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Productivity and profitability study of farmers managed and research managed potato production system

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ABSTRACT

The potato is of economic importance to the people of Munshiganj. Mastering good farming practices would therefore help to improve the yields of the varieties grown. Our study consisted of evaluating the yields of two potato cultivars (V_1=BARI Alu-25 and V_2=BARI Alu-37) at the Tuber Crops Research Sub-Centre in Munshiganj, using the cultivation practices implemented by the researchers (P_1) and the farmers' cultivation practices (P_2). The highest yields and cost-benefit ratios were obtained by the cultivars subjected to the cultivation practices implemented by the researchers (P_1), with 41.29 t/ha and BCR=2.56 for cultivar V_2 and 34.04 t/ha and BCR=2.46 for cultivar V_1, respectively. The cultivation practices introduced by the researchers should therefore be disseminated so that farmers adopt them, which will have a positive impact on farmers' incomes.

Keywords: Potato, researchers' practices, farmers' practices, cultivation practices, yield, income.

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INTRODUCTION

Potato (*Solanum tuberosum* L.), one of the most important and cultivated vegetable crops in the Munshiganj region, is a major source of income for farmers (Sujan et al., 2017). Every family in this district is dependent on foreign money, but most of the farmers also earn cash through potato cultivation. About 14 percent of the country's total potato production is produced in the Munshiganj district (Department of Agriculture Extension-DAE, Munshiganj). The farmers prefer to use a different production system rather than the recommended practice by research organizations. Farmers are used to using imported seed and have to buy a box of 50 (Fifty) kg seed potatoes at a minimum of 8000/- (eight thousand taka). They plant cut tuber with densely maintaining spacing (40 cm x 15 cm) in addition to high dosages of fertilizer application (DAE, Munshiganj). According to Nolte et al. (2003), whole-seed potatoes had greater vigor than cut seeds since the cut seeds need to increase their metabolic activity in developing a new suberin and phylum barrier. Previous works suggest that seed type and weight are important determinants of plant development and yield (Adhikari, 2005; Webster et al., 2018). Planting large seeds is reported to result in a higher number of tubers per plant and higher total tuber yields than planting smaller seeds (Arioglu, 2009; Masarirambi et al., 2012). These countries include Bangladesh, where unsustainable fertilization is heavily practiced. Over-fertilization also may adversely affect productivity and fruit or crop quality (Swietlik, 1992). Traditional fertilizer broadcasting, in which fertilizers are cast across the surface of crop fields by hand, a method that cannot control the rate of nutrient frequency, triggers inefficient fertilization (IFDC, 2013). It increases production costs by roughly 33 % and greenhouse gases by 60% and decreases yields by 15–18 % (IFDC, 2013). Excessive use of fertilizers has been a great challenge to Bangladesh agriculture (IFDC, 2013). According to the 2005 National Fertilizer Recommendation Guide, on average, farmers overuse urea (IFDC, 2013) and fertilizer use has increased by 400% in the last 30 years (BBS, 2017). Urea, triple superphosphate (TSP), and muriate of potash (MoP) are the main inorganic fertilizers used in Bangladesh, with nitrogen (urea) alone constituting about 75% of nutrient use (Sultana et al., 2014; FRG, 2012). The excessive use of chemical fertilizers is also harmful to soil health. The microbial activities are disturbed, and infiltration and productivity are reduced. The use of chemical fertilizers can increase tubers but has negative effects on tuber quality, environmental pollution, public health and economic losses; starch and sugar contents are reduced in tubers (Alva, 2004). Nitrogen is essential for increasing plant height, leaf area index, shoot dry matter and tuber yield (Zelalem et al., 2009). Phosphorus is required for early growth and maturity (UIES, 2010). Optimal production requires considerable attention to the K requirement of potatoes. These requirements are large in comparison to cereals, pulses, oilseeds, and other commercial crops; however, potato produces considerably much more dry matter during a shorter growing cycle than some of these crops (Li et al. 2015). Nitrogen is often the limiting nutrient to achieve high tuber yields (Marshall, 2007), but excessive amounts of N may be deleterious to quality traits and pollute groundwater due to leaching (Bucher and Kossmann, 2007). A balanced and timely provision of fertilizer is a prerequisite for getting the optimum yield potential of potatoes (Kushwah et al., 2005). Proper nutrient management is essential to maximize potato production and sustain agricultural production while minimizing the negative impact on soil fertility (Ahmed et al. 2017). Tuber Crops Research Centre (TCRC) recommends whole tuber potato seed, maintaining optimum spacing (60 cm x 25 cm) and optimum dosages of fertilizer, i.e., urea 350kg, TSP 220kg, MoP 300kg, Gypsum 120kg, 14kg $ZnSO_4$, and 6 kg boric acid per hectare. However, farmers are not interested in adopting this (TCRC) generated practice due to assumed low economic returns. Agricultural production policy decisions in Bangladesh are constrained by a lack of information on the profitability of growing different crops (Sarkar and Yesmin, 2014). Nevertheless, sufficient number of research work were not undertaken to analyze the profitability and resource use efficiency of potato production in a major potato-producing area like the Munshiganj district. So, the specific objective of the present study is to compare the yields between the farmers' practice and research practice and find out the better potato production system concerning economic output and insect-disease reaction in the selected study area.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj, during the rabi season of 2021-2022. Geographically, it is located between $23^0$22 © North Latitude to $90^0$28© -$90^0$36© East Latitude. TCRSC, Munshiganj lies under the Agro-Ecological Zone (AEZ) 8, 9, 10, 12 and 16. Soil pH is 5.2-7.5.

