry matter percentage was evaluated during screening of fifteen genotypes and results are presented in Table 3; Figure 1 & 2. Relatively higher dry matter percentage (22.50%) was recorded in potato genotype 'Romeo' the same study was conducted by La Molina Amoros (2000) who concluded that the highest values of dry matter contents (24–26%) were obtained in Romeo followed by Cardinal (20.60%). The overall analysis suggested significant difference in the dry matter percentage among genotypes (t=58.73, P=0.000). The trend of results for dry matter showed similarity to those recorded for the horticultural traits of these genotypes. Martinez and Ligarreto (2005) evaluated five promising potato genotypes on the basis of qualitative and quantitative characteristics and pointed out that genotypes were selected on the basis of tuber weight and dry matter contents. During our study, the lowest dry matter percentage (16.10%) was obtained in genotype Zia-III. Almost similar dry matter contents were noticed for remaining genotypes screened in this study. However, for chips, French fries and dried out

products, tuber dry matter contents must be more than 20% (Ezekiel et al., 1999). (Geremew et al.2007) conducted a research study on screening of potato cultivars and reported that dry matter yield varied markedly among potato cultivars and dry matter contents and specific gravity had very high connections. Early planting increase dry matter contents than that of late planting. Loamy soils produce improved dry matter levels than that of light r or heavy textured soils due to strong interactions between moisture contents and temperature (Bord Bia. 2010). Phosphorus seems to have normal effect on dry matter production. In order to accomplish good dry matter contents for potato, harvesting should be more than 90 days (Bord Bia. 2010). In an excellent environment of store room, dry matter levels will remain quite constant. Globally, Irish potato have high dry matter contents which means that they are more "floury" potato as compared to varieties common in other countries of the world (Bord Bia. 2010). But the present research study demonstrated that the commercial variety Romeo in Pakistan also have high dry matter contents as compared to other local or commercial varieties. Potato having high dry matter contents is an ideal source of energy and carbohydrates. It will be suggested that the commercial variety 'Romeo' have good source

of income for farmers and also for potato processing industries in Pakistan.

Tuber Characteristics

Tuber characteristics also called quality characteristics are important factors for processing as well as marketing purposes. The selected genotypes showed variation in these evaluation parameters (Table 4). The most important tuber characteristics include tuber shape, eye depth and flesh color. The genotypes Romeo, Cardinal and 17-19 produced oval shape of their tubers. For chips industry, oval shaped tubers are preferred. Tuber shapes are controlled by genetic make-up and environment (Abbas et al. 2012). During this study only Romeo produced deep eye, while all other genotypes gave shallow tuber eyes. The deep eye tuber is liked by consumers. The attribute of eye depth is mainly controlled by specific genes Kabira and Lemaga (2006). During our study, all the genotypes showed variable flesh color of tubers, while Romeo produced pale yellow flesh color of

tuber. Likewise, specific genes control flesh color of tubers (Anwar 1982).

CONCLUSION

Our study showed that the genotype 'Romeo' produced the highest specific gravity and dry matter percentage as compared to other fourteen potato genotypes and hence it would be useful for potato processing industries. The dry matter content is important for chips making industries in all over the world. On the basis of present findings, it would be suggested that for achieving high potato yield, "Romeo" might be preferably be cultivated due to its high specific gravity and dry matter percentage.

Table 1: Accession number and source of fifteen advanced potato genotypes

S.No.	Advanced Potato Genotypes	Source
1	17-19	NARC
2	Potato-II	International Potato Center
3	393574-72	International Potato Center
4	Kuroda	HOLLAND
5	51-60	NARC
6	2002-1	NARC
7	Sarpomira	HOLLAND

8	NARC-Potato-III	International Potato Center
9	394012-96	International Potato Center
10	Cardinal	HOLLAND
11	Romeo	HOLLAND
12	Desiree	HOLLAND
13	Zia-I	HAR Station Abbotabad.
14	Zia-II	HAR Station Abbotabad.
15	Zia-III	HAR Station Abbotabad.

