The Agriculturists 13(2): 120-132(2015) ISSN 2304-7321 (Online), ISSN 1729-5211 (Print)
A Scientific Journal of Krishi Foundation ***Indexed Journal***

Yield Potential of Twelve Potato (*Solanum tuberosum*) Varieties Grown from Different Generations of Seed

Shafayet Hossain[1]*, Golam Rasul[2], M. A. Khaleque Mian[2], M. Moynul Haque[3] and Abdul Mannan Akanda[4]

[1]*Bangladesh Agricultural Development Corporation, Krishi Bhaban, 49-51 Dilusha C/A, Dhaka 1000;* [2]*Depts. of Genetics and Plant Breeding,* [3]*Agronomy and* [4]*Plant Pathology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh*

**Corresponding author and Email: shafayetbadc@gmail.com*

Received: 10 July 2014 Accepted: 12 December 2015

Abstract

An experiment was conducted at the research field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur to determine the yield potential of twelve potato varieties for consecutive years during 2009-2011. The mean performance of varieties, generations and their interactions varied significantly. Field performance revealed that the plant height decreased in all the varieties Raja, Arinda, Patrones, Multa, Asterix, Granola, Felsina, Diamant, Cardinal, Provento, Ailsa and BARI TPS1 in the 4th generation compared to 2nd generation (Breeders' Seed) except Raja and Arinda and it decreased compared to 3nd generation in Patrones and Felsina. The highest plant vigor was observed in Felsina and Asterix in the 1st generation, Patrones, Multa and Asterix in the 2nd generation and Raja and Granola in the 3rd generation. The highest number of stems per hill was produced by Patrones in all the three generations and the lowest was in Arinda in the 3rd generation. The highest number of hills per plot was recorded in Asterix and Granola and the lowest were in Ailsa and Raja. Higher tuber yield per hill was obtained from Ailsa, followed by Raja, Arinda and Felsina. Patrones produced higher number of tubers per plot in all the three generations while Ailsa produced the minimum which were followed by Felsina, Diamant, Raja and Arinda in all the generations. The yield of different varieties in the 2nd generation ranged from 11.94 t/ha (Ailsa) to 26.18 t/ha (Asterix) with an average yield of 19.06 t/ha. However, the highest yield was observed by Asterix followed by Granola, Arinda, Provento and Diamant in the 2nd generation.

Keywords: Potato varieties, yield potential, generation

1. Introduction

Among all the crops in the world, potato (*Solanum tuberosum*) is the most important one in respect of yield potential. Potentiality of any crop is determined by its genetic makeup. The production of protein and calorie per unit area and time is higher as compared to other major food crops including rice and wheat (Pushkarnath, 1976). Now, it occupies the second place in acreage and production after rice in Bangladesh (Anonymous, 2010). Better varieties with integrated crop management practices will increase yield and provide higher productivity for the farmers. There are significant opportunities for improved potato production to address poverty, food security and

environmental degradation. The total production of potato in the world was 315.10 million tons with an average yield was 16.73 t/ha in the year 2006. In Bangladesh, the production was 7.93 million tons in 2010 (Anonymous, 2010).

The yield per hectare was 35.26 tons in Denmark, 40.19 ton in France, 36.57 tons in Germany, 41.67 tons in the Netherlands and 43.67 tons in USA in 2006 (Anonymous, 2008). This indicates the high yield potential of potato crop. The yield of potato per ha in Bangladesh is lower compared to those in many potato growing countries of the world (BBS, 2010). The reasons for such a low yield and non-profitability of potato cultivation include lack of quality seeds of desired varieties, unavailability of certified seeds, lack of improved production methods, use of low yield potential cultivars, high production cost and short growing season. Out of the 42 varieties released by TCRC of Bangladesh Agricultural Research Institute, only a few are being cultivated by the farmers due to some reasons. The most important reasons for non acceptability of these varieties are susceptibility to the diseases and pests (Hossain, 2010), low yield and non-availability of quality seed tubers (Choudhury *et al*., 1995).

Yield can be increased considerably using high yield potential cultivars. Generally, the yield of exotic varieties is higher in their first generation (TCRC, 1988). The total seed potato requirement of Bangladesh is estimated at about 7.5 lakh tons per annum. Most of the seeds used are not of high quality. The farmers generally use the tubers for their own consumption as seeds, which results in poor yield in the following season. The locally produced certified seed or Truthfully Labelled Seed (TLS) meets only about 6.0 % of the total requirement. For that reason, every year about 10,000 tons of potato seeds need to be imported spending huge amount of foreign currency (Hossain, 2010). As per seed potato production system, Breeder seed (2^{nd} generation) are produced by BARI which is used for production of Foundation seed (3^{rd} generation) by BADC.

