Yield and Economic Return of Seedling Tuber Derived from True Potato Seed as Influenced by Tuber Size and Plant Spacing

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Abstract The experiment was conducted at Agronomy research field of Sher-e-Bangla Agricultural University, Dhaka, during 10 November 2012 to 10 March 2013 to observe the response of seedling tuber weight and plant spacing on yield and economic analysis of potato. Four weight of seedling tubers *viz.*, 40 ± 2, 30 ± 2, 20 ± 2 and 10 ± 2 g and three plant spacing *viz.*, 60 cm × 25 cm, 60 cm × 20 cm and 60 cm × 15 cm were used as treatment and laid out in Randomized Complete Block Design (RCBD) with three replications. Results revealed that in general yield attributes such as tubers hill^{-1} and tuber weight and tuber yield of gross, marketable and non-marketable were significantly influenced by seedling tuber weight and plant spacing .The highest tuber yield ha^{-1} both gross and marketable was recorded in the tuber weight of 30 ± 2 g due to increased number of tubers hill^{-1} and tuber yield hill^{-1} and the lowest from smaller seedling tuber of 10 ± 2 g. Results showed that tubers hill^{-1}, single tuber weight and tuber weight hill^{-1} increased with increasing plant spacing. The highest gross and marketable tuber yield ha^{-1} was observed in the plant spacing of 60 cm × 20 cm and the lowest from closer spacing of 60 cm × 15 cm. For combined effect of seedling tuber weight and plant spacing, the highest gross and marketable tuber yield was observed in the treatment combination of 40 ± 2 g seed tuber with the plant spacing of 60 cm × 25 cm. But economic point of view with high yield performance, the seedling tuber size of 30 ± 2 g with plant spacing of 60 cm × 20 cm was more profitable than those of other treatment combinations.

Keywords True Potato Seed, Seedling Tuber, Seed Size, Spacing, Yield, Economic Return

1. Introduction

Potato (*Solanum tuberosum*) is the 4th world crop after wheat, rice and maize. Bangladesh is the 7th potato production country in the world [1]. In Bangladesh, it ranks 2nd after rice in production. The total area under potato crop, national average yield and total production in Bangladesh are 430446 hectares, 19.071 tons ha^{-1} and 8205470 metric tons, respectively. Total production is increasing day by day as such consumption also rapidly increasing in Bangladesh [2].The yield of potato is very low in Bangladesh comparison to 40.16 tha^{-1}in USA, 42.1 tha^{-1} in Denmark and 40.0 tha^{-1} in UK [3], due to the use of low quality seed and use of sub-optimal production practices. Performance of potato can be increased by optimizing use of manure and fertilizer, planting time, spacing and use of optimal sized seed [4]. A good TPS progeny can produce 500 to 800 small tubers ranged from 1 to 45 g (seedling tuber) in a meter of land when planted at 10 cm × 10 cm spacing [5].These seedling tubers can be planted as good quality tubers for ware potato production having higher yield potentiality when an optimum planting spacing is used [6]. Till now the farmers of Bangladesh don't know the optimum grade, time, weight of seedling tuber to cultivate commercial. The planting material of potato is very important which are related to the cost. They used bulk amount of tuber by cutting but as a result they spend more money. So from this point of view, this experiment was carried out to optimize the most promising seed size and plant spacing. The seedling derived from true potato seed has performed better with the seed size and plant spacing phenomenon respectively. True potato seed technology could reduce the cost of production mainly during planting of potatoes on the field. With the utilization of optimum seed tuber size and plant spacing of seedling tuber, the farmers could improve their production practices so that they can reduce their cost of cultivation and transportation cost during carrying the bulk tuber instead of true potato seed derived seedling tubers. Trials were conducted in 2001 in Tamil Nadu, India by[7]* to investigate suitable agro-techniques for obtaining the maximum number of seed size tubers from potato cultivars Kufri Swarna and Kufri Jyoti. Treatments includes: tuber weights of 10-20, 20-30, 30-40 and 40-50 g; intra row spacings of 10, 15 and 20 cm; and 2 dates of haulm killing (75 and 90 days after planting). The authors reported that in both cultivars, 30-40

and 20-50 g tubers, might be used at an intra-row spacing of 10 cm, and with haulm killing at 90 days after planting to obtain the maximum number of seed tuber size. Research on seed tuber weight and plant spacing have been found to influence the yield and economic return reported by [7-9].But only a few studies have been done considering size of seedling tubers and plant spacing on the performance of potato in Bangladesh. Therefore, this experiment was undertaken to find out the principle purpose, response of seedling tuber size and spacing on the yield and economic return of potato.

