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RESEARCH ARTICLE

SELECTION OF PROCESSING POTATO VARIETIES THROUGH MULTI-LOCATION TRIALS

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ABSTRACT

Thirteen exotic potato varieties along with four checks were evaluated at six agro-ecological locations of Bangladesh for three generations during 2015-16 to 2017-18 in order to identify table purpose and processing quality varieties. Results indicated significant variation among the varieties. Based on the results of the 1st year multi-location trial, seven superior ones were selected for further testing in AYT and RYT in next two years. In the SYT, varieties Farida and 7four7 were the highest yielders. In the AYT, the highest average yield over location was also produced by 7four7 (38.70 t/ha). Varieties Cimega and Memphis also gave comparable yields to that of 7four7 (37.33 and 36.67 t/ha, respectively). Considering the yield of the three generations, the above four varieties were significantly better than the checks. Considering the specific qualities, Farida was found most suitable for table purpose because of its high yield, medium-sized oval and smooth tubers with good eating quality. The variety Taisiya produced tubers with good size and shape, but low in dry matter content; so not suitable for processing. Memphis might be selected for French fry as it produces maximum large sized tubers with good long oval shape. On the other hand, variety Panamera is a high yielder but its plant type was undesirable. On the whole, varieties Cimega, 7four7 and Farida are suitable for table purpose, and Memphis may be selected for French fry under Bangladesh condition. None was found quite suitable for Chips preparation.

KEYWORDS

Potato variety, french fry, table potato, processing potato, multi-location trial.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is the world's largest non-cereal food crop and ranked 4th most important food crop after wheat, corn and rice (De Haan and Rodriguez, 2016). It is a vital crop to safeguard food security because of its growing demand and nutritional value. Considering the high yield potential, it can be a good substitute of cereal crops that have a high harvesting index above 75% (Scott et al., 2020; Thiele et al., 2010). In Bangladesh, it is grown all over the country only in the winter season for its high demand to feed the hungry people. According to Food and Agriculture Organization, Bangladesh ranks 7th position in potato production among the potato producing countries of the world and is considered as 2nd most important food crop in the country (FAOSTAT, 2020). The country's average yield of potato is 20.61t/ha with a total production of 9.65 million tons from 0.47 million hectares of land. The potato production has increased from 1.55 to 9.65 Mil. tons and the production area has increased from 0.136 to 0.47 Mil. hectares over the last two decades which improved the per unit area production 1.80-fold (FAOSTAT, 2020). However, this yield of potato is still low compared to other potato growing countries. To ensure the country's food and nutritional security, per unit area of potato production should be 41.50 t/ha by the year 2030 (Al-Mahmud et al., 2021).

There are two important factors for the low yield of potato in Bangladesh, one is the lack of improved cultivars and the second factor is the low investment from the potato farmers (Kundu et al., 2020). During the harvesting time, the price of potato goes down due to glut of potato in the market and farmers experience financial loss, which influences low investment. The only way to overcome this situation is to increase the export and processing of potato (Hussain, 2012). To enhance the export and processing of potato, it is necessary to improve the tuber quality through suitable varieties and improved management practices.

For varietal improvement, hybridization and selection is the common practice, but in Bangladesh, conventional breeding is very lengthy and cumbersome due to climatic constraint. So introduction and selection is the common practice for variety development in Bangladesh which began in the 1960s (Siddique et al., 2015). Introduced varieties mostly from European countries are tested here for several years and several locations to check the yield stability, degeneration rate, disease susceptibility, and specific qualities like Chips making, French fry preparation, flakes making, and export quality. This study was a part of the variety identification program through which desirable varieties can be selected under Bangladesh condition

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2. Materials and Methods

2.1 Planting materials and location

The experiment was conducted during the Rabi (winter) season of three consecutive years, 2015-16 to 2017-18 in six agro-ecological environments across the country, namely Gazipur, Bogura, Jamalpur, Jashore, Debiganj and Munshiganj. The secondary yield trial (SYT) was the first multi-location trial, and it included thirteen exotic varieties, namely Canberra, Cimega, Coronada, Farida, Granada, Jelly, Memphis, Montreal, Navigator, Panamera, Rosi, Taisiya and 7 four 7 along with four check varieties, BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta). The next year trial named advance yield trial (AYT) was conducted with seven exotic varieties namely, Cimega, Farida, Memphis, Jelly, Panamera, Taisiya and 7 four 7 along with the same check varieties at five locations. The final year evaluation, regional yield trial (RYT), was conducted with Cimega, Farida, Memphis, Taisiya, and 7 four 7, along with the three check varieties in six locations. Participatory variety trial (PVS) was done at five locations, but number of farmers per location varied from 3 to six. All the seed materials were supplied from the Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh.