Planting materials

For research practice locally produced followed by scientific method, whole tubers were used for potato production, whereas imported seed tubers from foreign countries as cut tubers were used as seed materials for farmers' practices as farmers did the same.

Treatment details, manure and fertilizer application

The experiment was executed with two varieties, namely V_1= BARI Alu-25 and V_2= BARI Alu-37, with two management practices, namely P_1= Research practice and P_2= Farmers' Practice. Thus, the number of total treatments is 4 and was laid out in a randomized complete block design (RCBD) (factorial experiment) with three replications. In TCRC Practice, cow dung was applied (10t/ha) during final land preparation. Fertilizers were applied at 350 kg urea, 220 kg TSP, 300 kg MP, 120 kg gypsum, 14kg $ZnSO_4$, and 6 kg boric acid per hectare. Half of the urea and a full dose of other fertilizers were applied immediately before planting the seed in furrows and mixed properly with the soil. The rest of the urea was side-dressed 35 days after planting.

On the other hand in the case of Farmers' Practice, high dosages of fertilizers were applied at 700 kg urea, 500 kg TSP, 600 kg MP, and 240 kg gypsum per hectare. Farmers applied all the fertilizers at a time before final land preparation. Farmers didn't use any kind of organic fertilizer like cow dung or other organic fertilizers.

Fungicide and pesticide application:

For both research at the time of final land preparation Eco-furan 5G and Chlorophyriphos 25EC was applied to the soil against cut worm and other soil pests. Mencozeb and Secure were sprayed to control diseases and Admire was sprayed at regular interval of 10 days to prevent insects like aphid and jassids. Haulm pulling was done after 85 days of planting. On the hand, for farmers' practices, although Eco-furan 5G and Chlorophyriphos

25EC was applied to the soil against cut worm and other soil pests. But, no earthing up was done. Fungicides were used 10 to 12 times at 7 days interval but insecticides were used single time. Weeding and sprinkler irrigation with irrigation pipe were done 85 DAP which very favorable for common scab infestation.

