Tuber yield and quality of potato chips as affected by mulch, variety, and potash levels under western Terai, Nepal

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Abstract

An experiment was conducted at Divyapuri of Nawalparasi district in the western Terai during winter season 2008/09. There were 16 treatments consisting of two mulch levels (mulched and no mulch) as main plot, two varieties (Kufri Chipsona-1 and Kufri Chipsona-2) as sub plot and four levels of potash (0, 50, 100 and 150 kg K_2O /ha) as sub-sub plot arranged in split-split plot design with four replications to evaluate the effect of these treatments on tuber production and their effect on quality of potato chips. The result showed that plant height, number of shoot per plant, dry matter accumulation, number and weight of tuber per plant and tuber yield were significantly higher in Kufri Chipsona-2 than in Kufri Chipsona-1. Lower reducing sugar and browning percent of chips and higher dry matter content and chips recovery were also recorded in Kufri Chipsona-2 compared to Kufri Chipsona-1. Simple economic analysis on gross return, net return and B/C ratio were higher in Kufri Chipsona-2. However, increasing levels of potash from 0-150 kg K_2O /ha increased the dry matter accumulation, LAI, number and weight of tuber per plant. The result also showed that as the level of potash increased there was a decrease level of reducing sugar and browning of chips as well. On the other hand, higher potash levels increased the percentage of fat content and recovery of chips. Also increase in potash levels resulted to increase in gross return, net return, and B/C ratio. There was no effect of mulching levels on tuber yield and quality of chips recovery. Of the two varieties, Kufri Chipsona-2 with 100 kg K_2O/ha was found suitable for tuber production and recovery of chips quality.

Key words: Mulch, potato chips, potash levels, tuber yield

Introduction

The cultivated potato is the fourth biggest crop in the world in terms of total production after wheat, rice and maize (NPRP, 1998). Potato, whether in processed or fresh form, is an interlocking and critical component of the food economies in developing countries (Scott *et al.*, 2000). Fresh potato consumption, once the mainstay of world potato utilization, is decreasing in several countries, especially in developed ones. Most of the potato processing is presently confined to the developed countries (Holm *et al.,* 1994). It is still in its infancy in Nepal, though the demand for processed products in the country is rising at a fast pace.

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For maintaining increasing demand of varieties for chips production, Nepal is either importing raw potato packed chips from India and other countries. The tuber dry matter and reducing sugar content of potatoes are the two most important parameters in selecting raw material for processing. The potato processing trade needs varieties with above 20% tuber dry matter to ensure high recovery of quality processed product (Young, 1981). On the other hand, production and productivity of potato in Nepal is lower than that of SAARC nations and other potato growing countries. Development of suitable potato cultivars inside the country with improved agronomic practices will help increase the productivity of potato and save valuable foreign exchange; and open up opportunities for our farmers to get better returns from investment of time and energy. Therefore, this study was carried out to determine the optimum levels of potash and mulch levels on production of tuber and quality of potato chips.

Methodology

An experiment was conducted at Divyapuri, Nawalparasi during winter season, 2008/09. Texture of the soil was sandy loam. The treatments were arranged in split-split plot design in the experiments. There were altogether 16 treatment combinations. Mulching practices (mulched and no mulch) were in main plots, two varieties (Kufri Chipsona-1 and Kufri Chipsona-2) in sub plot and four levels of potash (0, 50, 100 and 150 kg /ha) in sub-sub plots with four replications. The crop was planted in a plot size of 12 $m^{2\ at}$ the spacing of 60 cm row to row and 25 cm plant to plant distances. The spacing between two blocks and plots were maintained 1m and 0.5 m, respectively. The crop was planted in7th November, 2008. The FYM @ 10 t /ha was applied in all experimental plots. The crop was fertilized with 100:100:0/50/100/150 kg NPK /ha through Urea, DAP and MoP. The half dose of nitrogen was applied in furrow at 5 cm depth at the time of tuber planting and the remaining half dose of nitrogen was further divided into two equal amounts; 1st dose was applied at first earthing up 45 days after planting (DAP) and remaining dose was applied at 2nd earthing up (60 DAP). Full dose of phosphorous and potassium fertilizers was applied at the time of final land preparation. Four sprays of protective and curative fungicide SAAF (*Carbendazim* 12% + *Mancozeb* 63% W.P.) @ 2 g/L of water were done to overcome the problem of late blight at an interval of a week from the first symptoms seen in the plants. Altogether two irrigations were provided during entire growing period of potato, 1st at 30 DAP and second at 45 DAP. The collected data were compiled and subjected for analysis of variance. MSTAT-C package was used for data analysis. Means were separated at 5% level of significance by using Duncan's Multiple Range Test (DMRT). Followings were the treatment combinations:

Table 1. Treatment combinations

Treatment	Combination	Symbol
T_1	Mulching+Kufri Chipsona-1+0 kg K_2O /ha	$M_1V_1K_0$
T_2	Mulching+Kufri Chipsona-1+50 kg K_2O /ha	$M_1V_1K_{50}$
T_3	Mulching+Kufri Chipsona-1+100 kg K_2O /ha	$M_1V_1K_{100}$
T_4	Mulching+Kufri Chipsona-1+150 kg K_2O /ha	$M_1V_1K_{150}$
T_5	Mulching+Kufri Chipsona-2+0 kg K_2O /ha	$M_1V_2K_0$
T_6	Mulching+Kufri Chipsona-2+50 kg K_2O /ha	$M_1V_2K_{50}$
T_7	Mulching+Kufri Chipsona-2+100 kg K_2O /ha	$M_1V_2K_{100}$
T_8	Mulching+Kufri Chipsona-2+150 kg K_2O /ha	$M_1V_2K_{150}$
T_9	No mulch+Kufri Chipsona-1+0 kg K_2O /ha	$M_2V_1K_0$
T_{10}	No mulch+Kufri Chipsona-1+50 kg K_2O /ha	$M_2V_1K_{50}$
T_{11}	No mulch+Kufri Chipsona-1+100 kg K_2O /ha	$M_2V_1K_{100}$
T_{12}	No mulch+Kufri Chipsona-1+150 kg K_2O /ha	$M_2V_1K_{150}$
T_{13}	No mulch+Kufri Chipsona-2+0 kg K_2O /ha	$M_2V_2K_0$
T_{14}	No mulch+Kufri Chipsona-2+50 kg K_2O /ha	$M_2V_2K_{50}$
T_{15}	No mulch+Kufri Chipsona-2+100 kg K_2O /ha	$M_2V_2K_{100}$
T_{16}	No mulch+Kufri Chipsona-2+150 kg K_2O /ha	$M_2V_2K_{150}$

Results and discussion

Effect on agronomic attributes

Agronomic attributes such as plant height, number of shoot per plant, number of leaves per plant, plant vigor, and total dry matter accumulation at 90 DAP were not influenced by the mulch but affected by varieties and the potash levels (Table 2). Variety Kufri Chipsona-2 produced significantly taller plant, more number of shoot per plant and total dry matter accumulation per square meter as compared to Kufri Chipsona-1, whereas more number of leaves per plant was found in Kufri Chipsona-1. Varieties differed in the vegetative characters because of its genetically governed characteristics. LAI at 75 DAP was observed higher in mulched condition and higher potassium level. Higher LAI at higher potassium level was because of larger and broader leaves rather than higher number of leaves per plant. Adhikari *et al.* (2000) reported that there was little effect of applied potassium on leaf area of potato crop.

There was increasing tendency in plant height, plant vigor, LAI and total dry matter accumulation with the increase in potassium levels from 0 to 150 kg K_2O /ha. Significantly taller and more vigorous plants were obtained at higher level of potassium. Similarly higher LAI and more total dry matter accumulation were observed in higher level of potash. Number of shoots per plant was found to be higher in potash level of 100 kg K_2O /ha which was statistically at par with 50 and 0 kg K_2O. Increase in plant height with increasing rate of potassium applied might be due to proper utilization of nitrogen and phosphorus by plant; hence the overall shoot growth is expected. Barevadia *et al*., (1978) and Moinuddin *et al*., (2005) reported the increase in plant height and biomass in higher levels of potash.