2.2 Experimental procedure and management

All the trials were conducted on 3 x 3 m plot with 3 replications. Spacing was 60cm x 25 cm. seeds were planted during mid-November, and harvesting was done at 95 DAP. Manure and fertilizers were applied @ Cowdung 10 t/ha, Urea-350 kg/ha, TSP-220 kg/ha, MP-260 kg/ha, Gypsum-120 kg/ha, Boric acid-15 kg/ha and ZnSO4 12 kg/ha (Kundu et al., 2013) where half of Urea and a complete dose of other fertilizers were thoroughly mixed with the soil before planting. At 35 days after planting, the remaining Urea was added as side-dressing. Necessary intercultural operations such as weeding, earthing up, irrigation and plant protection measures were carried out according to the recommendation of TCRC, BARI (Kundu et al., 2013). The meteorological data of all the locations are presented in Figures 1 and 2 (BAMIS, 2021).

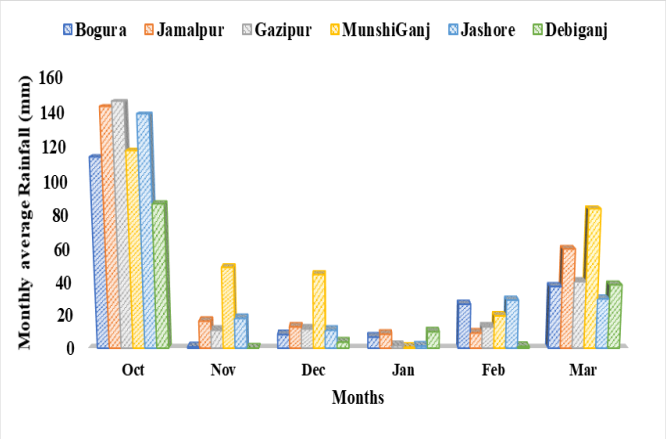

Figure 1: Monthly mean rainfall (mm) of the experimental sites during the potato growing season (average of 2015–2016, 2016-2017 and 2017–2018 crop season).

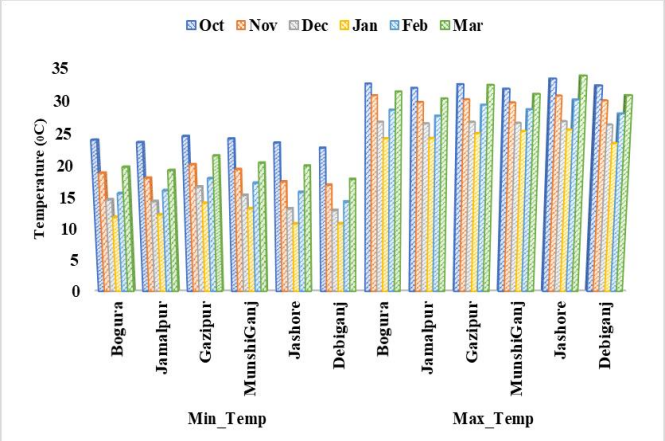

Figure 2: Monthly mean minimum and maximum temperature (0C) the experimental sites during the potato growing season (average of 2015–2016, 2016-2017 and 2017–2018 crop season)

2.2 Data collection and analysis

Data were collected on several parameters, but only important ones are presented in tables in the Results and Discussion with proper analysis. Tuber yield data were collected whole plot basis. The data were statistically analyzed, and the means were separated by LSD (least significant difference) tested at 5% level of probability using statistical software R x 64-program version 3.3.2 (Core Team, 2013).