Planting, harvesting and intercultural operation

The Experiment was set on the 20^{th} of November, 2021, maintaining a 4.8m X 3.0m plot with 60cm x 25cm spacing (TCRC Practice) and 40cm x 15cm spacing (Farmers' Practice). Weeding, earthing up, 3 times flood irrigation at 30 DAP, 50 DAP and 70 DAP and other intercultural operations were done as and when necessary for raising a good crop. Final harvesting was done on the 20^{th} of February, 2022.

Data collection

Data were taken on Days to start of emergence, Emergence (%) at 30 DAP, Plant height at 45 and 60 DAP, Number of stem per hill at 45 and 60 DAP, Foliage coverage (%) at 45 and 60 DAP, Plant vigor (1-10) Scale at 45 DAP, Tuber Grade (% by number) and (% by weight), Tuber fresh yield ton per hectare (t/ha) at 95 DAP, Marketable tuber fresh yield ton per hector (t/ha), Non-marketable tuber fresh yield ton per hector (t/ha), Tuber dry matter (%) at 95 DAP and Cost Benefit ratio.

Statistical analysis

Collected field data were analyzed using the statistical software Statistix-10 (Statistix-10, 1985). The means of all data were compared using the least significant difference (LSD) at a significant level of $p \leq 0.05$.

RESULTS

The results obtained from the experiment are presented and discussed character-wise:

Days to start of emergence

The interaction effect of variety and management practice on days to the start of emergence was significant (Table 1). Days to start of emergence were earlier in treatment combination V_1P_1 (12.67 days) and later (14.90 days) in V_2P_2.

Emergence (%) at 30 DAP

Significant variation was observed for the interaction effect of variety and management practice on emergence (%) at 30 DAP. The highest (94.44%) emergence at 30 DAP was found from treatment combination V_1P_1, which was followed by V_2P_1 treatment combination, whereas the lowest (71.42%) emergence at 30 DAP was recorded from V_2P_2 (Table 1).

Plant height at 45 and 60 DAP

Plant height at 45 and 60 DAP varied significantly due to the interaction effect of variety and management practice (Table 1). At 45 DAP, the maximum (76.67cm) plant height was obtained from treatment combination V_1P_1, whereas the minimum (57.19cm) plant height was found from V_2P_2. But at 60 DAP, the tallest plant (82.23 cm) was recorded from V_2P_1 whereas the shortest plant (65.49 cm) was observed in V_1P_2 (Table 1).

Number of stem per hill at 45 and 60 DAP

Variation due to the interaction effect of variety and management practice on the number of stems per hill at 45 and 60 DAP was significant (Table 1). At 45 DAP, the maximum (4.30) stem per hill was recorded from V_1P_1, whereas the minimum (2.61) value was found from V_1P_2. At 60 DAP, the highest (4.97) stem per hill was recorded from V_1P_1, whereas the lowest (2.59) stem per hill was found from V_2P_2 (Table 1).

Foliage coverage at 45 and 60 DAP

Foliage coverage at 45 and 60 DAP varied significantly due to the interaction effect of variety and management practice (Table 1). At 45 DAP, the maximum (78.22%) foliage coverage was obtained from treatment combination V_2P_1, whereas the minimum (67.00) plant was found from V_1P_1. At 60 DAP, the maximum (92.05%) foliage coverage was obtained from treatment combination V_2P_1 whereas the minimum (80.36) plant was found from V_1P_2 (Table 1).

Plant vigor at 45 and 60 DAP

Variation due to the interaction effect of variety and management practice on plant vigor at 45 and 60 DAP was significant (Table 1). At 45 and 60 DAP, the maximum (9.33 and 8.67) vigorous plant was observed, respectively, from V_1P_1, whereas the minimum (6.67) value was found from V_2P_2 at 45 and 60 DAP, respectively (Table 1).

Tuber grade (% by number) at 95 DAP

The interaction effect of variety and management practice

Table 1. Interaction effect of variety and management practice on days to start of emergence, emergence % at 30 DAP, plant height, number of stem per hill foliage coverage and plant vigor of potato.

