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Title: Screening of Potato Varieties in Relation to Yield and Processing Quality

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ABSTRACT

Good quality potato is the main bottleneck for the expansion and improvement of potato processing industry in Bangladesh. Application of suitable organic manure *viz.*, vermicompost along with required fertilizers might improve its processing quality. From this perspective, four years consecutive experiments were carried out in the research field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207 from November, 2015 to April, 2018. Thirty six (36) potato varieties namely: Asterix, Cardinal, Rojato, Destiny, Festa Pakri, Tel Pakri, Bot Pakri, Stick, Dora, Granolla, BARI Alu-68, Raja, Binella, Dheera, Sagita, Patrones, Courage, Provento, Felsina, Multa, Lady Rosetta, Meridian, Forza, Saikat, Laura, Ailsa, Cumbica, Omera, Rumba, Jerla, Elgar, Doly, Agila, Quincy, Almerah and Steffi were used as treatments under this experiment. The design used was RCBD with tree replication. Collected data on different parameters were analyzed statistically using the analysis of variance (ANOVA) technique with the help of WASP (Web Agri Stat Package: version-1) computer program and means were adjusted by using LSD (Least Significant Difference) test at 5% level of probability. The results revealed that, among the thirty-six potato varieties, Lady Rosetta, Asterix, Courage, Destiny, Doly and BARI Alu-68 exhibited the best performance regarding tuber yield, specific gravity and dry matter content.

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INTRODUCTION

Potato (*Solanum tuberosum* L.F) is one of the most important vegetable crops and having a balanced food containing about 75 to 80% water, 16 to 20% carbohydrates, 2.5 to 3.2% crude protein, 1.2 to 2.2% true protein, 0.8 to 1.2% mineral matter, 0.1 to 0.2% crude fats, 0.6% crude fiber and some vitamins (Abbas et al., 2012). It is a staple diet in European countries and its utilization both in processed and fresh food form is increasing considerably in Asian countries (Brown, 2005). Human nutrition and food security is also contributed from potato cultivation and it has more potentiality to earn huge money from the export of processing and export quality produce especially to European countries (Karim et al., 2010). Among all crops, potato is one of the most important vegetables as well as cash crops in Bangladesh (Haque et al., 2012). Bangladesh is the 7th potato producing country in the world, 3rd biggest in Asia and in Bangladesh, potato ranks 2nd after rice in production. Significance of potato crop was rightly assessed by FAO (Food and Agriculture Organization) before declaring 2008 as the International Year of Potato and indicating potato as future crop for fighting hunger and poverty. Due to its wide distribution across the world and a greater production rate compared to other crops, potato has the potentials to fulfill the increased demand of food supply in the developing countries including Bangladesh (FAOSTAT, 2020; Devaux et al., 2020).

The genetic makeup, crop maturity, agronomic practices, environmental conditions, storage temperatures, pests and diseases are affecting potato tuber. Studying the genetic variability present among different potato genotypes for a given character is a basic precondition to design systematic breeding methods. Predominantly, genetic variability for a given character is a basic precondition for its improvement by systematic breeding (Engida et al., 2007; Arslanoglu et al., 2011). Considering the above fact, the present study is undertaken to discover suitable potato genotypes for yield and processing quality (specific gravity and dry matter).

MATERIALS AND METHODS

Thirty six (36) potato varieties and cultivars' were used as treatment under present study namely: BARI Alu-25 (Asterix), Cardinal, Rojato, BARI Alu-70 (Destiny), Festa Pakri, Tel Pakri, Bot Pakri, Stick, Dora, Granolla, BARI Alu-68 (Atlantic), Raja, Binella, Dheera, Sagita, Patrones, BARI Alu-29 (BARI Alu-29 (Courage), Provento, Felsina, Multa, BARI Alu-28 (Lady rosetta), Meridian, Forza, Saikat, Laura, Ailsa, Cumbica, Omera, Rumba, Jerla, Elgar, BARI Alu-71 (Doly), Agila, Quincy, Almerah and Steffi.

The experiments were carried out in the research field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207 in a Randomized Complete Block Design (RCBD) with three replications. The total number of unit plot was 108. The size of unit plot was 2.5 m × 2.5 m.

The expt. was conducted during the period from November, 2015 to March, 2016. The experimental area belongs to 23^{o}7'N latitude and 93^{o}E' longitude at an altitude of 8.6 meter above the mean sea level (Anon., 2004) and the research area belongs to agro-ecological zone of "Madhupur Tract" (AEZ-28). The surface soil was characterized by silty clay with slight sandy loam in texture and olive-slight grayish white with common fine to medium distinct dark whitish brownish-light brown mottles were seen on the top soil. Tubers of uniform size (50-60 g) were used for planting and kept in room temperature to facilitate good sprouting. Finally full sprouted potato tubers were used as planting material in a pit of allocated plot.