3. Results and Discussion

2.3 SYT (Secondary Yield Trial): Cropping Season 2015-16

The mean performances of the first-year multi-location trial with 13 exotic varieties (average of six locations) for all the characters are presented in table 1. The range of days to start of emergence (12.94 – 16.83), emergence % at 30 DAP (64.41 – 96.32), plant vigour (7.06 – 9.00), plant height (54.27 –74.31 cm), number of stems/hill (3.42– 6.95) and foliage coverage percentage (57.33 – 88.22) were in standard scale and desirable though they showed statistically significant differences among the tested genotypes. The highest mean emergence % was found (96.3) in Rosi, whereas the lowest mean (64.4) was in 7four7. Early emergence is a desirable trait in a variety because it promotes early foliar production and reduces seed tuber pre-emergence damage. Plant vigour is the sign of plants good health which was 9.00 in Rosi on a scale of 1-10, where 1 means the poorest and 10 means the best (Lobato et al., 2008). The number of stems hill^{-1} was also good for the exotic plant materials along with the check varieties and this character is important because it increases the soil coverage and photosynthetic area which ultimately increases the tubers yield per plant (Knowles and Knowles, 2006). Field resistance to virus diseases is an important character in respect of degeneration of potato. The varieties Montreal, Panamera and Rosi were highly susceptible to virus diseases; that's why they were rejected from the next year trial even though they have the high yielding ability. Farida gave the significantly highest yield (32.53 t/ha) at 65 DAP which was statistically identical with Cimega (32.05 t/ha). All the tested genotypes gave a higher yield than the checks at 65 DAP except Coronada. Farida and Cimega were selected for further trials based on potential varieties for early cultivation. Varieties Farida and 7four7 were the highest average yielder at maturity, followed by Cimega, Panamera, Memphis and Taisiya. The performance of these varieties was also satisfactory in all six locations (Table 2). In the case of dry matter content, none of the variety was better than the check varieties in the first-year trial which are in agreement with the report of (Patel et al., 2000). Finally, based on the tuber yield and other economic characters, varieties Cimega, Farida, Jelly, Memphis, Panamera, Taisiya, 7four7 were selected for the next year trial.

3.2 AYT (Advanced Yield Trial): Cropping Season 2016-17

3.2.1 Tuber Yield

The second year's results are presented in Table 3 which showed that the mean yields varied from almost 30 to 38.7 t/ha in the imported varieties, while the check varieties produced 24.8 to 27.5 t/ha. When location-wise yield was considered, Farida topped in the list yielding 57.37 t/ha at Debiganj, followed by 7four7, Cimega and Memphis at the same location. These varieties were also performed better at most of the locations. The mean yields of these varieties were also significantly higher than the check varieties. When the location averages were considered, Debiganj was the best, followed by Munshiganj and Bogura. The performances at Jamalpur were very poor, and that of Jashore was medium. Usually, Jamalpur yields are better than those of the other locations, but this year, all the varieties including checks performed very poorly at this station. It might be due to some stress conditions, either from the fertilizer or water or from any other management practices.

Table 1: Performances of the exotic potato varieties in SYT (Av. of six locations), 2015-16

Variety	Days to first emergence	Emergence at 30 DAP (%)	Plant vigour at 45 DAP (1-10 score)	Plant height (cm)	No. of stems /hill	Foliage coverage at 60 DAP (%)	Percentage of virus infection
Canberra	14.11	93.2	8.58	68.2	4.58	85.2	8.3
Cimega	14.28	90.3	8.61	61.3	4.32	85.2	1.7
Coronada	16.11	65.5	7.06	54.2	3.42	57.3	1.3
Farida	12.94	86.9	8.56	60.8	4.37	87.0	2.4
Granada	16.83	85.9	8.03	54.9	3.71	78.1	1.7
Jelly	15.72	91.0	8.78	67.9	5.38	88.2	3.3
Memphis	16.06	89.8	8.83	66.9	3.66	86.8	3.7
Montreal	14.11	87.3	8.47	69.3	4.94	84.4	20.7
Navigator	14.83	90.4	8.39	58.4	4.69	84.0	7.2
Panamera	14.61	94.9	8.14	73.6	4.34	81.5	19.7
Rosi	13.83	96.3	9.00	74.3	4.16	86.5	17.9
Taisiya	15.06	89.4	8.22	61.4	4.95	80.7	2.3
7 four 7	14.94	64.4	8.11	55.9	4.26	68.8	2.7
BARI Alu-7 (Diamant)	14.00	93.8	8.86	63.5	6.95	87.4	12.7
BARI Alu-13 (Granola)	14.28	93.3	8.17	55.4	4.87	83.8	2.3
BARI Alu-25 (Asterix)	14.11	93.9	8.25	65.3	6.01	83.6	6.7
BARI Alu-28 (L. Rosetta)	13.06	91.6	8.36	58.9	5.12	86.9	9.7
Range	12.94 – 16.83	64.40 – 96.32	7.06 – 9.00	54.27 – 74.31	3.42– 6.95	57.33 – 88.22	1.3-19.7
LSD	0.59	2.64	0.344	1.73	0.262	1.65	