Effect on yield attributes

Yield attributes of potato such as the number of tubers per plant and weight of tuber per plant. The data on the yield and yield attributing character is presented (Table 3). The yield attributing characters of potato were significantly influenced by variety and potash levels but mulch had significant effect only on number of tuber per plant of grade >75 g. Higher number of tuber per plant of grade >75 g was recorded in mulched plot as compared to no mulch. Chandra *et al*. (2002) reported that the mulch produced 9.4% more large sized (> 50 mm) tubers than no mulch. Wang *et al.* (2009) showed that all the mulched treatments had more jumbo (>300 g) tubers by weight than the non-mulched treatment. Kufri Chipsona-2 produced significantly more number and weight of small as well as large sized tubers per plant as compared to Kufri Chipsona-1. Tuber yield per hectare was higher in Kufri Chipsona-2. Ability of variety to produce higher yield is mainly dependant on its genetic make up. The potato varieties differ widely with regard to K use efficiency. Potato cultivars namely Kufri Bahar and Kufri Badshah responded only upto 50 kg K/ha. Kufri Jyoti and Kufri Chandramukhi on the other hand responded upto 100 kg K/ha (Trehan and Grewal, 1994). There is decrease in number of small sized tuber with the increase in potassium rate. The number of medium and large sized tubers per plant increased with the increase in potassium rate. Pronounced effect of applied potassium was observed on weight of tuber of size 50-75 g, > 75 g and aggregate as well. There was no effect of potash levels on weight of tuber per plant of grade < 25 g and 25-50 g. The higher weight of tuber per plant with the increase in potash dose also reported by Moinuddin *et al,*(2004).

Effect on tuber yield and quality

The result of the research revealed that Kufri Chipsona-2 produced significantly higher tuber yield (24.15 t /ha) than Kufri Chipsona-1 (22.49) exhibited (Table 3) which was significant at 5% level of significance. This could be attributed to genetic makeup of the varieties. The result of the experiment showed that there was the trend of increase in yield of potato with the increase in potash levels. Higher potash level i.e. 150 kg K_2O /ha produced significantly higher tuber yield as compared to all other potash levels. Potassium is involved in several aspects of the plant physiology such as activation of enzymes, maintaining cell turgor, promotion of water uptake and regulation of nutrients translocation in plant (Marschner, 1995). These multiple functions of K in several metabolic processes lead to numerous positive effects of an adequate K nutrition for potato and thus increase yield, increase proportion of marketable tubers and increase tuber size (Imas and Bansal, 1999). Higher yield of potato tuber at higher level of potash might be due to more weight of tuber per plant of medium and large size. Moinuddin *et al,* (2004) reported increase in tuber yield per plant with the progressive application of potassium.

The effect of mulch on specific gravity and reducing sugar content of potato tuber was found not significant but the tuber dry matter content was significantly higher in mulched condition as compared to no mulch condition. There were higher specific gravity and dry matter content of potato tuber in variety Kufri Chipsona-2 than Kufri Chipsona-1. Reducing sugar content was lower in Kufri Chipsona-2 than Kufri Chipsona-1. Differences among varieties for reducing sugar, specific gravity and dry matter content are reported by previous workers (Foda, 1973) and are probably due to genetic variability of different potato varieties (Burton, 1966). The highest specific gravity and dry matter content of potato tuber were recorded at potash level of 50 kg K_2O /ha which was statistically at par with potash level of 100 kg K_2O /ha. Reducing sugar content of potato tuber decreased with the increase in potassium rate, however, there were no significant differences in reducing sugar content of potato tuber at potash doses of 50, 100 and 150 kg K_2O /ha. Potassium influences the water content of the plasma volume, thus affecting the water content of fleshy storage tissues, like the tubers. Iritani and Weller (1978) reported that fertilizer rates influenced sugar accumulation in tuber. Elevated K concentrations in the tubers of above 2% dry weight (DW) can lead to above-normal water contents and lower contents of dry matter (Bergmann, 1992). Maier *et al.*(1994) reported that site deficient or marginal in K should show an increase in specific gravity in response to K applied as potassium sulphate. Westermann *et al.*(1994) reported that specific gravity and dry matter content of potato tuber were the highest at lower dose of N and K (112 kg N and K /ha). On contrary, the highest specific gravity of potato tuber was in potash level of 50 kg K_2O /ha. This result is in the line of Abdelgadir *et al.*(2003) who found the highest specific gravity of potato tuber at potash level of 50 kg K_2O /ha.