2. Materials and Methods

Experiment was carried out at Agronomy research field of Sher-e-Bangla Agricultural University, Dhaka, during 10 November 2012 to 10 March 2013, which was belonging to the Madhupur Tract (AEZ-28). Four seedling size, viz., T_1 = 40 ± 2 g, T_1 = 30 ± 2 g, T_3 = 20 ± 2 g, T_4 = 10 ± 2 g and three spacing, viz., S_1= 60cm×25cm, S_2 = 60cm×20cm, S_3= 60cm×15cm were used as treatment. The experiment was laid out in RCBD (factorial) with three replications. The planting material was the first generation TPS seedling tubers of BARI TPS-1. The size of the unit plot was 2.5 m×2.0 m. Distances between block to block and plot to plot were 1.0 m and 0.50 m, respectively. Fertilizer was applied, viz. 320, 232, 285, 120, 10, 10 and 10000 kg ha^{-1} for urea , TSP, MOP, gypsum, ZnO, boric acid and cow dung respectively . Cowdung was applied 10 days before final land preparation. Total amount of TSP, gypsum, ZnO, boric acid and half of urea and MP were applied at basal doses during final land preparation. The rest 50% urea and MP were side dressed in two equal splits at 25 and 45(DAP) during first and second earthing up. To protect the young seedlings from the attack of cut worm, soil was treated with Furadan 5G @ 15 kg ha^{-1}. The well sprouted seed tubers were planted on November 10, 2009, at a depth of 5-7 cm in furrow made 60 cm apart and seed tubers were covered with soil. Two weeding was done, 1st at two weeks after emergence and 2nd was done before 2nd top dressing of urea. Earthing up was done twice during growing period at 25 DAP and 45DAP respectively. Irrigation was done three times at 25 DAP, 45 DAP and 65 DAP throughout the growing period in controlled way. Crop protection measures were taken as and when necessary. Ten sample plants were randomly selected from each plot and tagged separately for recording necessary data and then the whole plot was harvested at 90 DAP with the help of spade. The data were collected on tuber hill^{-1}, single tuber weight, tuber yield, grades of potato and benefit cost ratio (BCR). The collected data were analyzed statistically and means were adjusted by using the Duncan's Multiple Range Test.

3. Results and Discussion

Result revealed that the number tubers hill^{-1}increased with increasing tuber weight till 30 ± 2 g tuber and thereafter further increase tuber weight did not increase tubers hill^{-1} in (Table 1) . The highest production of tubers hill^{-1} was observed in the tuber weight of 30 ± 2 g (8.07) that was statistically similar to tuber weight of 40 ± 2 g (7.70 hill^{-1}) and lowest from 10 ± 2 g (6.46). Reduction in the tubers hill^{-1} under smaller weight seed tuber might be due to lesser stems hill^{-1}[10].In Table 1, result showed that tuber number hill^{-1} increased with increasing plant spacing. The highest tubers hill^{-1} (7.85) was recorded in 60 cm × 25 cm spacing which was statistically similar to 60 cm × 20 cm spacing (7.57) and lowest from 60 cm × 15 cm spacing (6.73). Reduction in tuber number in densely populated area might be due to increased number of plants per unit area. This increased number of plants per unit area exerted competition among plants for nutrients and light that caused a reduction in tuber number [11].

Table 1. Effect of seed tuber weight, plant spacing on yield attributes and yield of potato

Treatments	Tubers hill^{-1} (no.)	Single tuber weight (g)	Tuber weight hill^{-1} (g)	Tuber yield (t ha^{-1})
Tuber weight				
40 ± 2 g	7.70 ab	52.03 a	304.1 a	26.47 a
30 ± 2 g	8.07 a	52.13 a	317.2 a	27.27 a
20 ± 2 g	7.30b	45.29 b	248.5 b	22.33 b
10 ± 2 g	6.46 c	30.13 c	146.0 c	16.33 c
F-test	**	**	**	**
SE	0.145	1.069	7.955	0.606
Spacing				
60cm×25cm	7.85 a	48.70 a	293.8 a	23.18 ab
60cm×20cm	7.57 a	44.75 b	258.9 b	23.92 a
60cm×10cm	6.73 b	41.24 c	209.0 c	22.20 b
F-test	**	**	**	*
SE	0.125	0.926	6.889	0.524
CV%	5.89	7.15	9.40	7.87