Table 2: Tuber yields (t/ha) of the varieties at 95 DAP at different locations in SYT, 2015-16

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Canberra	31.75	43.71	28.12	34.90	24.89	32.03	32.57fg
Cimega	39.77	61.96	36.26	43.54	34.58	36.11	42.04 b
Coronada	41.71	40.44	23.11	23.79	24.54	38.18	31.96 g
Farida	51.47	64.69	35.40	38.73	33.42	42.78	44.42 a
Granada	36.68	43.53	24.27	34.38	27.87	35.98	33.79 ef
Jelly	35.58	60.06	30.01	38.14	33.64	38.34	39.30 c
Memphis	39.17	58.46	34.49	41.03	35.65	42.35	41.86 b
Montreal	36.73	49.79	39.00	31.66	37.58	35.74	38.42 c
Navigator	33.45	47.88	27.55	35.70	30.99	30.47	34.34 de
Panamera	44.34	61.06	35.22	43.48	32.41	37.61	42.35 b
Rosi	35.94	49.18	20.52	42.24	30.12	34.49	35.42 d
Taisiya	42.64	57.44	30.12	41.96	35.35	41.98	41.58 b
7 four 7	49.48	67.56	49.11	33.02	28.13	47.58	45.81 a
BARI Alu-7 (Diamant)	30.12	41.88	27.48	29.53	26.62	41.83	32.91 efg
BARI Alu-13 (Granola)	28.55	46.29	26.44	33.52	20.54	37.52	32.14 g
BARI Alu-25 (Asterix)	25.97	45.54	26.24	30.25	30.87	40.64	33.25 efg
BARI Alu-28 (L. Rosetta)	24.69	47.87	25.78	26.51	26.81	39.18	31.81 g
LSD							1.499

Table 3: Tuber yields (t/ha) of the tested varieties at 95 DAP at different locations in AYT, 2016-17

Variety	Locations					
	Bogura	Debiganj	Jamalpur	Jashore	Munshiganj	Mean
Cimega	41.37 abc	53.62 ab	12.44 bc	34.61 a	44.59 a	37.33 a
Farida	25.52 fg	57.37 a	14.82 abc	24.48 bc	43.08 a	33.06 b
Jelly	33.96 cde	41.66 c	10.94 bc	21.11 c	42.12 a	29.96 c
Memphis	46.69 a	53.14 ab	18.68 ab	22.52 bc	42.31 a	36.67 ab
Panamera	42.09 ab	42.99 c	15.30 abc	24.92 bc	42.52 a	33.57 b
Taisiya	37.91 bcd	48.20 bc	12.71 bc	21.64 c	43.07 a	32.71 bc
7four7	43.89 ab	54.97 ab	22.02 a	30.11 ab	42.50 a	38.70 a
BARI Alu-7 (Diamant)	32.15 def	26.91 d	13.20 bc	27.12 abc	38.15 ab	27.51 cd
BARI Alu-13 (Granola)	17.97 g	42.33 c	10.31 c	22.38 bc	30.94 b	24.79 e
BARI Alu-25 (Asterix)	29.29 ef	32.33 d	11.06 bc	23.75 bc	39.72 a	27.23 cd
BARI Alu-28 (L. Rosetta)	30.33 def	31.59 d	10.20 c	21.72 c	37.78 ab	26.33 de
Mean	34.65	44.10	13.79	24.94	40.62	31.6
CV(%)	9.37					

3.2.2 Tuber grading by weight

The tuber grade by weight is an important character of a variety to find out its suitability for export and processing. The average grades of tubers by weight are presented in table 4. Variety Memphis produced the maximum large sized tubers. Cimega and 7four7 also produced large-sized tubers, but at a lower proportion. All the check varieties and Taisiya produced a higher proportion of small-sized tubers. Farida and Jelly produced maximum medium-sized tubers. So these two varieties are most suitable for table purpose, while Memphis is most suited for processing.