Effect on quality of chips

Chips recovery was significantly higher in Kufri Chipsona-2 (31.35%) than in Kufri Chipsona-1 (28.22%). Browning of chips was significantly lower in Kufri Chipsona-2 (5.99 %) than that of Kufri Chipsona-1 (10.94 %). Chips recovery is the function of specific gravity and dry matter of potato tuber. The higher chips recovery in Kufri Chipsona-2 may be attributed due to higher specific gravity and dry matter content of potato tuber. The potato variety with relatively less percentage of browning is considered to be suitable for chips making. Lower reducing sugar content of Kufri Chipsona-2 resulted lower browning of chips during frying of chips. Significantly lower peel loss (9.31%) was observed in potash level of 100 kg K_2O /ha. Highest peel loss was observed in potash level of 0 kg K_2O/ha which was statistically at par with potash levels of 50 kg K_2O /ha and 150 kg K_2O/ha. Significantly higher chips recovery (30.73%) was observed in potash levels of 150 kg K_2O/ha which was statistically at par with the potash levels of 100 kg K_2O /ha and 50 kg K_2O/ha.

Table2. Agronomic attributes of potato as affected by treatments at Divyapuri, Nawalparasi, western Terai, during winter season 2008/2009

Treatment	Final plant height (cm)	Number of shoot per plant at 75 DAP	Number of leaves per plant at 75 DAP	Plant vigour	LAI at 75 DAP	Total Dry matter accumulation (gm^{-2}) at 90 DAP
Mulch						
Mulched	51.27	3.96	35.47	3.406	1.12^a	569.43
No Mulch	51.20	3.87	34.12	3.531	1.11^b	566.47
SEm±	1.447	0.109	1.055	0.173	0.002	7.77
LSD	NS	NS	NS	NS	0.009*	NS
[a]Variety						
KC-1	48.37^b	3.47^b	36.05^a	3.531	1.11	550.72^b
KC-2	54.10^a	4.36^a	33.54^b	3.406	1.12	585.18^a
SEm±	1.004	0.069	0.441	0.134	0.010	5.12
LSD	3.475**	0.238**	1.526**	NS	NS	17.71**
Potassium						
0 kg K_2O	49.35^b	3.83^{ab}	32.99	3.06^c	1.02^c	542.48^c
50 kg K_2O	50.01^b	4.01^a	35.17	3.43^b	1.10^b	559.27^b
100 kg	50.93^b	4.08^a	35.27	3.62^a	1.14^b	573.70^b
150 kg	54.65^a	3.73^b	35.75	3.75^a	1.21^a	596.37^a
SEm±	0.812	0.092	0.953	0.16	0.015	5.47
LSD	2.329**	0.263*	NS	0.481**	0.043**	15.69**
CV (%)	6.34	9.49	10.96	13.70	5.51	3.85

Means within the column followed by the same letter(s) are not significantly different at 5% level of significance by DMRT. SEm = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variance. * Significant at 5%, ** Significant at 1%. DAP= Days After Planting, LAI= Leaf Area Index, [a]KC-1= Kufri Chipsona-1, KC-2= Kufri Chipsona-2

Significantly lower chips recovery (28.13%) was observed in potash level of 0 kg K_2O /ha. There was decrease in the browning percentage with the increase in potash dose. Similarly, significantly lowest browning of potato chips in frying (7.47%) was observed in the potash level of 150 kg K_2O /ha which was statistically at par with the potash level of 100 kg K_2O /ha (7.80%) that was again statistically similar with the potash level of 50 kg K_2O /ha (8.54%). Significantly higher browning of potato chips was found in 0 kg K_2O /ha.

Higher chips recovery in 50 and 100 kg K_2O /ha may be due to higher specific gravity and dry matter content of potato tuber. Furthermore, higher chips recovery in higher level of potassium i.e. 150 kg K_2O /ha was due to absorption of higher percentage of fat during the process of frying. This result is in the line of Cunningham and Stevenson (1963) who reported that high French fry weight of low specific gravity and dry matter varieties could be due to the absorption by fried slices, of the frying oil. A positive correlation between specific gravity of potato tuber and weight after frying was observed by Tawfik *et al,* (2002). Percent of chips having darkened appearance upon frying were within acceptable limit of local potato chip industries i.e. less than 15% (Abdelgadir *et al*., 2003). They also reported that potash level of 50 kg K_2O /ha increased specific gravity of tuber and reduced fried color defect (FCD). Darker chip color is associated with higher reducing sugar concentration (Dahlenburg *et al*., 1990). Application of K as Murate of Potash (MOP) has been reported to decrease enzymatic discoloration and phenol content thereby reducing the browning of potato chips (Joshi *et al*, 1982).