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.*; ** indicate significant at 5% and 1% level of probability, respectively. T1 = 40 ± 2 g; T2 = 30 ± 2 g; T3 = 20 ± 2 g; T4 = 10 ± 2 g; S1 = 60 cm × 25 cm; S2 = 60 cm ×20cm; S3 = 60cm × 15cm.
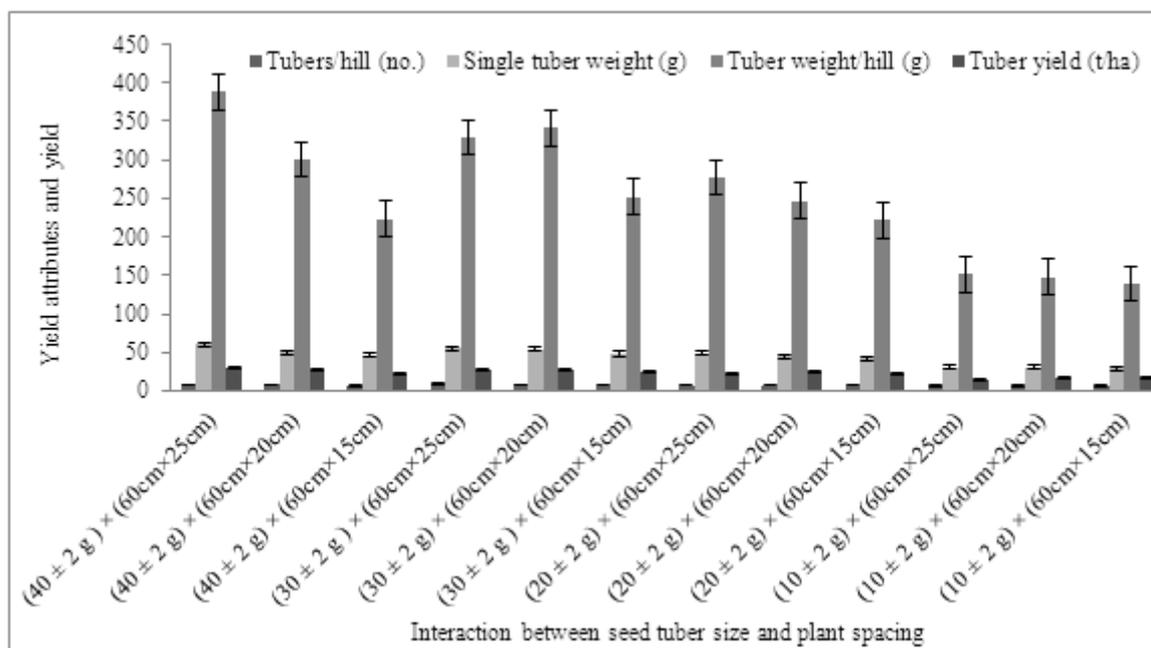
Figure 1. Interaction effect of seed tuber weight and spacing on yield attributes and yield of potato. Vertical bar represent SE value (0.251, 0.852, 13.778 and 1.049). $T_1 = 40 \pm 2$ g; $T_2 = 30 \pm 2$ g; $T_3 = 20 \pm 2$ g ; $T_4 = 10 \pm 2$ g ; $S_1 = 60$ cm × 25 cm ; $S_2 = 60$ cm ×20cm ; $S_3 = 60$ cm × 15cm.

The highest tubers hill[-1] was observed in 30 ± 2 g tuber weight with 60 cm × 25 cm spacing (8.60) and lowest from 10 ± 2 g tuber with 60 cm × 15 cm spacing (6.40) (Fig. 1). Results presented in Table 1 revealed that single tuber weight increased with increasing seed tuber weight till 30 ± 2 g seed tuber followed by no increment was observed. The higher single tuber weight was observed in 30 ± 2 g and 40 ± 2 g seed tuber with being the highest in 30 ± 2 g seed tuber (52.13 g) and lowest from 10 ± 2 g (30.13 g). Results showed that single tuber weight decreased with decreasing plant spacing (Table 1). The largest tuber was observed in wider spacing, 60 cm × 25 cm (48.70 g) followed by the plant spacing of 60 cm × 20 cm (44.75 g) and lowest from 60 cm × 15 cm (41.24 g). The larger tuber in wider spacing was probably due to less competition among the plants for space, light, water and nutrients which were facilitated to faster growth and development of tuber thereby increase tuber size in wider spacing as compared to closer spacing [12]. The highest single tuber weight was recorded from 60 cm × 25 cm plant spacing with 40 ± 2 g seed tuber (60.20 g) followed by the treatment combination of 60 cm × 25 cm plant spacing with 30 ± 2 g seed tuber (55.0 g) and lowest from 60 cm × 15 cm plant spacing with 10 g seed tuber (29.0 g) in (Fig. 1). Result revealed that tuber weight hill[-1] increased with increasing seed tuber weight upto 30 ± 2 g seed tuber followed by decline trend (Table 1). The higher tuber weight hill[-1] was observed in 30 ± 2 and 40 ± 2 g seed tuber with being the highest in 30 ± 2 g seed tuber (317.2 g hill[-1]) and lowest 10 ± 2 g (146.0 g hill[-1]).The lesser tuber weight in smaller size seed tuber might be due to fewer tubers hill[-1] and smaller weight tuber [13].