Land preparation

The land of the experimental site was first opened in the second week of November with power tiller and to obtain the desirable tilth the land was ploughed and cross-ploughed four times followed by laddering. Weeds and stubbles were removed from the corners of field using spade. The land was finally prepared on 3rd week of November for every experiment just three days before of the planting of whole seed tuber. In order to avoid water logging, drainage channels were made around the land. The soil was treated with Furadan 5G @ 20 kg ha^{-1} when the plot was finally ploughed to protect the young plant from the attack of cut worm.

Fertilizer and manure application

The crop was fertilized by using recommended dose of fertilizers at the rate of 350-220-250-120-10 kg ha^{-1} of Urea, TSP, MoP, Gypsum and Zinc sulphate, respectively (Azad et al., 2017). Vermicompost was used as per treatment as manure. Zinc sulphate and vermicompost was applied during final land preparation. Half urea along with full TSP, MoP and gypsum was applied in furrow during planting of tuber. The rest amount of Urea was applied at 35 DAP as top dressing.

Planting of seed tuber

The well sprouted healthy and uniform sized potato tubers were planted according to requirement. Seed potatoes were planted at a depth of 5-6 cm on November 15 for each experiment maintaining 50 cm × 25 cm spacing.

Intercultural operations

Earthing up

Earthling up was done at 35 DAP and second was at 50 DAP with a narrow spade for the development of tubers.

Weed control

First weeding was done two weeks after emergence. Another weeding was done before 2nd top dressing of urea. It was also done as and when required to keep the crop free from weeds and to keep the soil loose for proper aeration and development of tubers.

Water management

Three irrigations were provided throughout the growing period in controlled way. The first irrigation was given at 35 DAP. Subsequently, another two irrigations were given at 50 and 65 DAP. Top dressing of urea was followed by irrigation for proper utilization of fertilizers.

Control of insects and diseases

All possible phytosanitary measures were adopted to keep plant healthy. Dursban @ 7.5 litre ha^{-1} was drenched on both sides of ridges at 30 DAP to control the cutworm. Dimecron 100 EC @ 2% and Admire 200 SL @ 0.5% were applied to control aphid and jassid. To prevent incidence of late blight of potato, Dithane M-45 @ 2 g $litre^{-1}$ was applied at the advent of moist condition of weather and Ridomil Gold MZ @ 1 g $litre^{-1}$ was applied at an interval of 7 days after seeing the late blight of potato disease for good harvest and healthy of tuber.

Haulm cutting

For this experiment, haulm cutting was done at second week of March when 60-70% plants showed senescence and these potatoes were harvested after 7 days of haulm cutting for skin hardening and tuber bulking. Then the tuber was collected, bagged and tagged separately for taking quality data further in laboratory.

Recording of data

Some of the data was taken after harvesting of tuber by using digital electronic balance; some of the data was taken by different biochemical processes in laboratory and by using different instruments. Finally, the means were calculated by using a digital calculator for quality analysis for following data-

i. Tuber yield (t ha^{-1})
ii. Specific gravity (g cm^{-3})
iii. Dry matter content (%)

RESULTS AND DISCUSSION

Tuber Yield (t ha^{-1})

A significant variation ($p \leq 0.01$) was found among the different varieties of potatoes in respect of yield of tubers (Table 1). The highest tuber yield (34.57 t ha^{-1}) was produced by BARI Alu-28 (Lady rosetta) which was statistically similar to BARI Alu-25 (Asterix) (32.54 t ha^{-1}) followed by BARI Alu-29 (Courage) (31.52 t ha^{-1}), BARI Alu-71 (BARI Alu-71 (Doly)) (31.47 t ha^{-1}), BARI Alu-70 (Destiny) (28.55 t ha^{-1}) and BARI Alu-68 (Atlantic) (26.25 t ha^{-1}). The lowest tuber yield (19.56 t ha^{-1}) was found from Stick which was statistically similar to Granolla, Binella, Dora, Dheera, Sagita, Provento, Felsina, Multa, Meridian, Forza, Saikat, Laura, Ailsa, Cumbica, Omera, Rumba, Agila, Quincy, Almerah, Festa Pakri, Tel Pakri and Bot Pakri. Yield was significantly influenced by variety and season of production (Sinha et al., 1992, Sandhya and Basavaraj (2020)). Gupta et al. (2009) also confirmed that there were significant effects of the season on total tuber yield, which might be due to different responses of different genotypes to environmental conditions. Patel et al. (2008) reported that higher tuber yield might be due to better plant growth, genotype, and adaptability in wide range of environment and combined effect of all other growth and yield attributes.