Table 4: Size grades (%) of tubers by weight (Average of five locations) in AYT, 2016-17

Variety	<15 mm	15-28 mm	28-40 mm	40-55 mm	>55mm
Cimega	0.65	5.21	30.29	47.85	16.0
Farida	1.24	5.18	33.94	47.19	12.4
Jelly	1.28	4.97	32.01	51.67	10.1
Memphis	0.42	6.81	28.42	46.21	18.1
Panamera	0.72	7.70	35.89	45.79	9.9
Taisiya	1.23	10.33	35.40	49.05	4.0
7 four7	0.70	5.48	31.48	45.07	17.2
BARI Alu-7 (Diamant)	1.40	10.82	36.77	44.14	6.8
BARI Alu-13 (Granola)	1.02	13.09	33.30	48.72	3.9
BARI Alu-25 (Asterix)	1.07	7.23	36.24	47.81	7.6
BARI Alu-28 (L. Rosetta)	2.78	11.34	42.41	40.99	2.5
Mean	1.14	8.01	34.20	46.77	9.8

3.2.2 Dry matter content (%)

The dry matter content of a tuber is an important characteristic for the processing quality of a variety (Leonel et al., 2017). It is also a good indicator for the keeping and storage quality of potatoes (Lisinska and Leszczynski, 1989). Tuber dry matter must be greater than 20% for processing of a variety and Tuber dry matter content varies greatly between cultivars and is a highly genetically determined trait (Ezekiel et al., 1999; Kellock, 1995). The dry matter content of the tested varieties is presented in table 5. All the varieties did not behave similar from location to location, might be due to the microclimatic effect of different location or partially sampling error. The known high dry matter containing variety BARI Alu-28 produced the highest dry matter at all the locations, and the average is 21.22%, while Taisiya produced the lowest (16.83%). All other varieties including the checks were medium in dry matter content.

Table 5: Dry matter (%) of the tested varieties at 95 DAP at different locations in AYT, 2016-17

Variety	Locations					
	Bogura	Debiganj	Jamalpur	Jashore	Munshiganj	Mean
Cimega	18.05 ab	18.90 cd	18.90 cd	20.32 bc	18.31c	18.90 b
Farida	18.46 ab	20.33 abc	20.33 abc	18.13 de	19.22 bc	19.04 b
Jelly	18.05 ab	20.08 bc	20.08 bc	20.45 bc	18.46 c	19.26 b
Memphis	16.80 b	21.56 ab	21.57 ab	19.52 cd	18.71 c	19.65 b
Panamera	18.71 ab	20.23 bc	20.23 bc	18.67 cde	18.68 c	19.08 b
Taisiya	17.30 b	14.90 e	14.90 e	15.77 f	19.37 bc	16.83 c
7 four7	17.55 b	19.01 c	19.01 c	18.62 cde	19.15 bc	18.59 b
BARI Alu 7 (Diamant)	19.71 a	19.16 c	19.17 c	21.7 1	18.65 c	19.81 b
BARI Alu 13 (Granola)	17.76 b	17.07 d	17.07 d	17.42 ef	20.75 ab	18.25 b
BARI Alu 25 (Asterix)	18.30 ab	22.21 a	22.21 a	20.34 bc	18.38 c	19.81 b
BARI Alu 28 (L. Rosetta)	18.05 ab	22.01 ab	22.01 ab	22.60 a	22.22 a	21.22 a
Mean	18.07	19.59	19.59	17.44	19.26	18.79
CV (%)	3.76					

3.2.3 *Processing qualities*

Seven exotic varieties of Advanced Yield Trial were tested to assess the quality of the chips (Figure 3) and French fries (Figure 4). No verities were found super in chips quality. The varieties Panamera, Farida, Cimeha, Taisiya and 7 four 7 showed medium quality for chips, where Memphis and Jelly showed poor quality. While the French fry quality was considered, none was found to produce super, none was found to show poor results. Almost all varieties produced medium quality French fries. The results indicated that these varieties may be utilized if other qualities like tuber size, tuber shape, dry matter content, reducing sugar, etc. are found suitable (Storey and Davies, 1992). Yield-wise all the imported varieties were good, but for commercial feasibilities, these varieties should be further checked for other qualities like pest resistance, degeneration rate, and preservation and post-harvest losses. Based on the AYT results, five varieties Farida, 7four7, Cimega, Taisiya and Memphis were selected for RYT (Regional Yield Trial).

