

RESEARCH ARTICLE

SEED QUALITY ASSESSMENT OF FARMER'S PRODUCED SEED POTATO

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ABSTRACT

The experiment was conducted at the research field and post graduate laboratory of Plant Pathology Department, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during 2015 - 2016 to find out suitable method of farm saved seed potato production by the farmers. Farm saved seed was compared with certified seed, positive selection seed, seed plot technique's seed and TLS seeds potato in the experiment. The maximum yield (27.72 ton/ha) was recorded from Positive Selection's Seeds which was similar with Certified and Seeds of SPT. But the maximum plants ($\geq 8\%$, 7.33% and 4.17%) were infected by PVY, PLRV and PMV respectively in Farmer's seed. The seed potatoes of positive selection and seed plot technique are the best alternate to supplement the certified seed.

KEYWORDS

Positive Selection's Seeds, Certified Seeds, seed plot technique's seed.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) belonging to the family Solanaceae is economical important crop of the world's. It is also very popular in Bangladesh because of its more profit return. It gives remarkable high yield and produces more palatable energy per unit area and time than many other crops. The adaptation of potato cultivation in developing countries are increasing as food crop (Naik and Karihaloo, 2007). Potato is the 3rd most important food crop of Bangladesh; it is mainly used as a vegetable crop, auxiliary to main food. It is also world leading crop that furnishes appreciable amount of vitamin-B and Vitamin-C as well as some minerals (Thomson and Kelly 1997). Total area under potato crop at 2016-17 has been 4,99,725 hectares compared to 4,75,488 hectares of the year 2105-16 which is 5.097% higher. Average yield rate of potato has been estimated 20.44 metric tons per hectare and total potato production has been estimated 102,15,957 metric tons at 2016-17 compared to 94,74,098 metric tons of the year 2015-16 which was 7.83% higher (BBS 2018). The seed rate of potato is very high which increase total production cost and it is count as a major inhibitor to use quality by the growers. The major constraints in potato production have been the incidence of unavailability of quality and healthy seed potato, difficulties in the production and distribution of disease free seeds, wide range of pests and diseases, inadequacies of cold storage facilities resulting in rotting and sprouting and violent price fluctuations. So it is essential to ensure quality seed potato within farmer's ability. Use of low quality seed is one of the main reasons for this low yield of potato. Only 10% quality seed potato of the

total requirement is being supplied by GOB and other private sectors. The remaining 90% seed requirement is being mitigated by the farmers' retained seed which are usually of poor quality (Kabir and Haque, 2012). For this reason, it is essential to increase the quality of farmer's own seed potato, which can directly decrease the yield gap between the yield of farmers and potential yield. a large groups of potato growers use their farm saved low quality seed tubers. Considering these the experiment was undertaken for the following objectives to find out suitable method of farm saved potato seed production by producer, to improve farmer's own seed and to increase average yield of Bangladesh.

2. MATERIALS AND METHODS

The experiment was conducted at the research field and post graduate laboratory of Plant Pathology Division, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, during November 2015 to March 2016. Maximum temperature, minimum temperature, humidity (%) and total rainfall during the cropping period have been presented in Fig. 1. Soil texture of the experiment field was clay loam to sandy loam having 6.25 P^H. The experiment was laid out in Randomized complete block design (RCBD) was used with 03 (three) replications where plot size was 2.4 m × 4.0 m with 60 cm × 25 cm spacing. Treatments were as (i). Farmer's seed, (ii). Seeds of Positive selection, (iii). Certified seed, (iv). Seeds of seed plot technique and (v). Truthfully level seed of the most popular variety "Cardinal". The tillage operations were done for 4-5 times during 25 Oct to 03 November 2015. Before final land preparation, 3 t ha⁻¹ compost of cowdung and total amount of K-S-Mg-Zn-B were applied 100-