Table 2: Specific gravity of fifteen selected potato genotypes

Serial #	Genotypes	Specific gravity
1.	17-19	1.074
2.	Potato-II	1.074
3.	393574-72	1.074
4.	Kuroda	1.075
5.	51-60	1.075
6.	2002-1	1.075
7.	Sarpomira	1.077
8.	NARC-Potato-III	1.077
9.	394012-96	1.077
10.	Cardinal	1.082
11.	Romeo	1.091
12.	Desiree	1.078
13.	Zia-I	1.078
14.	Zia-II	1.078
15.	Zia-III	1.060
	S.E.	0.0016
	t-value	667.92
	Probability	0.000

Table 3: Dry matter percentage of fifteen selected potato genotypes

Serial #	Genotypes	Dry matter (%)
1.	17-19	19.0
2.	Potato-II	19.0
3.	393574-72	19.0
4.	Kuroda	19.2
5.	51-60	19.2
6.	2002-1	19.2
7.	Sarpomira	19.6
8.	NARC-Potato-III	19.6
9.	394012-96	19.6
10.	Cardinal	20.6
11.	Romeo	22.5
12.	Desiree	19.8
13.	Zia-I	19.8
14.	Zia-II	19.8
15.	Zia-III	16.1
	S.E.	0.3315
	t-value	58.73
	Probability	0.000

Table 4: Quality characteristics of fifteen selected potato genotypes

Serial Number	Selected varieties	Tuber shape	Eye depth	Flesh color
1	17-19	Oval	Shallow	Cream
2	Potato-II	Round	Shallow	White
3	393574-72	Oblong	Shallow	Cream
4	Kuroda	Oblong	Very shallow	Yellowish white
5	51-60	Oblong	Shallow	Cream
6	NARC 2002-1	Oblong	Shallow	Cream
7	Sarpomira	Long	Shallow	Yellow
8	NARC-Potato-III	Long	Shallow	Cream
9	394012-96	Oblong	Shallow	Cream

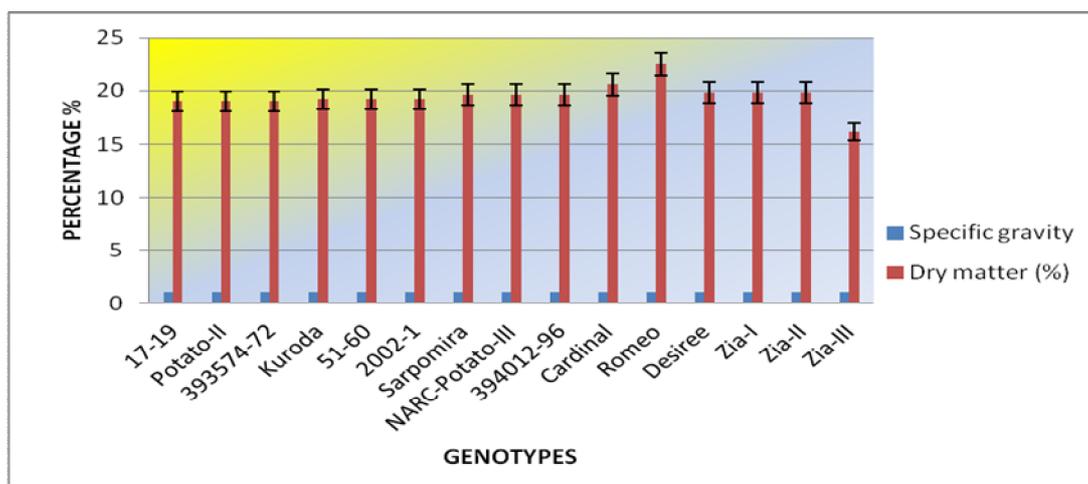| 10 | Cardinal | Oval | Shallow | Cream |
11	Romeo	Oval	Deep	Pale yellow
12	Desiree	Oblong	Shallow	Pale yellow
13	Zia-I	Round	Shallow	Cream
14	Zia-II	Round	Shallow	Cream
25	Zia-III	Round	Shallow	Cream

Figure 1: Graph shows the specific gravity and dry matter percentage of fifteen selected potato genotypes