The Foundation seed is ultimately used for production of Certified seed (4^{th} generation) and or Truthfully Labelled Seed (TLS) to be used at farmers' level. The Breeder seeds possess the highest genetic purity and yield potentiality, which declines with advancing generations. The increase or decrease in yield over generations gives an idea about the yield potentiality of a variety but the information on the yield potential of different potato varieties is insufficient. In this context, an investigation was undertaken to study the field performance and yields of twelve potato varieties recommended for cultivation in Bangladesh over the generations and to identify the low degenerated potato varieties.

2. Materials and Methods

The study was conducted at the experimental field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur. Breeders seeds of twelve potato varieties namely Diamant, Cardinal, Granola, Patrones, Provento, Multa, Raja, Asterix, Felsina, Arinda, Ailsa and BARI TPS 1 were obtained from Breeders Seed Production Centre, BARI, Debigonj, Panchagarh for the study.

The study was conducted consecutively for three years. Breeder Seed was planted in 2008-09, third generation seed tubers foundation seed obtained from breeder seed were planted in 2009-10 and the 4th generation seed potato tubers or certified seed obtained from third generation were planted in 2010-11. The plant spacing was 60 cm from row to row and 15 cm from tuber to tuber. The unit plots were 4 m $\times$ 2.4 m (9.6 m^2). Each plot contained 104 hills at the rate of 26 per row. The seed tubers were planted in November in the first, second and third years, respectively.

The experiment was laid out in a Randomized Complete Block Design with three replications in each generation. Data were recorded on growth and yield. Collected data were transformed into square roots and analyzed with MSTAT-C programme following two factors

RCBD. The mean separation was done by Duncan's New Multiple Range Test at 5% level of significance.

3. Results and Discussion

3.1. *Morphological characters*

The morphological characters of plants distinctly varied among the generations and varieties. The highest plant height was recorded in 2nd generation which was similar to 4th generation and decreased in 3rd generation (Table 1). Plant height varied significantly among the varieties. Provento attained the tallest height of 35.30 cm, 42.92 cm, 52.38 cm and 57.90 cm at 35, 40, 45 and 50 days after planting (DAP), respectively. This was followed by Asterix (32.43 cm at 35 DAP, 48.48 cm at 45 Days after planting (DAP) and 52.97 cm at 50 DAP) and Felsina (37.78 cm at 40 DAP). At 50 DAP, the shortest plant height (35.49 cm) was observed in Arinda was similar to Patrones (Table 2), Ailsa (36.52 cm) and Granola (38.30 cm). Interaction of variety and generations revealed that the tallest plants were observed in 2nd generation of Felsina (64.37 cm) followed by 2nd generation of Provento (62.67 cm) and 4th generation of Provento (62.07 cm) at 50 DAP.

Table 1. Average plant height recorded in three successive generations

Generation	plant height(cm)			
	35DAP	40DAP	45DAP	50DAP
2nd gen. (G_2)	31.48 a	35.09 a	43.90 a	47.77 a
3rd gen. (G_3)	19.33 c	26.15 b	36.24 c	39.54 b
4th gen.(G_4)	29.81 b	35.92 a	40.82 b	46.38 a
CV(%)	10.00	12.21	10.22	8.52

Figures with the same letter(s) in column are not significantly different.

Table 2. Performance of different varieties for plant height

Varieties	Plant height(cm)			
	35 DAP	40 DAP	45 DAP	50 DAP
Diamant	27.40 de	32.43 de	39.71 de	43.50 de
Patrones	25.27 e	28.63 ef	33.19 gh	36.02 f
Raja	22.46 f	29.61 ef	37.78 ef	42.11 e
BARI TPS 1	25.62 e	31.43 de	43.55 cd	47.70 c
Arinda	17.18 g	23.12 g	30.57 h	35.49 f
Provento	35.30 a	42.92 a	52.38 a	57.90 a
Felsina	30.13 bc	37.78 bc	47.34 bc	52.00 b
Multa	31.59 b	32.47 de	41.98 de	45.91 cd
Asterix	32.43 b	39.37 ab	48.48 b	52.97 b
Granola	25.93 de	29.16 ef	34.94 fg	38.30 f
Cardinal	28.57 cd	35.03 cd	41.05 de	46.33 cd
Ailsa	20.64 f	26.67 fg	32.88 gh	36.52 f
CV(%)	10.0	12.21	10.22	8.52

Figures with the same letter(s) in column are not significantly different.