Specific gravity (g cm^{-3})

Profound variation ($p \leq 0.01$) was found among the different varieties of potatoes in respect of specific gravity (Table 1). The maximum (1.1033 g cm^{-3}) specific gravity was exhibited by BARI Alu-28 (Lady rosetta) which was statistically similar to the BARI Alu-25 (Asterix) (1.0833 g cm^{-3}) and BARI Alu-29 (Courage) (1.0933 g cm^{-3}) followed by Cardinal, BARI Alu-71 (Doly), BARI Alu-70 (Destiny) and BARI Alu-68 (Atlantic). The minimum (1.0087 g cm^{-3}) specific gravity was found from Malta which was statically similar to Rojato, Dora, Granolla, Raja, Binella, Dheera, Sagita, Patrones, Provento, Felsina, Meridian, Forza, Saikat, Laura, Ailsa, Cumbika, Quincy, Almerah, Steffi. The present result is in agreement with the findings of Roy et al., (2017b). They said that the lower dry matter content of tuber and lower weight of tuber resulted the lower specific gravity and vice-versa.

Dry Matter (%)

Dry matter content of tuber was found significant ($p \leq 0.01$) due to different varieties of potatoes (Table 1). The highest dry matter content (22.090%) was partitioned by BARI Alu-28 (Lady rosetta) which was statistically similar to the BARI Alu-29 (Courage) (21.623%) and BARI Alu-25 (Asterix) (20.527 %) and followed by BARI Alu-71 (Doly), Destiny, and BARI ALU-68 (ATLANTIC). The lowest dry matter (15.220%) was partitioned in Dora which was statistically similar to Raja, Binella, Dheera, Granolla, Stick, Provento, Felsina, Multa, Meridian, Forza, Cumbica, Omera, Rumba, Jerla, Elgar, Almerah. The Present result is in agreement with the findings of Rahman et al. (2016). They reported that potato varieties having dry matter percentage more than 20% are suitable for processing.

Table 1. Yield, specific gravity and dry matter content of thirty-six potato varieties

Varieties	Tuber Yield ($t\ ha^{-1}$)	Specific gravity ($g\ cm^{-3}$)	Dry Matter (%)
BARI Alu-25 (Asterix)	32.45 ab	1.0833 ab	20.527 ab
Cardinal	24.44 de	1.0633 b-d	17.367 d-j
Rojato	22.48 ef	1.0267 e-i	17.973 c-g
BARI ALu-70 (Destiny)	28.55 c	1.0433 d-e	18.560 cd
Festa Pakri	21.83 e-g	1.0367 e-g	16.897 d-k
Tel Pakri	21.56 fg	1.0467 c-e	18.037 c-g
Bot Pakri	21.06 fg	1.0333 e-h	15.973 h-k
Stick	19.56 g	1.0400 ef	16.183 g-k
Dora	22.23 e-g	1.0300 e-i	15.220 k
Granolla	21.21 fg	1.0267 e-i	15.617 jk
BARI Alu-68 (Atlantic)	26.25 cd	1.0433 d-f	18.147 c-f
Raja	22.36 ef	1.0227 f-i	16.823 d-k
Binella	21.62 fg	1.0257 e-i	16.580 e-k
Dheera	22.01 e-g	1.0150 g-i	16.747 d-k
Sagita	21.09 fg	1.0150 g-i	17.473 d-j
Patrones	22.40 ef	1.0257 e-i	18.137 c-f
BARI Alu-29 (Courage)	31.52 b	1.0933 a	21.623 a
Provento	22.09 e-g	1.0213 f-i	16.780 d-k
Felsina	20.92 fg	1.0177 g-i	16.807 d-k
Multa	21.45 fg	1.0087 i	15.870 i-k
BARI Alu-28 (Lady rosetta)	34.57 a	1.1033 a	22.090 a
Meridian	21.58 fg	1.0140 hi	16.047 h-k
Forza	20.76 fg	1.0163 g-i	16.173 g-k
Saikat	20.51 fg	1.0160 g-i	17.147 d-j
Laura	21.19 fg	1.0153 g-i	17.403 d-j
Ailsa	22.18 e-g	1.0173 g-i	17.570 d-j
Cumbica	21.27 fg	1.0237 f-i	16.477 f-k
Omera	20.77 fg	1.0330 e-h	16.840 d-k
Rumba	22.18 e-g	1.0347 e-h	16.703 d-k
Jerla	22.46 ef	1.0330 e-h	16.440 f-k
Elgar	22.40 ef	1.0323 e-h	16.850 d-k
BARI Alu-71 (Doly)	31.47 b	1.0667 bc	19.600 bc
Agila	20.98 fg	1.0363 e-g	17.817 c-h
Quincy	20.69 fg	1.0277 e-i	17.807 c-h
Almerah	22.02 e-g	1.0283 e-i	16.870 d-k
Steffi	22.46 ef	1.0303 e-i	18.447 c-e
CV (%)	7.35	1.33	6.63
LSD $_{(0.05)}$	2.774	0.022	1.882
Significance Level	**	**	**