Varieties	Days to start of emergence	Emergence % at 30 DAP	Plant height at 45 DAP	Plant height at 60 DAP	Number of stem per hill at 45 DAP	Number of stem per hill at 60 DAP	Foliage coverage at 45 DAP	Foliage coverage at 60 DAP	Plant vigor at 45 DAP	Plant vigor at 60 DAP
V_1P_1	12.67[a]	94.44[a]	76.67a	73.15[ab]	4.30[a]	4.97[a]	67.00[b]	89.27[ab]	8.33[a]	8.67[a]
V_1P_2	14.56[ab]	73.25[bc]	62.32[b]	65.49[b]	2.61[b]	3.20[bc]	76.49[a]	80.36[b]	6.67[b]	7.00b
V_2P_1	13.68[b]	91.94[ab]	68.23[a]b	82.23[a]	3.46[ab]	3.74[b]	78.22[a]	92.05[a]	8.67[a]	8.67a
V_2P_2	14.90[ab]	71.42[c]	57.19[b]	71.01[a]b	2.38[b]	2.59[c]	77.35[a]	81.51[b]	6.67[b]	6.67b
Level of significance	*	*	*	*	*	**	*	*	**	*
CV (%)	5.98	9.14	6.82	10.36	17.02	12.15	4.40	5.49	7.61	8.33

Means bearing same letter (s) do not differ significantly at 1 or 5% level of probability by LSD.
**= Significant at 1% level of probability, *= Significant at 5% level of probability.
V_1= BARI Alu-25, V_2=BARI Alu-37, P_1= Research practice and P_2= Farmers' practice.

resulted in substantial differences in the entire tuber grade (Table 2). The treatment combination V_1P_2 produced the highest (33.76%) tuber grade <28mm, whereas the lowest (11.44%) tuber grade <28 mm was found from V_2P_1 (Table 2). The maximum (46.78%) 28-40 mm tuber grade was recorded from V_1P_1, whereas the minimum (34.80%) tuber grade was observed in V_2P_2 (Table 2). The treatment combination V_1P_1 produced the maximum (36.02%) 40-55 mm tuber grade, whereas the minimum (30.21%) was produced by treatment combination V_1P_2. The treatment combination V_1P_1 produced the highest (9.61%) tuber grade >55mm, whereas the lowest (4.32%) tuber grade >55 mm was found from V_1P_2 (Table 2).

Tuber grade (% by weight) at 95 DAP

The interaction effect of variety and management practice gave significant variation in the entire tuber grade (Table 2). The treatment combination V_2P_2 produced the highest (3.99%) tuber grade <28mm, which was statistically at par with V_1P_2, whereas the lowest (0.90%) tuber grade <28 mm was found from V_2P_1, which was followed by V_1P_1 (Table 2). In the case tuber grade 28-40mm, the maximum (48.04%) was observed in treatment combination V_2P_1, which was at par with V_1P_1, whereas the lowest value (43.46%) was produced by treatment combination V_1P_2 (Table 2). The treatment combination V_2P_1 produced the highest (22.48%) tuber grade >55mm, whereas the lowest (10.59%) tuber grade >55 mm was found from V_1P_1 (Table 2).

Table 2. Interaction effect of management practice on tuber grade <28mm, 28-40mm, 40-55mm and >55mm (% by number) and (% by weight) at 95 DAP of potato.