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15-10-4,1 kg ha⁻¹ and half of N and P were applied as basal, respectively. Remaining half of N and P were top dressed at 35 DAP (FRG 2012). The sprouted seed potatoes were planted as per treatments at 4 November 2015. Planting was done at the depth of 5-7 cm at 25 cm × 60 cm spacing. After planting the tubers were covered with soil. Earthing up and weeding was done two times during growing period. The first earthing up was done after planting and second earthing up was done at 35 DAP (Days after planting). Irrigation was provided thrice throughout the growing period at 10, 35 and 50 DAP. Dursban @ 5 ml per litre and Metasystox @ 1 ml per litre was applied respectively to control cut worm and aphid. The fungicide Mencozeb @ 2.0 gm per liter was sprayed at every 10 days interval as routine spray for seed potato production to keep the potato plants free from late blight infection. The crop was haulm pulled at 75 DAP. After 10 days haulm pulling the crop was harvested. The ten plants were harvested at the first time from each plot and then the rest of the plants were harvested with help of a country plough and spade. Care was taken to avoid injury in potatoes during harvesting. Emergence percentage was recorded by eye observation at 20 DAP and 30 DAP. The percent disease incidence of different diseases was recorded by observing the symptoms of diseases like Potato leaf roll virus (PLRV), Potato mosaic virus (PMV), Potato virus Y (PVY), Late blight (LB) of potato and Bacterial wilt, etc. For confirmation of viral diseases ELIESA test were done at Tuber Crop Research Centre, Bangladesh Agricultural Research Institute, Gazipur. The incidence of PLRV, PVY and PMV and bacterial wilt was assessed with the following formula-

$$\text{Percent disease incidence of plants} = \frac{\text{Number of plants infected by disease}}{\text{Total number of plants observed}} \times 100$$

The yield was taken by calculation of weight of tubers per plot after harvest. Tubers were graded into four categories namely over size (> 55 mm), "B" grade (40-55 mm), "A" grade (28-40 mm) and small size (10-28 mm). Tuber number and weight per plant, seed tuber number and weight per plant, were determined. The number of infected tubers by Common scab, *Rhizoctonia* canker and Deformed tuber were counted by eye inspection of the tubers at room storage condition. The disease incidence (%) was calculated according to the equations given below.

$$\text{Disease incidence (\%)} = \frac{\text{Total no. of infected tubers}}{\text{Total number of tubers}} \times 100$$

Percentage of deformed tuber were calculated using the following formula:

$$\text{Deformed tuber (\%)} = \frac{\text{Number of deformed tuber}}{\text{Number of total tuber}} \times 100$$

Data were subjected to statistical analysis to find out the levels of significance of the experimental results. The mean of all the treatments were calculated and analysis of variance was performed, and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) at 5% level of probability using the statistical computer package program.

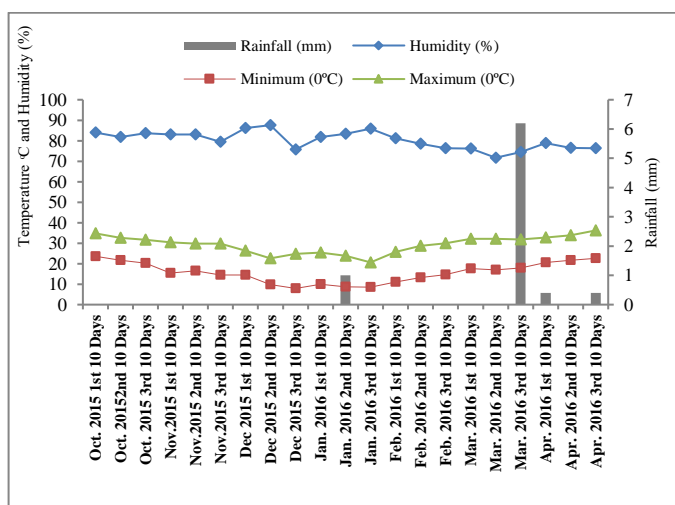


Figure 1: Ten days average maximum temperature, minimum temperature, humidity and rainfall during the cropping period of 15-16 at HSTU, Dinajpur

3. RESULTS AND DISCUSSIONS

The quality of farmer's seed potato is most remarkable and noticeable subjected to low cost quality seed potato production.