Values with common letter (s) within a column do not differ significantly at 5% level of probability
** indicates significant at 1% level of probability

Correlation co-efficient (r)

A strong positive relation (r=0.872) was found between tuber yield and specific gravity of potato tuber-Figure 1. In Figure-2, a strong positive relation (r=0.861) was found between tuber yield and dry matter content of potato tuber. Specific gravity and dry matter content of potato tuber was strongly (r=0.819) related with each other (Figure-3). Rastovski *et al*. (1981) also noticed that there is a significant relationship exists between dry matter content and specific gravity.

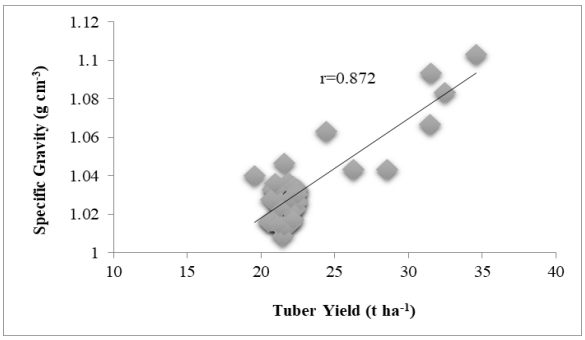

Figure 1. Relationship between tuber yield (t ha^{-1}) and specific gravity (g cm^{-3}) of potato

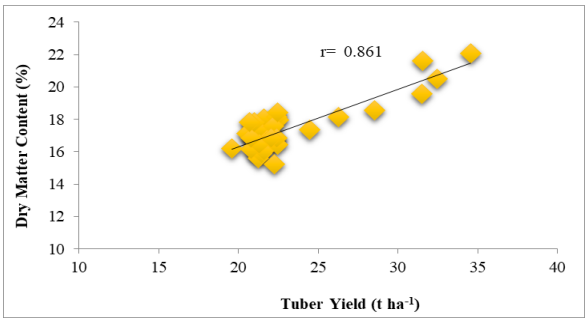

Figure 2. Relationship between tuber yield and dry matter content of potato

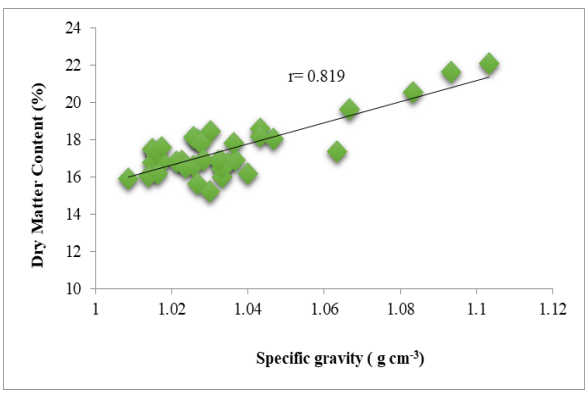

Figure 3. Relationship between tuber specific gravity (g cm^{-3}) and dry matter content of potato

Table 2. Mean sum square values for tuber yield, specific gravity and dry matter content of potato tuber

Source of variation	df	Tuber yield	Specific gravity	Dry matter content
Varieties	35	41.536**	0.028**	7.013**
Error	70	2.905	0.038	1.336
LSD		2.774	0.022	1.882
CV(%)		7.35	1.33	6.63
Significance Level		**	**	**

** indicates significant at 1% level of probability

CONCLUSION

It was discovered that varietal differences had a significant impact on yield and potato characteristics. These results discovered significant heterogeneity in tuber production and other yield-related variables across the released potato varieties. The results revealed that, among the thirty-six potato varieties, Lady Rosetta, Asterix, Courage, Destiny, Doly and BARI Alu-68 exhibited the best results for tuber yield, specific gravity and dry matter content.

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