Treatments	% by number				% by weight			
	<28mm	28-40mm	40-55mm	>55mm	<28mm	28-40mm	40-55mm	>55mm
V_1P_1	7.60[c]	46.78[a]	36.02	9.61[a]	1.46[b]	46.80[a]	41.16[a]	10.59[c]
V_1P_2	33.76[a]	30.71[d]	30.21	5.32[b]	3.44[a]	43.46[b]	39.18[a]	13.92[c]
V_2P_1	11.44[c]	44.16[b]	35.15	9.24[a]	0.90[b]	48.04[a]	28.58[b]	22.48[a]
V_2P_2	28.24[b]	34.80[c]	31.45	5.51[b]	3.99[a]	45.59[b]	32.29[b]	18.12[b]
Level of significance	**	**	*	*	**	**	**	**
CV (%)	12.42	2.89	8.87	18.35	14.11	7.29	8.05	7.22

Means bearing same letter (s) do not differ significantly at 1 or 5% level of probability by LSD.
**= Significant at 1% level of probability, *= Significant at 5% level of probability.
V_1= BARI Alu-25, V_2=BARI Alu-37, P_1= Research practice and P_2= Farmers' practice.

Tuber fresh yield (t/ha) at 95 DAP

The interaction effect of variety and management practice on tuber fresh yield (t/ha) at 95 DAP was significant. The maximum tuber fresh yield (41.29 t/ha) was produced by treatment combination V_2P_1, whereas the minimum (26.40 t/ha) tuber fresh yield was found from V_1P_2 (Table 3). The results indicate clear advantages of planting whole seed tubers compared to cut seed tubers.

Marketable tuber fresh yield (t/ha) at 95 DAP

The interaction effect of variety and management practice on marketable tuber fresh yield (t/ha) at 95 DAP was significant. The maximum marketable tuber fresh yield (38.16 t/ha) was produced by treatment combination V_2P_1, which was statistically at par with V_1P_1, whereas the minimum (16.24 t/ha) marketable tuber fresh yield was found from V_1P_2 (Table 3).

Non-marketable tuber fresh yield (t/ha) at 95 DAP

The interaction effect of variety and management practice on non-marketable tuber fresh yield (t/ha) at 95 DAP was significant. The maximum non-marketable tuber fresh yield (10.15 t/ha) was produced by treatment combination V_1P_2, which was statistically at par with V_2P_2, whereas the minimum (3.14 t/ha) non-marketable tuber fresh yield was found from V_2P_1, which was statistically at par with V_1P_1 (Table 3).

Table 3. Interaction effect of managements on tuber fresh yield and dry matter percentage at 95 DAP.

Varieties	Tuber yield (t/ha) at 95 DAP	Marketable Tuber Fresh yield (t/ha) at 95 DAP	Non-marketable Tuber Fresh yield (t/ha) at 95 DAP	Dry matter (%) at 95 DAP	Common scab infection (%)	Cutworm infestation (%)
V_1P_1	34.04^b	29.32^a	4.71^b	22.81^a	8.23^b	4.57^b
V_1P_2	26.40^c	16.24^c	10.15^a	19.81^b	19.90^a	15.64^a
V_2P_1	41.29^a	38.16^a	3.14^b	20.25^b	5.51^b	4.41^b
V_2P_2	28.15^c	18.21^c	9.94^a	18.03^c	21.49^a	17.89^a
Level of significance	**	**	**	**	**	**
CV (%)	7.48	20.34	8.11	3.97	25.15	33.33

Means bearing same letter (s) do not differ significantly at 1 or 5% level of probability by LSD.
**= Significant at 1% level of probability, *= Significant at 5% level of probability.
V_1= BARI Alu-25, V_2=BARI Alu-37, P_1= Research practice and P_2= Farmers' practice.

Tuber dry matter (%) at 95 DAP

The interaction effect of variety and management practice on tuber dry matter percentages at 95 DAP was significant. The maximum (22.81%) tuber dry matter was obtained from treatment combination V_1P_1, whereas the minimum (18.03%) tuber dry matter was found from V_2P_2 (Table 3).

Common Scab infection (%) at 95 DAP

The interaction effect of variety and management practice on common scab infection percentage at 95 DAP was significant. The maximum (19.90%) common scab infection was found from treatment combination V_1P_2, whereas the minimum (5.51%) was found from V_1P_1 (Table 3).