Simple economic evaluation

The B/C (4.00) ratio was found to be significant (P=<0.05. High B/C ratio in no mulch condition might be due to avoidance of high cost of mulching material (rice straw).

Effect of different varieties on gross return, net return and B/C ratio was found to be significant. Kufri Chipsona-2 gave significantly more gross return (NRs. 289810.00 /ha), net return (NRs. 217060.00 /ha) and B/C ratio (3.97) than Kufri Chipsona-1. The highest yield of Kufri Chipsona-2 led the highest return from cultivation. More gross return (NRs. 305980.00 /ha) was found in 150 kg /ha K_2O applied plot. Gross return was in increasing trend with the increase in potash levels. Higher net return from potato cultivation (NRs. 229850.00 /ha) was obtained in potash level of 150 kg /ha which was statistically at par with potash level of 100 kg /ha. Higher B/C ratio (4.01) was obtained at potash level of 150 kg /ha which was statistically at par (3.94) with B/C ratio obtained at 100 kg /ha K_2O application. Lowest B/C ratio (3.61) was obtained at potash level of 0 kg /ha. Economic benefit from the cultivation of crops solely depends on the proper adjustment of input levels and the return from the cultivation. Sharma (1994) and Lalitha *et al.* (1997) had recorded the enhancement in net return with progressive application of potassium from 0 to 150 and 0 to 90 kg K_2O /ha respectively. They also noted an increase in tuber yield with increasing K application rates up to the highest rate. Higher B/C ratio at higher dose of potash was due to high gross and net return from the cultivation.

Table 3. Tuber yield and yield attributes of potato as affected by treatments at Divyapuri, Nawalparasi, western Terai, during winter season 2008/2009

Treatment	Number of tubers per plant					Weight of tuber per plant					Tuber yield
	<25 g	25-50 g	50-75 g	>75 g	Aggregate	<25 g	25-50 g	50-75 g	>75 g	Aggregate	(t /ha)
Mulch											
Mulched	2.87	1.70	1.90	1.89[a]	8.37	40.20	59.76	114.43	142.68	357.09	23.56
No Mulch	2.74	1.71	1.93	1.53[b]	7.92	39.31	61.80	118.57	131.26	350.96	23.08
SEm±	0.131	0.052	0.102	0.036	0.183	2.133	1.567	6.108	3.218	5.728	0.325
LSD	NS	NS	NS	0.163**	NS	NS	NS	NS	NS	NS	NS
[a]Variety											
KC-1	2.67[b]	1.60[b]	1.91	1.64[b]	7.83[b]	37.76[b]	56.71[b]	116.33	130.78[b]	341.60[b]	22.49[b]
KC-2	2.94[a]	1.81[a]	1.91	1.78[a]	8.46[a]	41.75[a]	64.85[a]	116.67	143.17[a]	366.45[a]	24.15[a]
SEm±	0.069	0.039	0.044	0.041	0.098	0.676	1.564	3.180	3.477	6.068	0.358
LSD	0.238*	0.134**	NS	0.141*	0.339**	2.339**	5.413*	NS	12.035*	21.004*	1.239*
Potassium											
0 kg K_2O /ha	3.10[a]	1.73	1.73[c]	1.52[b]	8.10	41.05	57.80	101.32[d]	117.23[c]	317.41[d]	20.86[d]
50 kg K_2O /ha	2.83[b]	1.75	1.86[bc]	1.63[b]	8.08	39.82	61.66	112.42[c]	129.58[b]	343.50[c]	22.69[c]
100 kg K_2O /ha	2.71[b]	1.67	1.96[b]	1.81[a]	8.16	39.62	61.02	121.17[b]	146.73[a]	368.56[b]	24.24[b]
150 kg K_2O /ha	2.58[b]	1.67	2.10[a]	1.88[a]	8.25	38.55	62.65	131.08[a]	154.35[a]	386.63[a]	25.49[a]
SEm±	0.088	0.053	0.044	0.042	0.13	1.138	1.827	2.814	3.634	5.875	0.378
LSD	0.252**	NS	0.126**	0.120**	NS	NS	NS	8.059**	10.423**	16.851**	1.084**
CV (%)	12.56	12.55	9.26	9.90	6.49	11.45	12.03	9.66	10.61	6.64	6.50