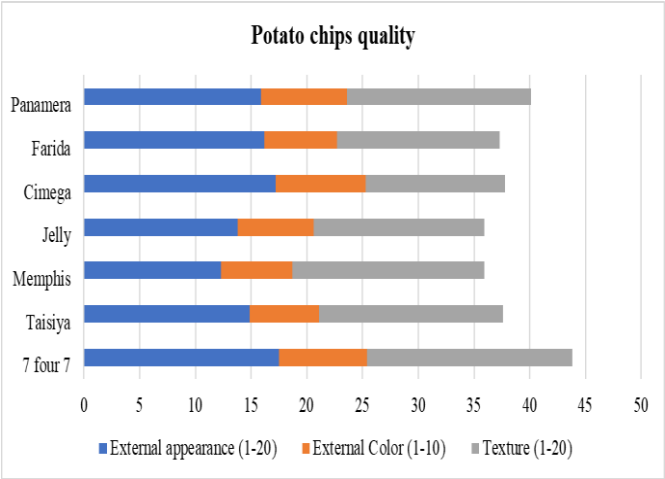

Figure 3: Chips quality of the seven exotic potato varieties. External appearance scale 1-20 (where 20=Excellent, 16=Very good, 12=Good, 8=Fair, 4=Poor); External colour scale 1-10 (where 10=Light whitish, 8=Light golden, 6=Golden, 4=slightly brown, 2=Dark); Texture (mealiness) scale 1-10 (where 20=Crispy, 16=moderately crispy, 12=slightly crispy/soggy,8=soggy)

3.3 RYT (Regional Yield Trial): Final year, Cropping Season 2017-18

Regional Yield Trial is mandatory before the release of a variety. The Technical Committee of the National Seed Board (NSB) critically analyze the results of the RYT before recommendation for release. Five best varieties of the lot were placed in the RYT at six locations along with three varieties as a check (Table 6). The economic worth of tuber production is determined by the marketable tuber yield (Kim et al., 2017). The yield results showed that the imported varieties were better than the three checks almost at all the locations. The variety 7four7 was the best one, followed by Cimega, Memphis, Taisiya and Farida. Among all the locations the variety 7four7 yielded the highest (54.4 t/ha), followed by Memphis at Munshiganj. Among the stations, Jamalpur was the best, followed by Munshiganj. In the farmer's field, Cimega produced the highest, closely followed by 7four7 and Memphis (Table 7). When tuber grade was considered, Memphis, Cimega and 7 four 7 produced higherproportion of large sized truber, while Taisiya produced the highest percentage of medium sized tubers (Table 7).

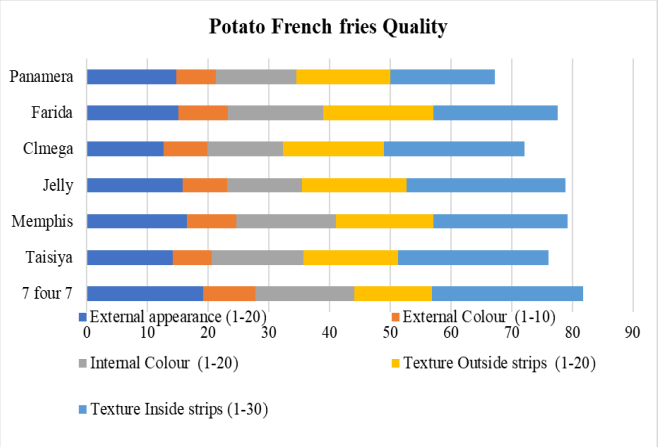

Figure 4: French fries quality of the seven exotic potato varieties. External appearance scale 1-20 (where 20=Excellent, 16=Very good, 12=Good, 8=Fair, 4=Poor); External colour scale 1-10 (where 10=Light whitish, 8=Light golden, 6=Golden, 4=slightly brown, 2=Dark); Internal colour scale 1-20 (where 20= Bright, white, crystalline, 16= Bright, white, 12= Off-white, opaque, 8=Grayish, 4=Dark gray); Texture of outside strips scale 1-20 (where 20=Crispy, 16=moderately crispy, 12=slightly crispy/soggy,8= moderately soggy, 4=soggy); Texture of inside strips scale 1-30 (where 30=Mealy, 24= moderately mealy/soggy, 18= slightly mealy/soggy,12=soggy, 6= very soggy)

Table 6: Tuber yield (t/ha) of potato varieties at 95 DAP at six locations in RYT, 2017-18