3.1 Emergence of seed potato

The maximum emergence percentage of potato is remarkably influenced by the quality of seed which is directly related with the source of seeds. The maximum emergence percentage (98.96) at 20 days after planting (DAP) was recorded from Positive Selection's Seeds which is statistically similar with Certified Seed and seeds of seed plot techniques (STP) and the minimum emergence percentage (89.38) recorded from Farmer's seed (Table 3). The seeds of positive selection were more vigorous than others. The result is supported by the findings of Okeyo *et al.*, (2018), where they stated that Positive Selection is a good management strategy to manage the seed borne potato viruses.

3.2 Plant population at haulm pulling time

The healthy potato plants can survive more time in the field than the diseased one. The highest plant percentage (98.96) at haulm pulling time was recorded from Positive Selection's Seeds, but the lowest plant percentage (85.82) recorded from Farmer's seed (Table 1.1). On the other hand, the greatest number of plant was found in positive selection and smallest number of losses plant was found from farmer's seed. Good quality seed tuber has the potentiality of good field performance. The result is corroborated with the findings of (Okeyo *et al.*, 2018; Gildemacher *et al.*, 2007), where they stated that positive selection seed potatoes are better than normal seed tubers.

3.3 Tuber number per plant

The tuber number per plant is most important for yield and quality of seed potato. The significant variation was also observed in tuber number per plant among the different sources of seed potatoes. The maximum tuber number (8.34) per plant was observed from positive selection's seed potatoes, which is statistically similar with the certified seed and split plot technique's seed potato. The minimum tuber number (5.96) per plants was counted from the truthfully labelled seed tuber which was statistically similar with farmer's own seed potato (Table 3). The seed potatoes of positive selection produced maximum tuber number per plant might be due to more vigorous and low disease susceptibility than other source's seed potato. The result is supported by the findings of Okeyo *et al.*, (2018). Where they stated that the field of positive selected seed potato had low visual virus incidences, higher number of tubers per hill and yield (t/ha) and low virus incidences of PVS (47%), and PVY (0.0%), PLRV (0.0%), and PVM (0.0%) were recorded and tested by ELISA from the plots of positive Selected seed potato.

Table 1: Status of different sources seed potatoes on plant population and tubers per plant

Treatments	% Emergence 20 DAP	% Emergence 30 DAP	% plants at Haulm Pulling Time	Tubers /plant
Farmer's Seed	89.38 b	97	85.42 b	6.18 b
Positive Selection's Seeds	98.96 a	100	98.96 a	8.24 a
Certified Seed	95.83 a	100	98.96 a	8.22 a
Seeds of SPT	96.67 a	100	97.92 a	7.46 a
TLS	90.62 b	99	95.83 a	5.96 b
LSD _{0.05}	4.692	NS	3.1681	1.1395
CV (%)	2.64		1.76	8.39

Figures in a column having similar letter(s) do not differ significantly at 5% level of probability

3.4 Performance of different sources seed potatoes on grading of tubers and yield

The seed potatoes of different sources were varied significantly in respect of 28-40 mm tuber per plant, 40-55 mm tuber per plant, over size tuber

per plant and also yield (Table-4). Considering the tuber yield and different size tuber's weight per plant were significant. The maximum weight of "A" grade seed tuber was found from the seed of SPT which was similar with Certified and Positive Selection's Seeds. But maximum weight of "B" grade (257.26 g) tuber was found from the positive Selection's seed potato and minimum weight (198.54 g) was found in farmer's seed. The highest weight (70.31 g) of oversized seed was counted from Farmer's own seed which was similar with positive Selection's Seeds. The largest weight of tuber per plant was observed in Positive Selection's Seeds which was similar with Certified and Seeds of SPT and the smallest weight (21.97 ton/ha) was observed in farmer's seed (Table 4). The collected seed from the healthy and vigorous plant performed better yield. The result is supported by the findings of Okeyo *et al.*, (2018). Where they stated that Positive selection plots had low visual virus incidences, high number of tubers per hill and yield (t/ha).