Figure 2. (A) Harvesting of fifteen potato genotypes (B) Calculating the weight of fifteen potato genotypes (C) The genotype cardinal ranked 2nd among all fifteen genotypes of potato with respect to specific gravity and dry matter percentage (D) Romeo; the best genotype with the highest specific gravity and dry matter percentage.
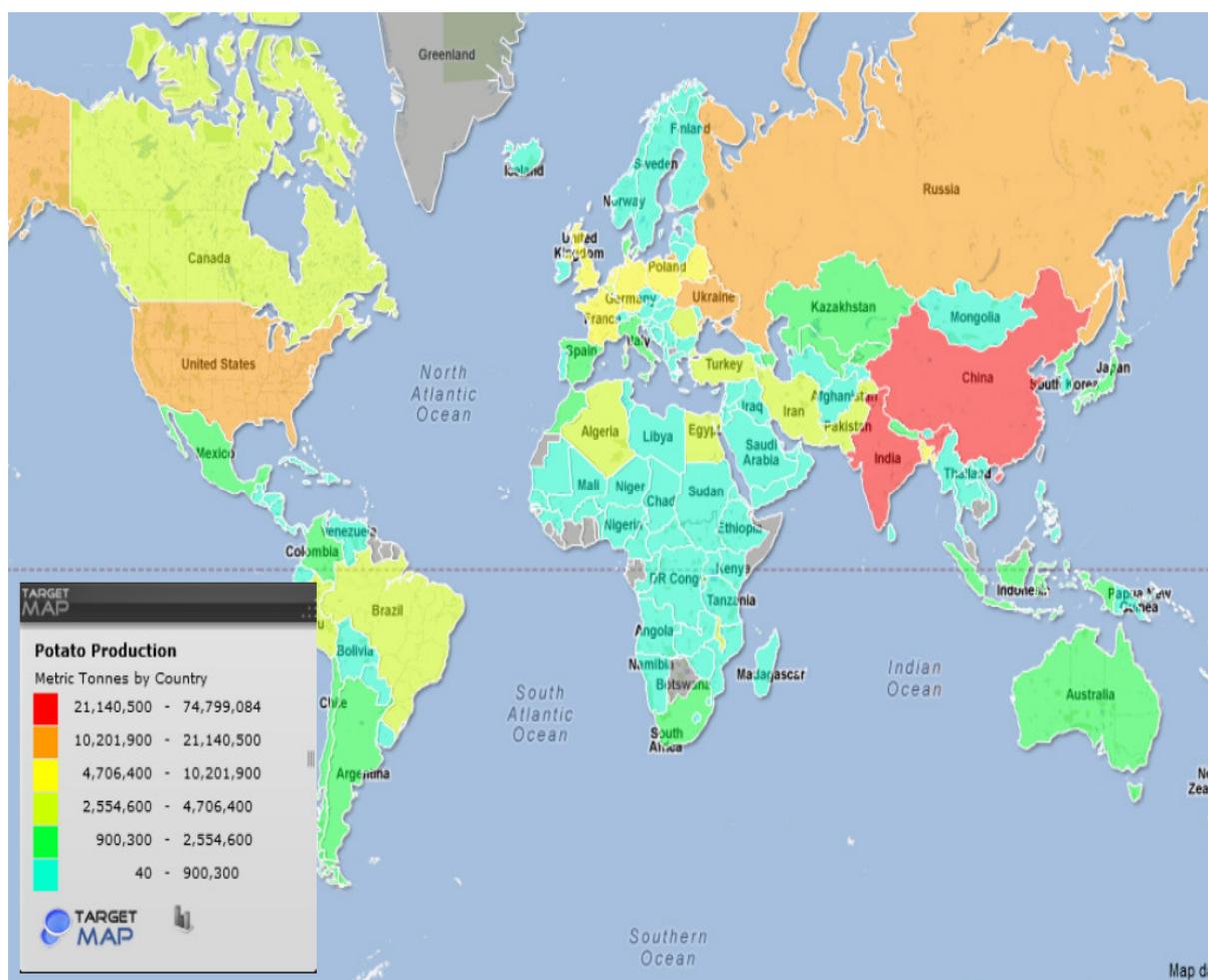
Figure 3: Potato Production throughout the world, Source: FAO estimates.

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