Results showed that tuber weight decreased with decreasing plant spacing in (Table 1). The highest tuber weight hill[-1] was observed in wider spacing, 60 cm × 25 cm (293.8 g hill[-1]) followed by the plant spacing of 60 cm × 20 cm (258.9 g hill[-1]) and lowest from 60 cm × 15 cm (209.0 g hill[-1]). The higher tuber yield hill[-1] in wider spacing was probably due to higher number of tubers hill[-1] and larger tuber [12]. In Fig. 1, the highest tuber weight hill[-1] was recorded in the treatment combination of 60 cm × 25 cm plant spacing with 40 ± 2 g seed tuber (388.3 g hill[-1]) followed by the treatment combination of 60 cm × 25 cm plant spacing with 30 ± 2 g seed tuber (328.9 g hill[-1]) and lowest from 60 cm × 15 cm plant spacing with 10 ± 2 g seed tuber (139.2 g hill[-1]). Result revealed that gross tuber yield increased with increasing seed tuber weight up to 25 ± 2 g seed tuber. The highest gross tuber yield was observed in the seed tuber weight of 30 ± 2 g (27.27 t ha^{-1}) followed by the seed tuber weight of 40 ± 2 g (26.47 t ha^{-1}) with same statistical rank and lowest from 10 ± 2 g (16.33 t ha^{-1}) in (Table 1).The gross tuber yield was lower in smaller weight seed tuber because of producing minimum tuber weight hill[-1][13].The effect of plant spacing on gross tuber yield in potato was significant (Table 1). The highest gross tuber yield was observed in the plant spacing of 60 cm × 20 cm (23.92 t ha^{-1}) that was identical to the plant spacing of 60 cm × 25 cm (23.18 t ha^{-1}) and lowest 60 cm × 15 cm (22.20 t ha^{-1}).Lower tuber yield per plant as well as per unit area under densely populated condition was might be due to lesser amount of assimilate produced by the plants through lesser photosynthetic area plant[-1] and competition of nutrients uptake by the plants[12].The highest gross tuber yield ha^{-1} was recorded from 60 cm × 25 cm plant spacing with 40 ± 2 g seed tuber (29.10 t ha^{-1}) followed by 60 cm × 20 cm plant spacing with 30 ± 2 g seed tuber (28.20 t ha^{-1}) and lowest from 60 cm × 25 cm plant spacing with 10 ± 2 g

seed tuber (14.70 t ha^{-1})(Fig. 1).It may be concluded that, the seed tuber weight and spacing influenced the seedling tuber performance as a whole, but from economic point of view, the seedling tuber weight of 30 ± 2 g with plant spacing of 60 cm × 20 cm was more profitable than those of other treatment combinations.

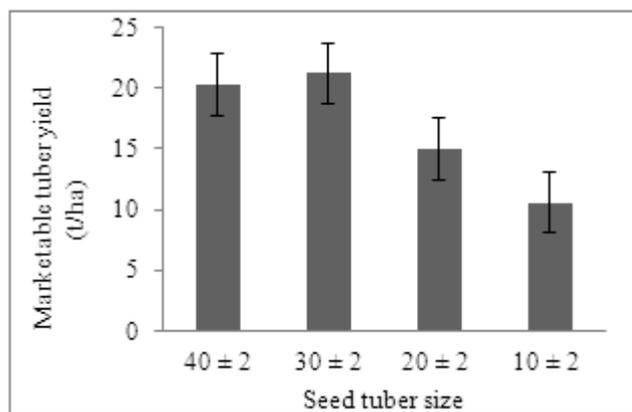Lower marketable tuber yield per unit area under densely populated condition was might be due to lesser amount of assimilate produced by the plants through lesser photosynthetic area plant^{-1} and competition of nutrients uptake by the plants [14].
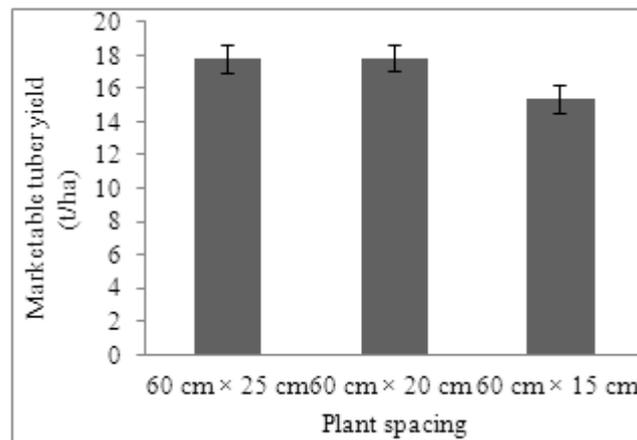

Figure 2. Effect of seed tuber size on marketable yield of potato. Vertical bar represent SE value (1.5). $T_1 = 40 ± 2$ g; $T_2 = 30 ± 2$ g; $T_3 = 20 ± 2$ g; $T_4 = 10 ± 2$ g.

Figure 3. Effect of plant spacing on marketable yield in potato. Vertical bar represent SE value (1.3). $S_1 = 60$ cm × 25 cm; $S_2 = 60$ cm ×20cm; $S_3 = 60$cm × 15cm.