Treatment	Weight of tuber per plant (g)					Yield (ton/ha)
	10-28 mm	28-40 mm	40-55 mm	>55 mm	total	
Farmer's Seed	13.13	47.5 b	198.54 c	70.31 a	329.48 b	21.97 b
Positive Selection's Seed	17.60	76.04 a	257.26 a	64.86 a	415.77 a	27.72 a
Certified Seed	16.25	77.34 a	250.49 ab	38.59 c	382.68 a	25.51 a
Seeds of SPT	17.42	91.77 a	229.58 b	45.21 bc	383.98 a	25.60 a
TLS	9.90	54.27 b	207.29 c	62.92 ab	334.37 b	22.29 b
LSD _{0.05}	NS	16.34	22.05	18.31	34.41	2.29
CV (%)		12.51	5.12	17.24	4.95	4.95

Figures in a column having similar letter(s) do not differ significantly at 5% level of probability

3.5 Status of different source's seed potatoes on viral diseases

The field performance of different seed sources on viral diseases like potato virus Y (PVY) potato leaf roll virus (PLRV) and potato mosaic virus (PMV) are shown in Figure 1. The maximum plants (more than 8 %) were infected by PVY in Farmer's seed, but no PVY infected plants was found in the seeds of certified and Positive selection. Considering PLRV infected plant, severely infection (7.33 %) observed in farmer's seeds, where certified seeds performed lowest infection (1.04% plant). Considering PMV infected plant, severely infection (4.17 %) observed in farmer's seeds, where certified seeds performed lowest infection (1.04% plant). Seeds of SPT and TLS (truthfully labelled seed) performed more infection than certified seed in both PLRV and PMV. These results are supported by Anonymous, where stated that seeds of SPT is better than farmer's seed (Anonymous, 2012). These results are also corroborated with Okeyo *et al.*, (2018) where they stated that Positive selection plots had low visual virus incidences.

3.6 Status of different source's seed potato on bacterial wilt and Black scurf

Maximum plants were infected by wilt at 60 DAP in farmer's seed, minimum plants are infected in the field of certified and seeds of SPT (Figure 3). On the other hand, highest percentage of plants infected by Black scurf (*Rhizoctonia* Canker) both in the field of positive selection seed and Certified seed. This result is supported by Anonymous 2012, they found that incidence of virus, bacteria, common scab, and late blight were very low in the trial compared to farmer's practice at neighbor plot.

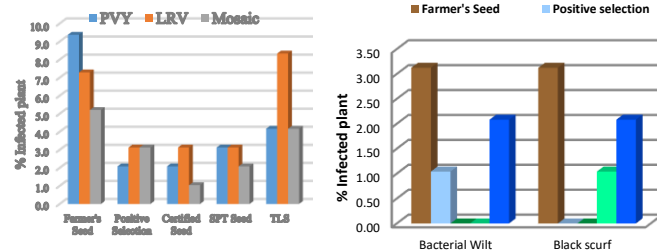


Figure 2: Status of different source's seed potato on viral diseases

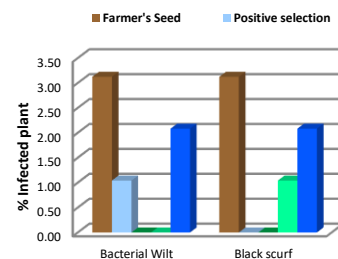


Figure 3: Status of different source's seed potato on bacterial wilt and black scurf

3.7 Status of different sources seed potatoes on tuber diseases and market-table Potato

Potato tubers, from the seeds of different sources, were infected significantly by *Rhizoctonia* Canker, common scab and deformed. The highest infected tuber percentage (1.00) of *Rhizoctonia* Canker found in the field of TLS which is similar with Farmer's seed. Lowest infected tuber percentage (0%) of *Rhizoctonia* canker found in the field of certified seeds. Considering the common scab maximum percent infected tuber recorded from Farmer's seed. In case of deformed or Physiological Disorder tuber, largest percent (7.36) was found in farmer's seeds. The lowest percent (1.55) of deformed tubers was found in positive selection seed, which is similar with the tubers of certified or SPT seeds (Table 5). These results are also supported by Anonymous 2012, where they stated that incidence of virus, bacteria, common scab, and late blight were very low in Split plot techniques plot compared to farmer's practice at neighbor plot.