Table 3. Interaction effect of variety and generations on plant height

Generation x variety		Plant height(cm)			
		35 DAP	40 DAP	45 DAP	50 DAP
G_2	Diamant	32.43 b-d	38.20 c-f	44.73 c-e	47.27 d-g
	Patrones	28.63 d-g	31.10 f-l	35.24 g-l	36.93 i-n
	Raja	22.97 h-k	28.15 gm	38.35 d-k	42.07 e-k
	BARI TPS 1	29.97 c-f	33.37 e-j	46.81 bc	52.77 cd
	Arinda	19.67 k-m	25.20 k-m	35.57 f-l	41.13 g-m
	Provento	41.63 a	45.90 ab	57.95 a	62.67 ab
	Felsina	40.23 a	45.93 ab	57.81 a	64.37 a
	Multa	34.87 bc	35.33 d-g	44.00 cde	47.17 d-g
	Asterix	41.40 a	44.80 abc	53.71 ab	56.40 bc
	Granola	31.30 b-e	32.27 e-k	40.82 c-i	44.47 e-h
	Cardinal	32.40 b-d	34.67 d-i	40.51 c-i	43.73 e-i
	Ailsa	22.27 i-l	26.11 j-m	31.37 jkl	34.27 lmn
G_3	Diamant	20.50 j-m	23.60 lmn	33.11 i-l	36.24 j-n
	Patrones	21.67 jkl	26.93 i-m	32.23 jkl	35.43 k-n
	Raja	16.47 mn	22.37 mn	31.95 jkl	36.08 j-n
	BARI TPS1	17.80 lmn	26.03 j-m	43.31 c-g	41.83 f-k
	Arinda	10.20 o	16.83 n	23.01 m	26.08 o
	Provento	21.93 i-l	33.37 e-j	44.26 cde	48.97 d-f
	Felsina	23.23 h-k	33.03 e-j	43.66 c-f	47.86 d-g
	Multa	24.60 g-k	30.00 g-j	38.96 c-j	43.64 e-i
	Asterix	24.23 g-k	35.33 d-g	47.12 bc	49.39 de
	Granola	16.47 mn	22.00 mn	28.82 lm	31.89 no
	Cardinal	20.97 jm	29.23 gm	37.72 d-k	43.18 e-j
	Ailsa	13.93 no	23.10 mn	30.70 kl	33.84 mn
G_4	Diamant	29.27 d-g	35.50 d-g	41.30 c-h	47.00 d-g
	Patrones	25.50 f-j	27.87 g-m	32.10 jkl	35.70 k-n
	Raja	27.93 d-h	38.30 c-f	43.03 c-h	48.17 d-g
	BARI TPS1	29.10 d-g	34.90 d-h	40.53 c-i	48.50 d-g
	Arinda	21.67 jkl	27.33 hm	33.13 i-l	39.27 h-m
	Provento	42.33 a	49.50 a	54.93 a	62.07 ab
	Felsina	26.93 e-i	34.37 d-i	40.53 c-i	43.77 e-i
	Multa	35.30 b	40.07 b-e	42.97 c-h	46.93 d-g
	Asterix	31.67 b-e	37.97 c-f	44.60 cde	53.13 cd
	Granola	30.03 c-f	33.20 e-j	35.17 h-l	38.53 h-n
	Cardinal	32.33 b-d	41.20 b-d	44.93 cd	52.07 cd
	Ailsa	25.70 f-j	30.80 f-l	36.57 e-l	41.47 f-l
CV(%)		10.00	12.21	10.22	8.52

Figures with the same letter(s) in a column are not significantly different.

The highest foliage coverage was in 4th generation (84.72%) which was similar to that in 3rd generation (Table 3). Among varieties the highest foliage coverage was recorded in Asterix (89.44%) and the lowest was in Ailsa (52.22%). Interaction of variety and generations also revealed that the highest foliage coverage (%) was in 2nd generation of Asterix (98.33%) followed by 2nd generation of BARI TPS1 (93.33%), and 2nd generation of Felsina (93.34%) and 4th generation of Provento (93.33%) at 50 DAP (Table 4). The highest plant vigor (5.00) was obtained in 2nd generation of Felsina and Asterix, 4th geneartion of Raja and Granola and the lowest was found in 2nd generation of Ailsa (1.66) followed by 3rd generation of Ailsa (2.33) and 4th generation of Ailsa (2.66).

Among the generations, the highest number of stems per hill was produced in 2nd generation followed by 3rd and 4th generations. A significant variation in number of stems per hill was observed among the varieties (Table 5). The highest number of stems per hill was produced by Patrones (5.20) followed by Multa (4.10), Diamant (4.06), Asterix (4.03) and Cardinal (3.89). The lowest number of stems (2.71) was produced by Arinda and Ailsa. Interaction of variety and generations revealed that the highest number of stems per hill was produced in 2nd generation of Diamant (5.83) and was followed by Cardinal (5.63) and Patrones (5.60) in 2nd generation and Patrones in 3rd generation. The lowest number of stems (2.23) was obtained in Ailsa, Cardinal, Felsina and Provento in the 4th generation (Table 6).