Cutworm Infestation (%) at 95 DAP

The interaction effect of variety and management practice on cut worm infestation percentage at 95 DAP was significant. The maximum (17.89%) cut worm infestation was found from treatment combination V_2P_2, which was statistically similar to treatment combinationV_1P_2, whereas the minimum (4.41%) was found from V_2P_1 (Table 3).

Economic analysis

For determining the cost of cultivation of potato, all variable costs like human labour, land preparation, seed, manures, fertilizers, insecticides, fungicides and irrigation were calculated per hectare basis (Table 4). The fixed cost of potato cultivation included the cost of land use and interest on operating capital. Treatment combination V_2P_1 showed the highest gross return (Tk. 763200/ha), net return (Tk. 465200/ha) and Benefit Cost Ratio (BCR)-2.56, which was followed by treatment V_1P_1 Gross return (Tk.733000/ha), net return (Tk. 435000/ha) and Benefit Cost Ratio (BCR)-2.46. The lowest gross return (Tk. 364200 /ha), net return (Tk. 36200/ha) and BCR-1.11 were found in treatment combination V_2P_2. The results revealed that potatoes grown with research managed practices are more profitable than the farmers' practices (Table 5).

Table 4. Cost of potato cultivation per hectare.

Variable cost (VC)		Fixed cost (FC)		Total cost of production (VC + FC)
Heads	**Tk.**	**Heads**	**Tk.**	
Labour	80000	Land use	15000	
Power tiller	10000			
Seed	90000			
Fertilizer	40000	Interest on operating capital	5000	(278000+20000)
Cow dung	20000			
Pesticides	20000			
Irrigation charge	18000			
Total	278000	Total	20000	298000

Table 5. Cost and return analysis of mulching and plant spacing on weed control and yield of sweet potato -system during 2021-2022.

Treatment	Fresh potato yield (t/ha)	Avg gross return (Tk)	Avg cost of production (TK)	Avg net return (Tk)	BCR
V_1P_1	29.32[a]	733000	298000	435000	2.46
V_1P_2	16.24[c]	406000	328000	78000	1.23
V_2P_1	38.16[a]	763200	298000	465200	2.56
V_2P_2	18.21[c]	364200	328000	36200	1.11

BCR= Benefit Cost Ratio
BARI Alu-25 = 25 tk/kg
BARI Alu-37= 20 tk/kg.

DISCUSSION

Our experiments provided information on the impact of potato production system between research cultivation practice and farmers' cultivation practice. This study hypothesises that the research cultivation practice of potato production would increase potato yields more than farmers' cultivation practices. From the above results, the common phenomenon was found that potatoes produced with research cultivation practice, i.e. if the farmers use whole tuber as seed tuber while maintaining 60 cm x 25 cm spacing, with Tuber Crops Research Centre (TCRC) recommended fertilizer dosages, both productivity and profitability of potato production will increase. On the other hand, in farmers practices, seed tuber was imported from foreign countries as cut tuber were used as seed materials and high dosages of fertilizers were applied at 700 kg Urea, 500 kg TSP, 640 kg MP, 240 kg Gypsum per hectare. At the time of final land preparation, Furadan 5G / Chlorophyriphos 25EC was applied to the soil against cutworms and other soil pests. No earthing up was done. Fungicides were used 10 to 12 times at 7 day intervals, but insecticides were used single times. For farmers' cultivation practices, weeding and sprinkler irrigation with irrigation pipe were done as and when necessary, even after 80 DAP irrigation was applied, which was very harmful to potato storability and made the potato susceptible to diseases-insects reaction.