Result revealed that marketable tuber yield increased with increasing seed tuber weight till 30 ± 2 g seed tuber followed by slight decline in (Fig. 2). The highest marketable yield of tubers was observed in the seed tuber size of 30 ± 2 g (21.28 t ha^{-1}) followed by the seed tuber weight of 40 ± 2 g (20.31 t ha^{-1}) with same statistical rank and lowest from 10 ± 2 g (10.52 t ha^{-1}). It was primarily due to high food reserves in large seed tubers which ultimately contributed to produce high yield through increase vegetative growth of plants and rapid development of tubers [9].

Fig. 3 shows that the highest marketable tuber yield was observed in the plant spacing of 60 cm × 20 cm (17.79 t ha^{-1}) that was identical to the plant spacing of 60 cm × 25 cm (17.75 t ha^{-1}) and lowest from 60 cm × 15 cm (15.32 t ha^{-1}).

The interaction effect of seed tuber size and plant spacing on marketable tuber yield ha-1 was significant (Fig. 4). The highest marketable tuber yield ha^{-1} was recorded in the treatment combination of 60 cm × 25 cm plant spacing with 40 ± 2 g seed tuber (23.28 t ha^{-1}) followed by the treatment combination of 60 cm × 25 cm plant spacing with 30 ± 2 g seed tuber (22.96 t ha^{-1}). The lowest marketable tuber yield ha^{-1} was recorded in the treatment combination of 60 cm × 25 cm plant spacing with 10 ± 2 g seed tuber (10.14 t ha^{-1}) that was statistically similar to the treatment combination of 60 cm × 20 cm plant spacing with 10 ± 2 g seed tuber (10.85 t ha^{-1}) and 60 cm × 15 cm plant spacing with 10 ± 2 g seed tuber (10.56 t ha^{-1}).
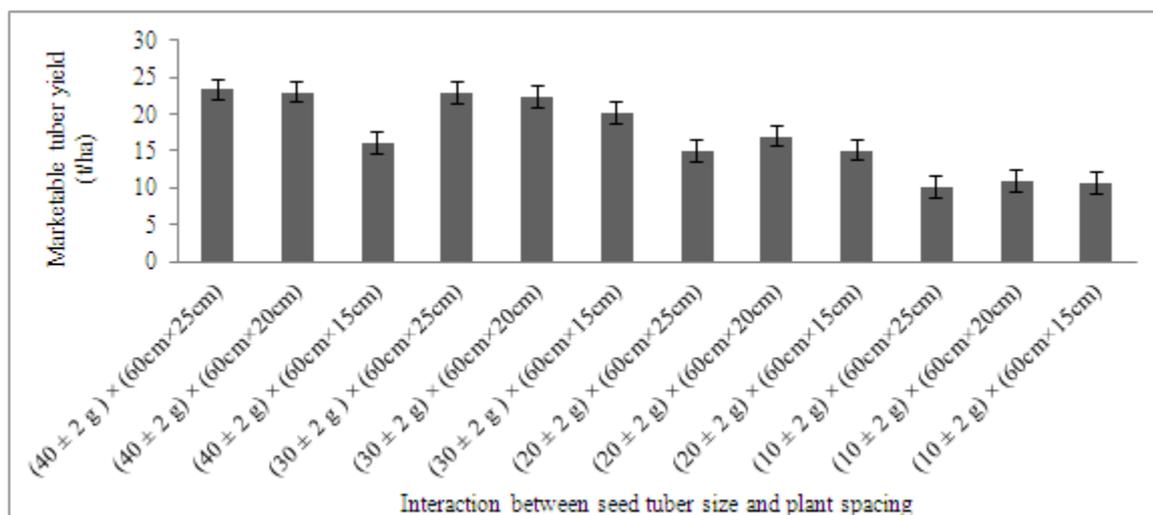

Figure 4. Interaction effect of seed tuber size and plant spacing on tuber marketable yield in potato. Vertical bar represents SE value (0.74). $T_1 = 40 ± 2$ g; $T_2 = 30 ± 2$ g; $T_3 = 20 ± 2$ g; $T_4 = 10 ± 2$ g; $S_1 = 60$ cm × 25 cm; $S_2 = 60$ cm ×20cm; $S_3 = 60$cm × 15cm.

There was a significant difference in non-marketable yield of tubers due to seed tuber size (Fig. 5). The highest non-marketable yield of tubers was observed in the seed tuber size of 20 ± 2 g (7.15 t ha^{-1}) followed by the seed tuber size of 40 ± 2 g (6.15 t ha^{-1}) and lowest from30 ± 2 g (5.40 t ha^{-1}). Lower non-marketable tuber yield per unit area under thin populated condition was might be due to available amount of assimilate produced by the plants through increase photosynthetic area plant[-1] and less competition of nutrients uptake by the plants [15].
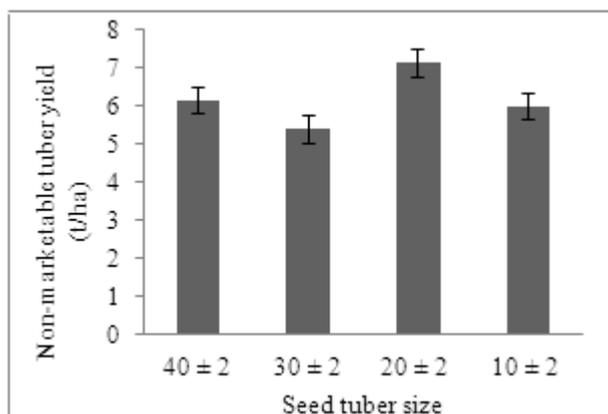