Table 4. Effect of generations on foliage coverage, plant vigor and stems/hill

Generation	Foliage coverage (%)	Plant vigor (0-5)	Stems/hill (no.)
G_2	82.08a	4.17ab	4.29a
G_3	74.31b	4.01b	3.69b
G_4	84.72a	4.35a	2.81c
CV(%)	10.44	9.6	10.04

Figures with the same letter(s) in a column are not significantly different

Table 5. Performance of varieties in respect of foliage coverage, plant vigor and stems/hill

Varieties	Foliage coverage (%)	Plant vigor (0-5)	Stems/hill (no.)
Diamant	83.33 a	4.39 ab	4.06 b
Patrones	85.00 a	4.39 ab	5.20 a
Raja	73.89 c	4.17 b	3.48 c
BARI TPS1	85.56 a	4.50 ab	3.21 c
Arinda	73.89 bc	3.61 c	2.71 d
Provento	84.44 a	4.56 ab	3.38 c
Felsina	82.22 ab	4.28 ab	3.14 c
Multa	87.22 a	4.28 ab	4.10 b
Asterix	89.44 a	4.67 a	4.03 b
Granola	85.56 a	4.67 a	3.30 c
Cardinal	81.67 abc	4.39 ab	3.89 b
Ailsa	52.22 d	2.22 d	2.71 d
CV(%)	10.44	9.60	10.04

Figures with the same letter(s) in a column are not significantly different.

Table 6. Interaction effect of variety and generations on foliage coverage, plant vigor and stems/hill

Variety X Generations		Foliage coverage (%)	Plant vigor (0-5)	Stems/hill (no.)
G_2	Diamant	90.0 a-c	4.66 a-c	5.83 a
	Patrones	83.33 a-f	4.00 c-f	5.60 ab
	Raja	63.33 h	3.66 e-g	4.30 c-e
	BARI TPS1	93.33 a	4.66 a-c	3.43 f-i
	Arinda	70.00 f-h	3.00 g-i	3.00 h-l
	Provento	90.00 a-c	4.83 ab	3.63 f-h
	Felsina	93.33 a	5.00 a	3.73 e-g
	Multa	88.33 a-d	4.33 a-e	4.46 c
	Asterix	98.33 a	5.00 a	5.10 b
	Granola	90.00 a-c	4.83 ab	3.76 d-g
	Cardinal	85.00 a-f	4.33 a-e	5.63 ab
	Ailsa	40.00 i	1.66 j	3.06 g-k
G_3	Diamant	71.67d-h	4.00 c-f	3.63 e-h
	Patrones	88.33 a-d	4.66 a-c	5.56 ab
	Raja	70.00 f-h	3.83 d-f	3.20 f-k
	BARI TPS1	73.33 c-h	4.00 c-f	3.50 f-i
	Arinda	66.67 gh	3.33 f-h	3.26 f-k
	Provento	70.00 f-h	4.00 c-f	3.86 c-f
	Felsina	83.33 a-f	4.50 a-d	3.36 f-j
	Multa	91.67 ab	4.66 a-c	4.40 cd
	Asterix	86.67 a-e	4.66 a-c	3.50 f-i
	Granola	75.00 b-h	4.16 b-e	3.46 f-i
	Cardinal	71.67 e-h	4.00 c-f	3.73 e-g
	Ailsa	43.33 i	2.33 i	2.86 i-n
G_4	Diamant	88.33 a-d	4.50 a-d	2.70 J-n
	Patrones	83.33 a-f	4.50 a-d	4.43 c
	Raja	88.33 a-d	5.00 a	2.93 h-m
	BARI TPS1	90.00 a-c	4.83 ab	2.70 j-n
	Arinda	85.00 a-f	4.50 a-d	1.86 o
	Provento	93.33 a	4.83 ab	2.63 k-n
	Felsina	70.00 f-h	3.33 f-h	2.33 l-o
	Multa	81.67 a-g	3.83 d-f	3.43 f-i
	Asterix	83.33 a-f	4.33 a-e	3.50 f-i
	Granola	91.67 ab	5.00 a	2.66 k-n
	Cardinal	88.33 a-d	4.83 ab	2.30 m-o
	Ailsa	73.33 c-h	2.66 h	2.20 no
CV(%)		10.44	9.6	10.04

Figures with the same letter(s) in a column are not significantly different.

3.2. *Yield and yield contributing characters*

A significant variation in respect of the number of hills per plot was observed among the varieties. The highest number of hills per plot was produced by Granola (89.44) followed by Asterix, BARI TPS1 and Diamant (Table 7). The lowest number of hills per plot was observed in the variety Ailsa. Interaction of variety and generation showed that the highest number of hills per plot was produced by Asterix and Granola in 2nd generation. The lowest number of hills per plot was produced by Ailsa in all three generations. The number of hills per plot of all the varieties decreased in the 3rd generation compared to 2nd generation except Multa. The same trend was observed in the 4th generation compared to 3rd generation except Raja, Arinda and Ailsa (Table 8).