Variety	Location						
	Bogura	Debiganj	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Cimega	41.4hij	42.0hi	46.4efg	50.5bc	38.2j-n	49.18b-f	44.6b
Farida	34.8o-r	32.5rst	45.8fg	43.3gh	31.1stu	36.3m-q	37.3e
Memphis	42.2hi	31.7rst	46.0efg	52.3ab	36.2n-q	50.6bc	43.2c
Taisiya	38.1k-o	32.1rst	47.8c-f	49.9bcd	31.2stu	41.7hi	40.2d
7 four 7	38.9i-n	46.6d-g	48.0c-f	54.4a	39.6i-m	49.2b-e	46.1a
BARI Alu-7 (Diamant)	37.9k-p	29.5 tuv	41.1h-k	39.7i-l	30.4tu	36.4l-q	35.9f
BARI Alu-25 (Asterix)	34.2qrs	23.7w	34.6pqr	44.1gh	29.3tuv	48.2c-f	35.7f
BARI Alu-28 (L.Rosetta)	28.1uv	26.4vw	30.3tu	31.5rst	24.5w	32.5rst	28.9g
CV%	5.33						

3.4 Participatory variety selection (RYT-PVS), 2017-18

Same five varieties along with checks were evaluated at farmers' fields of six different agro ecological environments during 2017-18 cropping season as PVS. Yield of all varieties varied significantly. The highest average tuber yield (46.55 t/ha) was recorded in Cimega followed by 7 four 7 (44.94 t/ha) and Memphis (43.22 t/ha) and lowest average yield was found in check varieties BARI Alu-28 (Lady Rosetta) (30.52 t/ha).

Considering size, shape, colour and yield, farmers of all locations liked all new varieties, although it varied from farmer to farmer.

Table 7. Tuber grade by weight (Average six locations in percentage) in RYT, 2017 -18

Variety	% of Tuber Grading by Weight				
	<15 mm	15-28 mm	28-40mm	40-55mm	>55mm
Cimega	0.40	3.62	25.93	40.18	29.87
Farida	0.76	4.91	34.34	46.75	13.24
Memphis	0.35	2.56	19.53	46.70	30.86
Taisiya	0.83	5.88	49.45	38.43	5.41
7 four 7	0.58	3.46	22.92	46.27	26.77
BARI Alu-7 (Diamant)	0.91	6.28	40.05	41.27	11.48
BARI Alu-25 (Asterix)	1.09	5.27	32.61	50.57	10.46
BARI Alu-28 (L.Rosetta)	0.22	3.97	36.57	49.39	9.85

Table 8: Tuber yield (t/ha) of the exotic varieties at 95 DAP in PVS (farmers' fields), 2017-18

Variety	Location					
	Bogura	Gazipur	Jamalpur	Jashore	Munshiganj	Mean
Cimega	43.60	38.23	67.60	30.60	52.74	46.55
Farida	45.02	37.58	44.33	24.30	30.47	36.34
Memphis	44.64	30.42	55.00	36.80	49.24	43.22
Taisiya	34.05	28.94	58.66	27.80	44.56	38.80
7four7	48.77	32.00	73.33	26.35	44.27	44.94
BARI Alu-7 (Diamant)	33.67	26.79	54.13	24.65	33.64	34.58
BARI Alu-25 (Asterix)	30.19	26.25	48.16	28.40	40.54	34.71
BARI Alu-28 (L.Rosetta)	26.53	28.95	38.58	22.90	35.66	30.52

4. Conclusion

From the results of the three years of multi-location trials, and on-farm observation, it can be concluded that all the five varieties (Cimega, Farida, Memphis, Taisiya, and 7four7) are suitable for commercial cultivation. So these varieties may be recommended for release. Of those, the variety 7four7 is the highest yielder for early as well as main crop cultivation; Variety Farida is most suitable for table purpose as because of its medium sized round-oval uniform tubers and palatability. Variety Cimega is also a high yielder but should be further checked for other specific qualities like pests and diseases. While Memphis may be tried as a processing variety, as it produces large sized tubers, long-oval shape, smooth skin and good dry matter. For quality chips production, none was found comparable to the check.

Authors' Contributions

BCK: Planning, Conceptualization, Supervision in all locations. SN, MAK, MMI, AAM, MNA, MNU and KMDH conducted experiments in different locations and collected data. SN, MMI and MNU gathered and analysed data, validation, writing and editing, and revised the whole manuscript. All authors read and approved the final manuscript.

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Conflict of Interest

All authors declare that there is no conflict of interest either financially or otherwise.

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