Figure 5. Effect of seed tuber size on non-marketable yield in potato. Vertical bar represent SE value (0.51). $T_1 = 40 \pm 2$ g; $T_2 = 30 \pm 2$ g; $T_3 = 20 \pm 2$ g; $T_4 = 10 \pm 2$ g.
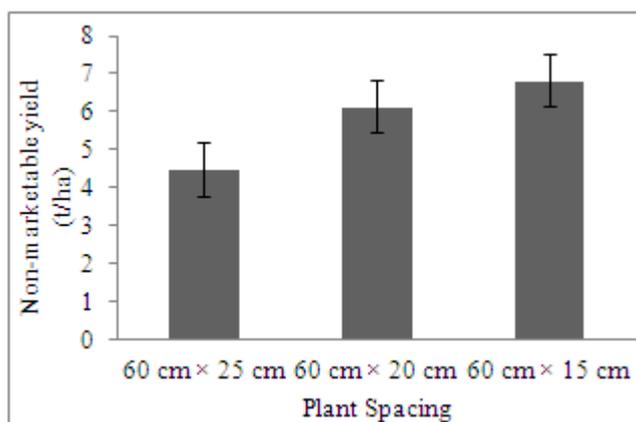

Figure 6. Effect of plant spacing on non-marketable yield in potato. Vertical bar represent SE value (0.52). $S_1 = 60$ cm $\times$ 25 cm; $S_2 = 60$ cm $\times$20cm; $S_3 = 60$cm $\times$ 15cm.

In Fig. 6, results showed that non-marketable tuber yield increased with decreasing plant spacing. The highest non-marketable tuber yield was observed in the plant spacing of 60 cm $\times$ 15 cm (6.80 t ha^{-1}) followed by the plant spacing of 60 cm $\times$ 20 cm (6.12 t ha^{-1}) and lowest from 60 cm $\times$ 25 cm (4.46 t ha^{-1}). This results also supported by [16].

The interaction effect of seed tuber size and plant spacing on non-marketable tuber yield ha^{-1} was significant (Fig. 7).The highest non-marketable tuber yield ha^{-1} from 60 cm $\times$ 15 cm plant spacing with 20 ± 2 g seed tuber (7.91 t ha^{-1}) followed by 60 cm $\times$ 25 cm plant spacing with 20 ± 2 g seed tuber (7.28 t ha^{-1}) and lowest from 60 cm $\times$ 25 cm plant spacing with 10 ± 2 g seed tuber (4.51 t ha^{-1}).