Significant variation in tuber yield per plot (kg) was observed among the varieties and interaction of generations and varieties (Table 7). The highest yield of tuber per plot was 24.22 kg in Granola followed by Asterix (23.36 kg), Provento (22.64 kg) and Arinda (22.01kg) and the lowest was obtained from Ailsa (11.14 kg). Interaction of generations and varieties revealed that the highest yield was produced by Granola (25.64 kg) in 2nd generation followed by Asterix, Arinda, Diamant and Provento 2nd generation and the lowest yield was produced by Ailsa (10.53 kg) in the 3rd generation (10.53 kg)(Table 8). Among the varieties, the highest number of tubers per plot was obtained from Patrones (678.6) followed by Granola (580.1), Asterix (541.8) and BARI TPS1 (531.1) and the lowest was in Ailsa (Table 7). Data on interaction of generations and varieties showed that the highest number of tubers per plot was obtained in Patrones (849.7) during 2nd generation and the lowest yield was produced by Ailsa (246.0) in the 3rd generation (Table 8).

The highest yield (t/ha) was produced by 2nd generation followed by 4th and 3rd generation (Figure 1). The highest yield was obtained from Granola followed by Asterix and Provento and the lowest was found in Ailsa. Although, Ailsa had the highest yield per hill but the yield per hectare was the lowest due to fewer numbers of hills per plot. Out of twelve potato varieties Ailsa, Multa, Felsina and Raja yielded less than 20.0 t/ha. The highest yield was obtained from Asterix in the 2nd generation (26.18) followed by Granola in the 3rd (23.92) and 4th (24.73) generations, while the lowest was obtained from Ailsa in 2nd (11.94) generation followed by 3rd (10.96) and 4th (11.92) generations (Figure 2).

Table 7. Performance of varieties on yield and yield contributing characters

Varieties	Hill/ Plot(no)	Tuber yield/ hill(g)	Tuber yield/ plot(kg)	No. of tuber/ Plot
Diamant	86.11 a	244.2 gh	20.91 de	437.6 c
Patrones	64.33 d	325.5 c	20.94 de	678.6 a
Raja	25.33 f	713.1 b	17.66 f	415.9 cd
BARI TPS1	88.11 a	227.9 h	19.58 e	531.1 b
Arinda	68.89 c	329.2 c	22.01 b-d	430.2 cd
Provento	81.44 b	289.8 d-f	22.64 bc	430.3 cd
Felsina	59.44 e	300.1 c-e	17.68 f	380.3 d
Multa	71.67 c	260.0 f-h	17.51 f	410.7 cd
Asterix	89.11 a	276.9 e-g	23.36 ab	541.8 b
Granola	89.44 a	277.0 e-g	24.22 a	580.1 b
Cardinal	70.22 c	316.9 cd	21.48 cd	452.2 c
Ailsa	13.11 g	850.6 a	11.14 g	295.8 e
CV(%)	5.98	8.96	10.82	10.82

Figures with the same letter(s) in a column are not significantly different.

Table 8. Interaction effect of variety and generation on yield and yield contributing characters