Treatments	% Infected tuber (wt basis)			% Non Marketable Tuber	% Marketable Potato
	<i>Rhizoctonia</i> Canker	Common Scab	Deformed		
Farmer's Seed	1.00 a	2.01	7.36 a	14.22 a	85.78 b
Positive Selection's Seeds	0.39 b	0.91	1.55 b	4.02 b	95.98 a
Certified Seed	0.00 c	0.77	1.68 b	3.36 b	96.64 a
Seeds of SPT	0.42 b	0.42	1.81 b	3.62 b	96.38 a
TLS	1.39 a	1.56	6.65 a	12.54 a	87.46 b
LSD _{0.05}	0.56	1.37	2.70	5.97	5.97
CV (%)	46.73	53.59	37.65	42.01	3.43

Figures in a column having similar letter(s) do not differ significantly at 5% level of probability

Farmer's seeds are infected with different diseases and so that maximum percent (14.22) Potato tubers were non marketable and minimum percent (85.78) potato tubers were marketable among the treatments. On the other hand, minimum non marketable percent (3.36) tubers and maximum marketable (96.64) percent produced by certified seeds which is similar with positive selection or SPT seed potato.

3.8 Economic analysis

Benefit-cost analysis of potato production from different sources seed potatoes are presented in Table 6. The highest gross return (3367.81\$ha⁻¹), net return (1823.50 \$ha⁻¹) and highest benefit cost ratio (2.2) was recorded from Positive Selection's Seeds. But closest benefit cost ratio (2.1) was recorded in Seeds of SPT. The lowest gross return (2385.55\$ha⁻¹) was observed in Farmer's Seed.

Table 6: Benefit Cost Ratio of potato production from different sources seed potatoes

Treatments	Yield (tha ⁻¹)	Marketable yield (tha ⁻¹)	gross return (\$ha ⁻¹)	Cost (\$ha ⁻¹)	Net return (\$ha ⁻¹)	BCR
Farmer's Seed	21.97	18.85	2385.55	1449.37	936.19	1.6
Positive Selection's Seeds	27.72	26.61	3367.81	1544.30	1823.50	2.2
Certified Seed	25.51	24.65	3120.62	1734.18	1386.44	1.8
Seeds of SPT	25.60	24.67	3123.20	1487.34	1635.86	2.1
TLS	22.29	19.49	2467.70	1639.24	828.46	1.5

Here, certified seed potato = 0.44 \$kg⁻¹, TLS= kg⁻¹0.38 \$kg⁻¹, Positive Selection's = kg⁻¹ 0.32\$kg⁻¹, Seeds Farmer's Seed = 0.25 \$kg⁻¹, Seeds of SPT= 0.29 \$kg⁻¹ and Potato = 0.13 \$kg⁻¹ Urea 0.20 \$kg⁻¹, TSP 0.28 \$kg⁻¹, MoP 0.19 \$kg⁻¹, Gypsum 0.32 \$kg⁻¹, ZnSO₄ 2.8 \$kg⁻¹, Boric Acid 5.32 \$kg⁻¹, Labour 5.1 \$Day⁻¹ Person⁻¹ and Land rent 190 \$ season⁻¹ ha⁻¹.

4. CONCLUSION

From the aforementioned results and discussions, it can be concluded that the seed potatoes of positive selection and seed plot technique are the best alternate to supplement the certified seed. Potato farmers can now choose to either buy commercial seed potatoes or practice positive selection or Seed Plot Technique (SPT). Although the positive selection technique does not require any cash investments, it does require an extra labor. Whereas Seed Plot Technique needs some extra effort and maintenance of isolated field.

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