It was observed that there was significant variation in size grade of tubers due to different seed tuber weight (Table 2). The highest number of Grade-A and Grade-B tuber was recorded in the seed tuber size of 40 ± 2 g (18.4% and 38.83% for grade-A and grade-B, respectively). The highest number of Grade-C and Grade-D tuber was recorded in the seed tuber size of 10 ± 2 g (45.04% and 37.37% for grade-C and grade-D, respectively) and lowest from 40 ± 2 g (31.13%% and 11.68% for grade-C and grade-D, respectively). This results also supported by [17].Tuber size was significantly affected by plant spacing (Table 2). Results revealed that greater number of larger tuber (grade-A & B) was produced in wider spacing, 60 cm $\times$ 25 cm (10.5 and 34.70% for grade-A and grade-B, respectively) followed by the plant spacing of 60 cm $\times$ 20 cm and lowest from 60 cm $\times$ 15 cm (4.80% and 25.43% for grade-A and grade-B, respectively). On the contrary, the highest number of smaller size tuber was produced in the closer spacing of 60 cm $\times$ 15 cm (43.95% and 25.83% for grade-C and grade-D, respectively). This results supported by [18].The interaction effect of seed tuber size and plant spacing on tuber grade distribution was significant (Fig. 8). The highest number of Grade-A and Grade-B tuber was recorded in 40 ± 2 g seed tuber with plant spacing of 60 cm $\times$ 30 ± 2 cm (24.10% and 45.20% for grade-A and grade-B, respectively). The highest number of Grade-C tuber was recorded in 10 ± 2 g seed tuber with plant spacing of 60 cm $\times$ 25 cm (47.31%) and Grade-D tuber was recorded in 10 g seed tuber with plant spacing of 60 cm $\times$ 15 cm (42.0%) and lowest from 40 ± 2 g seed tuber with plant spacing of 60 cm $\times$ 25 cm (9.74% and 21.0% for grade-D and grade-C, respectively).
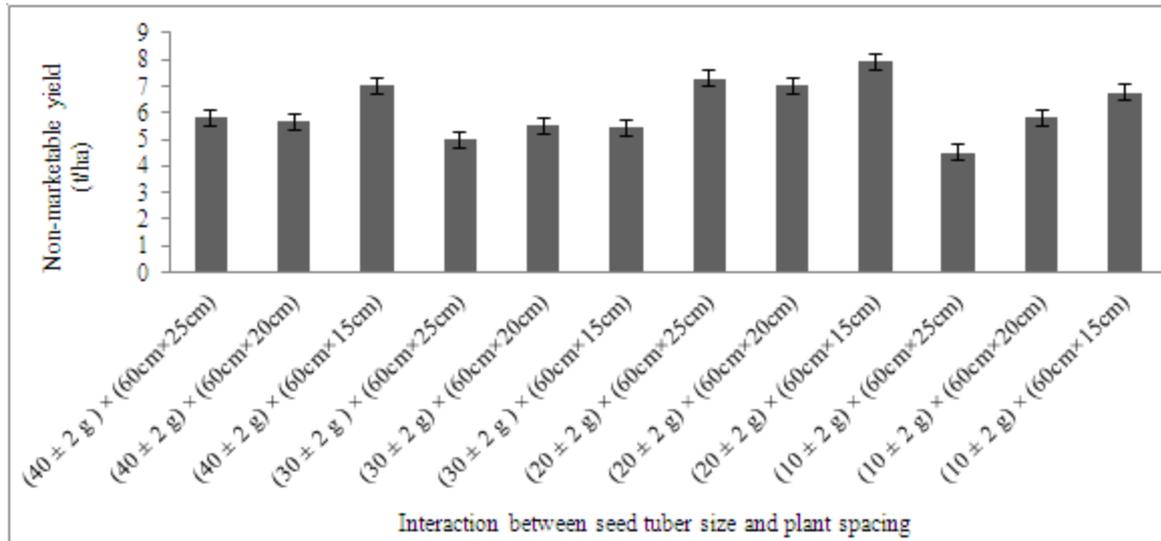
Figure 7. Interaction effect of seed tuber size and plant spacing on non-marketable Tuber yield in potato. Vertical bar represents SE value (0.25). $T_1 = 40 \pm 2$ g; $T_2 = 30 \pm 2$ g; $T_3 = 20 \pm 2$ g; $T_4 = 10 \pm 2$ g; $S_1 = 60$ cm $\times$ 25 cm; $S_2 = 60$ cm $\times 20$cm; $S_3 = 60$cm $\times 15$cm.

Table 2. Effect of seed tuber weight and plant spacing on the grade of tubers by number in potato

Tuber weight	Grade of tubers (%) by number			
	< 20 mm	20-35 mm	35-55 mm	> 55 mm
40 ± 2 g	11.68 d	31.13 d	38.83 a	18.4 a
30 ± 2 g	18.53 c	37.07 c	36.30 b	8.10 b
20 ± 2 g	21.40 b	41.50 b	31.73 c	5.37 c
10 ± 2 g	37.37 a	45.04 a	17.13 d	0.46 d
F-test	**	**	**	**
SE	0.677	0.993	0.799	0.225
Spacing				
60 cm × 25 cm	20.01 b	34.78 c	34.70 a	10.5 a
60 cm × 20 cm	20.90 b	37.33 b	32.88 a	8.90 b
60 cm × 15 cm	25.83 a	43.95 a	25.43 b	4.80 c
F-test	**	**	**	**
SE	0.586	0.860	0.692	0.195
CV (%)	9.14	7.70	7.74	8.38

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.*; ** indicate significant at 5% and 1% level of probability, respectively. $T_1 = 40 \pm 2$ g; $T_2 = 30 \pm 2$ g; $T_3 = 20 \pm 2$ g; $T_4 = 10 \pm 2$ g; $S_1 = 60$ cm $\times$ 25 cm; $S_2 = 60$ cm $\times 20$cm; $S_3 = 60$cm $\times 15$cm.
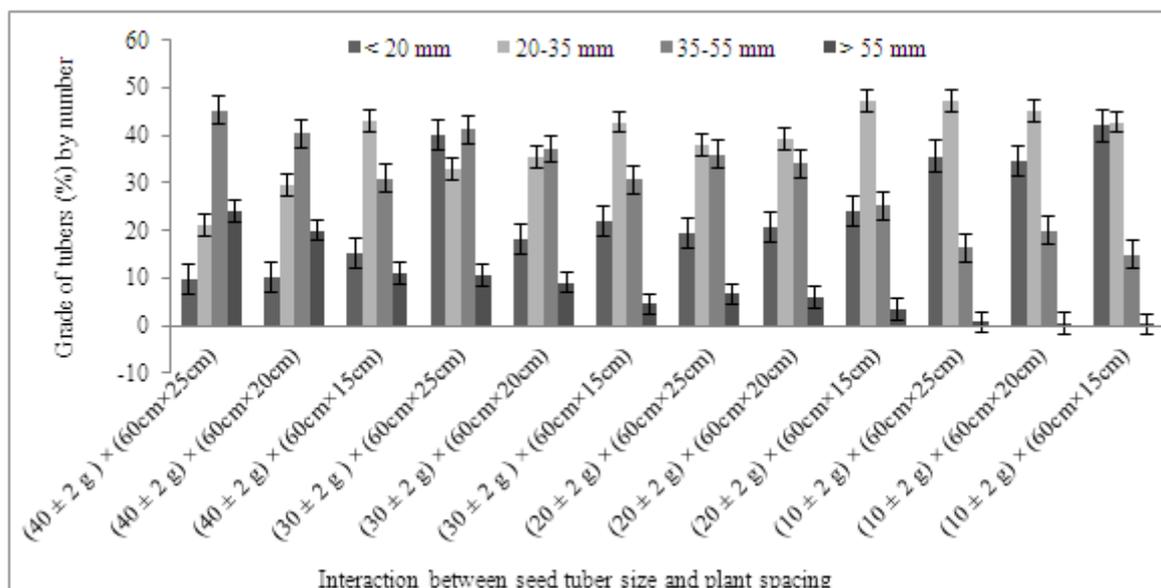