Variety x generation		No. of hill /plot	Tuber yield /hill(g)	Tuber yield /plot(kg)	No. of tuber /plot
G_2	Diamant	87.00 a-c	267.4 e-j	23.28 a-d	448.7 h-m
	Patrones	65.00 f-h	312.0 d-f	21.28 c-g	849.7 a
	Raja	25.67 i	724.0 c	18.63 g-l	508.3 e-i
	BARI TPS1	89.00 ab	239.3 h-j	20.61 d-h	638.0 bc
	Arinda	69.00 e-g	339.0 d	23.91 a-c	529.3 d-h
	Provento	82.00 bc	297.1 d-h	22.83 a-e	469.7 g-l
	Felsina	60.67 h	336.1 d	19.77 f-j	422.3 i-n
	Multa	72.33 ef	268.0 e-j	18.40 g-l	478.3 f-k
	Asterix	90.00 a	308.1 d-g	25.13 ab	627.7 bc
	Granola	90.00 a	298.1 d-h	25.64 a	680.7 b
	Cardinal	70.33 e-g	329.8 de	22.04 c-f	510.0 e-i
	Ailsa	13.00 j	889.3 a	11.47 m	376.3 lmn
G_3	Diamant	86.00 a-c	223.9 ij	18.94 g-k	484.7 f-k
	Patrones	64.33 gh	334.7 d	20.82 d-h	616.0 b-d
	Raja	25.00 i	702.2 c	16.27 kl	378.3 l-n
	BARI TPS1	87.67 a-c	217.4 j	18.44 g-l	468.0 g-l
	Arinda	68.33 e-g	311.0 d-g	19.77 f-j	401.7 k-n
	Provento	81.67 bc	286.3 d-i	22.48 b-f	408.7 j-n
	Felsina	60.00 h	263.1 f-j	15.97 l	326.0 no
	Multa	74.33 de	258.0 f-j	17.24 i-l	379.3 l-n
	Asterix	89.33 ab	260.0 f-j	22.24 b-f	582.0 c-e
	Granola	89.33 ab	246.1 g-j	22.00 c-f	503.7 e-j
	Cardinal	70.67 e-g	311.5 d-g	19.88 e-i	431.3 i-m
	Ailsa	13.00 j	807.9 b	10.53 m	246.0 o
G_4	Diamant	85.33 a-c	241.3 h-j	20.52 d-h	379.3 l-n
	Patrones	63.67 gh	329.8 de	20.72 d-h	570.0 c-f
	Raja	25.33 i	713.2 c	18.08 h-l	361.0 mn
	BARI TPS1	87.67 a-c	226.9 ij	19.70 f-j	487.3 e-k
	Arinda	69.33 e-g	337.7 d	22.36 b-f	359.7 mn
	Provento	80.67 cd	286.0 d-i	22.62 b-f	412.7 i-n
	Felsina	57.67 h	301.2 d-h	17.30 i-l	392.7 k-n
	Multa	68.33 e-g	253.9 f-j	16.88 j-l	374.3 lmn
	Asterix	88.00 a-c	262.4 f-j	22.70 b-f	415.7 i-n
	Granola	89.00 ab	286.7 d-i	25.02 ab	556.0 c-g
	Cardinal	69.67 e-g	309.5 d-g	22.52 b-f	415.3 i-n
	Ailsa	13.33 j	854.7 ab	11.44 m	265.0 o
CV(%)		5.98	8.96	10.82	10.82

Figures with the same letter(s) in a column are not significantly different at 5% level.

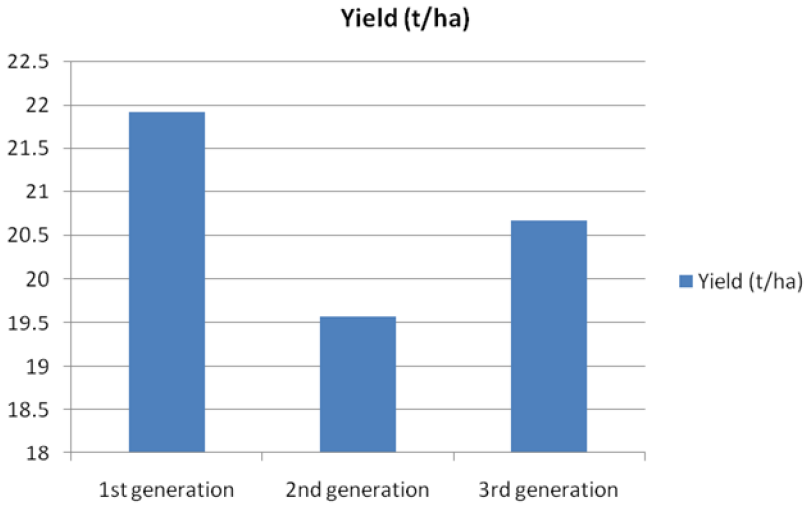

Figure 1. Effect of generations on yield (t/ha) of twelve potato varieties

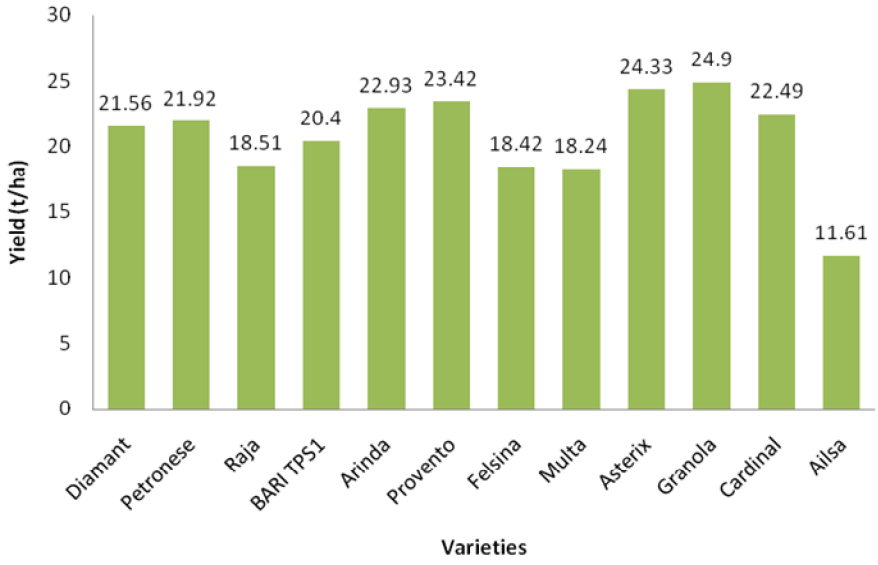

Figure 2. Yields of potato varieties (t/ha)