From the above results, it was revealed that the outcome of farmers' cultivation practice was not up to the mark. The performance of yield and yield contributing characters were higher in research cultivation than in farmers' cultivation practice. The result of the experiment was in line with the findings of Zamil et al. (2010), who reported that the widest spacing enhances the growth and height of the plant, significantly different from narrow spacing. According to Zebenay (2015), the maximum plant height was observed in wider spacing and medium to big tuber size. This current finding is also supported by a study done by Gebre et al. (2001). They reported a significant effect of spacing on plant height as a result of the availability of wider inter-row spacing for growth. The Tuber fresh yield (t/ha) and marketable tuber fresh yield (t/ha) were found better in research cultivation practice than in farmers' cultivation practice. This may occur due to the judicious use of fertilizer as recommended by TCRC with whole tuber, maintaining proper spacing like 60 cm x 25 cm, good intercultural operations and timely irrigation for the potato production system in the research cultivation practice. On the contrary, in the farmers' cultivation practice, due to using cut tuber with a high dosage of fertilizer and closer spacing (40 cm x 15 cm) with poor intercultural operation and irregular irrigation, productivity of fresh tuber yield and marketable tuber yield remained lower than research practice. These findings were supported by Kushwah et al. (2005), who reported that a balanced and timely fertiliser supply is a prerequisite for getting the optimum yield potential of potatoes. Bucher and Kossmann (2007) also reported that excessive amounts of N may be deleterious to quality traits and pollute groundwater due to leaching. The dry matter (DM) content was higher in research cultivation practice than in farmers' cultivation practice from the above results. Dry matter (DM) content is one of the most common indicators of tuber quality (Storey, 2007). Silva and Fontes (2016) reported that K fertilization decreased dry matter content. Potassium and magnesium can all have influences on tuber dry matter content. Getachew et al. (2013) found that increased plant population was associated with low dry matter content.

The Insect-disease reaction was also found to be more promising in research cultivation practice than the farmers' cultivation practice. From the results, it is clear that the potato produced by farmers' practice was more infected by common scab than the research practice. Whole seed tubers of potato (*Solanum tuberosum* L.) have been reported to have some performance advantages over seed pieces produced by cutting tubers, even if the cut seed is treated with fungicide dust (Kawakami et al., 2003). From the above results, it is also clear that the potato produced by farmers' practice was more infested by cutworms than the research practice. According to Nolte et al. (2003), whole-seed potatoes had greater vigor than cut seeds since the cut seeds need to increase their metabolic activity in developing a new suberin and phylum barrier. Planting large seeds is reported to result in a higher number of tubers per plant and higher total tuber yields than planting smaller seeds (Arioglu, 2009; Masarirambi et al., 2012). (Hirpa et al., 2010) reported that cutting seed potatoes had negative effects including delayed emergence, low sprout vigor and number because of low food reserve, intensive labor requirement, potential for transmission of plant pathogens, and higher risk for seed tuber decay after planting. Finally, Research cultivation practice showed a higher gross return, net return and benefit cost ratio than farmers' cultivation practice. These may occur due to excessive use of fertilizers, pesticides and imported seed from abroad for potato production which has a huge cost of production in farmers' cultivation practice. Therefore, the above discussion of results revealed that potatoes grown with research cultivation practices are more profitable than the farmers' cultivation practices.

CONCLUSION

The trial was conducted to verify the feasibility of research cultivation practices for potato production to compare its productivity and profitability with farmers' cultivation practices. From the above results, it appeared that research practice is superior to farmers' practice for both varieties in terms of fresh tuber yield, dry matter percentage, insect-disease reaction and cost benefit ratio analysis. Based on a year of experiment, it is concluded that the research cultivation practice is significantly superior as compared to farmers' cultivation in growth parameters viz., plant emergence, plant height, number of stems per plant, foliage coverage percentage, plant vigor; yield attributes viz., fresh tuber yield, dry matter production and diseases insect reaction. Hence, Cultivation practices implemented by the researchers using whole tuber maintaining 60 cm x 25 cm spacing with TCRC recommended dosages of fertilizer are recommended for better potato production. If the farmers adopt the research cultivation potato production system the productivity and profitability of potato production in our country can be increased by almost 50%. However, for maximization of productivity as well as profitability, the adoption of potato cultivation practices implemented by the researchers is the right solution.

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