Figure 8. Interaction effect of seed tuber size and plant spacing on grade of tubers (%) by number. Vertical bar represents SE value (1.173, 1.720, 1.385 and 0.390). $T_1 = 40 \pm 2$ g; $T_2 = 30 \pm 2$ g; $T_3 = 20 \pm 2$ g; $T_4 = 10 \pm 2$ g; $S_1 = 60$ cm $\times$ 25 cm; $S_2 = 60$ cm $\times 20$cm; $S_3 = 60$cm $\times 15$cm.

Table 3. Economic analysis in potato production as influenced by tuber size and spacing

Treatments	Seed rate (kg ha^{-1})	Cost of cultivation ha^{-1} (in US $)	Gross return ha^{-1} (in US $)	Net profit ha^{-1} (in US $)	Benefit cost ratio
40 ± 2 g size tuber					
60 cm ×25 cm	2333	2763.07	9414.22	6651.28	2.41
60 cm × 20 cm	2917	3087.1	8831.9	5744.8	1.86
60 cm × 15 cm	3889	3611.97	7440.79	3828.95	1.06
30 ± 2 g size tuber					
60 cm × 25 cm	1667	2896.6	8508.39	6111.79	2.55
60 cm × 20 cm	2083	2627.45	9123.06	6495.61	2.47
60 cm × 15 cm	2778	3002.73	8281.93	5279.2	1.76
20 ± 2 g size tuber					
60 cm × 25 cm	1333	2212.84	6761.42	4548.58	2.05
60 cm × 20 cm	1667	2398.15	7602.55	5204.4	2.17
60 cm × 15 cm	2222	2697.87	7311.39	4613.54	1.71
10 ± 2 g size tuber					
60 cm × 25 cm	667	1846.36	4755.64	2909.27	1.58
60 cm × 20 cm	833	1938.5	5402.66	3494.16	1.78
60 cm × 15 cm	1110	2088.61	5693.82	3605.21	1.73

Variation in cost of production was noticed due to the cost of seed tuber and different plant spacing (Table 3). The total cost of cultivation ranged between $ 1846.36 and $3611.97. The cultivation cost increased with increasing seed tuber size and decreasing plant spacing. The highest cost of production was involved when used 40 ± 2 g seed tuber with closer spacing of 60 cm × 15 cm ($ 3611.97) and lowest from 10 ± 2 g seed tuber with wider spacing of 60 cm × 25 cm ($ 1846.36). The highest gross return from 40 ± 2 g seed tuber with wider spacing of 60 cm × 25 cm ($ 9414.22) that was apparently similar to the treatment combination of 30 ± 2 g seed tuber with plant spacing of 60 cm × 20 cm (9123.06) and lowest from 10 ± 2 g seed tuber with wider spacing of 60 cm × 25 cm (4755.64). However, the highest net profit from 40 ± 2 g seed tuber with wider spacing of 60 cm × 25 cm ($ 6651.28) that was apparently similar to 30 ± 2 g seed tuber with plant spacing of 60 cm × 20 cm ($ 6495.61). The maximum benefit-cost ratio was observed in those two treatment combination (2.41-2.47). The lowest net profit and benefit-cost ratio was observed in the treatment combination of 10 ± 2 g seed tuber with plant spacing of 60 cm × 25 cm ($ 2909.27 and 1.58, respectively).

4. Conclusions

Potato yield and economic return mostly influenced by many production factors, among these seed tuber weight and spacing is most important. Finally it may be concluded that, different tuber weight and spacing significantly influence the yield and economic return of seedling tuber. But from economic point of view with high yield performance, the seedling tuber size of 30 ± 2 g with plant spacing of 60 cm × 20 cm was more profitable than those of other treatment combinations.

Acknowledgements

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