Table 9. Interaction effect of variety and generations on yield potential of potato

	Yield (ton/ha)				% increase or decrease over 1st generation			
Variety	BS gen.	FS gen.	CS gen.	*Mean	For FS gen.	For CS gen.	Mean	Diseased Plant (%)
Diamant	23.58a-d	19.73 g-j	21.38 d-h	21.56	-16.33	-9.33	-12.83	14.70
Petrones	22.50c-f	21.69 d-g	21.58 d-g	21.92	-3.60	-4.09	-3.84	23.83
Raja	19.74g-j	16.95 k	18.83 h-k	18.51	-14.13	-4.42	-9.37	16.75
BARI TPS1	21.47d-h	19.21 g-k	20.52 f-i	20.40	-10.53	-4.61	-7.48	30.16
Arinda	24.91a-c	20.59 e-i	23.29 c-e	22.93	-17.34	-6.50	-11.92	29.09
Provento	23.78a-d	23.42 b-d	23.06 c-f	23.42	-1.51	-3.03	-2.27	22.77
Felsina	20.60e-i	16.64 k	18.02 i-k	18.42	-19.22	-12.52	-15.87	26.66
Multa	19.17g-k	17.96 i-k	17.59 jk	18.24	-6.31	-8.24	-7.28	30.52
Asterix	26.18a	23.17 c-f	23.65 a-d	24.33	-11.50	-9.66	-10.58	23.83
Granola	26.04ab	23.92 a-d	24.73 a-c	24.90	-8.14	-5.03	-6.59	6.95
Cardinal	23.29c-e	20.71 e-h	23.46 b-d	22.49	-11.08	+0.73	-5.17	24.25
Ailsa	11.94l	10.96 l	11.92 l	11.61	-8.21	-0.17	-4.19	27.00
CV (%)			6.74					
$LSD_{0.05}$			2.275					
Mean	21.93A	19.58C	20.67B					

Figure with the same letter(s) in a column are not significantly different at 5% level.
*Average of 3 generations

The average yield of 3rd generation was significantly lower (19.58 t/ha) than that of 2nd generation (21.93 t/ha), this might be due to degeneration caused by viral diseases although the reduction of yield in the 3rd generation over the 2nd generation occurred in all varieties, the degree of reduction varied widely. It was the lowest in Provento (-1.51%) followed by Patrones (-3.6%) and Multa (-6.31%) and the highest in Felsina (-19.22%) followed Arinda (-17.34%), Diamant (-16.33%) and Raja (-14.13%) (Table 9). High reduction of yield in the 3rd generation over 2nd generation indicated that these varieties were more susceptible to degenerative diseases (Table 9). The average yield of 4th generation was lower (20.67 t/ha) than 2nd generation but higher than 3rd generation. In the 4th generation the yield ranged from 11.92 to 24.73 tons per hectare. All the varieties, except Provento and Multa, showed slightly increase in yield than the 3rd generation. This might be due to favorable environment in the 4th generation although disease infection was higher than other generations.

The rate of yield reduction is calculated as percent yield reduction in successive generations over 2nd generation. Considering all the three generations, the highest reduction in yield was observed in Felsina (-15.87%) followed by Diamant (-12.83%), Arinda (-11.92%), Asterix (-10.58%) and Raja (-9.37%) and the lowest was in Provento (-2.27%). Granola, Asterix, Provento, Arinda and Cardinal showed better performance in respect of yield in different generations indicating high yield potential. Arinda, Felsina, Asterix and Granola gave good yield in 2nd generation but the rate of yield reduction was very high in the subsequent generations.

Table 10. Incidence of PVY and PLRV in the three generations as detected by DAS-ELISA

Variety	Infected plants (Percent)											
	1st generation			2nd generation			3rd generation			Mean of three gen.		
	PVY	PLRV	Mixed	PVY	PLRV	Mixed	PVY	PLRV	Mixed	PVY	PLRV	Mixed
Diamant	4.12	0.00	0.00	15.00	0.00	5.13	25.00	0.00	5.64	14.71	0.00	3.59
Patrones	5.34	1.57	0.00	21.21	2.15	0.00	34.12	7.12	0.00	20.22	3.61	0.00
Raja	6.12	0.00	0.00	15.00	0.00	0.00	25.00	4.13	2.35	15.37	1.38	0.78
BARI TPS1	8.69	2.12	0.00	20.00	5.68	16.67	42.00	12.00	4.17	23.56	6.60	6.94
Arinda	8.24	2.00	0.00	25.37	5.00	9.50	40.00	6.68	8.00	24.54	4.56	5.83
Provento	7.98	2.35	0.00	15.00	8.00	0.00	25.00	10.00	0.00	15.99	6.78	0.00
Felsina	5.98	2.08	0.00	20.98	4.17	0.00	37.78	9.00	2.13	21.58	5.08	0.71
Multa	8.12	2.10	4.17	21.87	12.50	0.00	35.98	11.00	0.00	21.99	8.53	1.39
Asterix	4.14	2.08	2.08	22.08	4.17	0.00	31.13	7.89	4.17	19.12	4.71	2.08
Granola	2.15	0.00	0.00	6.59	0.00	4.17	9.13	2.98	0.00	5.96	0.99	1.39
Cardinal	5.34	0.00	0.00	21.68	3.24	0.00	37.38	5.12	0.00	21.47	2.79	0.00
Ailsa	9.13	3.21	5.12	15.00	10.32	4.65	32.00	11.34	5.67	18.71	8.29	5.15

Some varieties such as, Provento and Multa performed the best in the third and forth generations as compared to second generation. Hooker (1981) observed that some varieties gave good yield even with virus diseases but Rashid *et al*. (1986) found that degeneration due to viruses reduces the yield potential of potato varieties, often very rapidly. However, considering the studied parameters and giving emphasis on yield and degenerative trend and also disease incidence (Table 10), the varieties Provento, Granola and Cardinal showed acceptable performance.

4. Conclusions

In respect of plant height, Provento scored the highest at 50 DAP in all the three generations. The shortest plants were observed in the variety Arinda. Plant height decreased in all varieties except Raja and Arinda in the third generation as compared to the first generation and it decreased compared to the second generation only in Patrones and Felsina. The highest foliage coverage was found in Asterix (98.33%), Multa (91.67%) and Provento (93.33%) at 50 DAP in the first, second and third generations, respectively. The highest average plant vigor was observed in Granola followed by Asterix, Provento and BARI TPS1. The highest number of stems per hill was produced by Patrones in all the generations and the lowest by Arinda. The maximum number of hills per plot was recorded in Asterix (90.00) and Granola (90.00) while the minimum was in Ailsa and Raja in all the generations. Higher tuber yield per hill was obtained from Ailsa which was followed by Raja, Arinda, Felsina and Patrones. The minimum tuber yield per hill was recorded from BARI TPS1 which was more or less similar to Diamant, Multa and Asterix. The highest yield of tuber per plot was obtained from Granola (25.64 kg) which was followed by Asterix (25.13 kg), Arinda (23.91kg), Diamant (23.28 kg) and Provento (22.83 kg) in the first generation. Nearly similar trend was found in the third generation. In the second generation, Provento yielded the highest (22.48 kg) which was followed by Asterix (22.24 kg), Granola (22.00 kg) and Patrones (20.82 kg). Ailsa produced the minimum yield in all the generations, which was followed by Multa and Raja in the 1st generation, Felsina and Raja in the 2nd generation and Multa and Felsina (17.30 kg) in the 3rd generation. Among the three generations, higher yield was obtained in the 1st generation, and then it slightly decreased in the 2nd generation and again increased in the 3rd generation except in Patrones and Multa. The yields of different varieties in the 1st generation ranged from 11.94 t/ha (Ailsa) to 26.18 t/ha (Asterix) with an average yield of 19.06 tons/ha. However the highest yield potentiality was observed by Asterix followed by Granola, Arinda, Provento and Diamant in the 1st generation.

References

Anonymous. 2008. FAO Production Year Book. FAO, Rome, Italy. Database at http://apps.fao.org.

Anonymous. 2010. Annual Report, 2009-10. Tuber Crops Research Centre (TCRC), BARI, Joydebpur, Gazipur.

Anonymous. 2010. Statistical Year Book, 2009-10. Bangladesh Bureau of Statistics (BBS), Dhaka.

Anonymous. 1988. Annual report, 1987-88. Potato Research Centre. Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

Chowdhury, E. H. and. Rasul, M. G. 1995. True potato seed research and development in Bangladesh. Proc. of the workshop on National Programme for True Potato Seed in Bangladesh. BARC, Dhaka; 28-37 pp.

Hossain, M., Hossain, M. I., and Dey, T. K., 2010. Disease free seed potato production through seed plot technique at farm level. *Annual report 2009-10.* Tuber Crops Research Centre, BARI, Joydebur, Gazipur. 147 p.

Hooker, W. J. 1981. Compendium of potato diseases. American Phytopath. Soc. USA. 125 p.

Pushkarnath. 1976. Potato in Sub-tropics. Orient Longman Ltd., New Delhi. 110002, India. 289 p.

Rashid, M. M., Khan, A. L., and Ali, M. S., 1986. *Beej Alu Utpadon* (In Bangla). Potato Research Centre, BARI, Joydebpur, Gazipur, Bangladesh. 156 p.