Means within the column followed by the same letter(s) are not significantly different at 5% level of significance by DMRT. SEm = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variance. * Significant at 5%, ** Significant at 1%, [a]KC-1= Kufri Chipsona-1, KC-2= Kufri Chipsona-2

Table 4. Effect of mulch, variety and potassium levels on quality of potato and chips parameters at Divyapuri, Nawalparasi during winter season 2008/2009

Treatment	Tuber quality			Chips parameters			
	Specific Gravity	Dry matter content (%)	Reducing sugar % (antilog scale)	Peel loss (%)	Chips Recovery (%)	Browning of chips (%)	Fat content of Chips (%)
Mulch							
Mulched	1.076	22.82[a]	1.201	10.17	29.75	8.42	37.01
No Mulch	1.069	22.00[b]	1.206	10.43	29.82	8.51	38.10
SEm±	0.003	0.178	0.0149	0.149	0.194	0.309	0.328
LSD	NS	0.801*	NS	NS	NS	NS	NS
[a]Variety							
KC-1	1.071	21.85[b]	1.338[a]	10.51	28.22[b]	10.94[a]	39.15[a]
KC-2	1.073	22.97[a]	1.069[b]	10.09	31.35[a]	5.99[b]	35.97[b]
SEm±	0.006	0.223	0.018	0.379	0.392	0.344	0.359
LSD	NS	0.771*	0.06**	NS	1.356**	1.190**	1.242**
Potassium							
0 kg K_2O /ha	1.057[b]	21.58[c]	1.283[a]	11.00[a]	28.13[b]	10.05[a]	35.09[d]
50 kg K_2O /ha	1.089[a]	23.32[a]	1.203[b]	10.50[a]	29.60[a]	8.54[b]	36.02[c]
100 kg K_2O /ha	1.078[ab]	22.60[ab]	1.171[b]	9.31[b]	30.66[a]	7.80[bc]	38.77[b]
150 kg K_2O /ha	1.065[b]	22.13[bc]	1.157[b]	10.40[a]	30.73[a]	7.47[c]	40.35[a]
SEm±	0.008	0.255	0.017	0.379	0.40	0.317	0.298
LSD	0.022*	0.731**	0.049**	1.087*	1.147**	0.909**	0.854**
CV (%)	3.05	4.56	5.68	14.73	5.38	14.97	3.18

Means within the column followed by the same letter(s) are not significantly different at 5% level of significance by DMRT. SEm = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variance. * Significant at 5%, ** Significant at 1%, [a] KC-1= Kufri Chipsona-1, KC-2= Kufri Chipsona-2

Table 5. Simple economic evaluation as affected by treatments of potato at Divyapuri, Nawalparasi, western Terai, during winter season 2008/2009

Treatment	Economic evaluation [a]		
	Gross Return	Net Return	B/C Ratio
Mulch			
Mulched	282.74	206.24	3.68[b]
No Mulch	277.03	208.02	4.00[a]
SEm±	3.903	3.903	0.053
LSD(0.05)	NS	NS	0.240*
Variety			
Kufri Chipsona-1	269.96[b]	197.20[b]	3.71[b]
Kufri Chipsona-2	289.81[a]	217.06[a]	3.97[a]
SEm±	4.306	4.306	0.060
LSD(0.05)	14.90*	14.90*	0.207*
Potassium			
0 kg K_2O /ha	250.35[d]	180.97[c]	3.61[c]
50 kg K_2O /ha	272.27[c]	200.64[b]	3.80[b]
100 kg K_2O /ha	290.93[b]	217.05[a]	3.94[ab]
150 kg K_2O /ha	305.98[a]	229.85[a]	4.01[a]
SEm±	4.546	4.546	0.060
LSD(0.05)	13.04**	13.04**	0.174**
CV %	6.50	8.78	6.33

[a] Selling rate of 1US$= NRs 71.25 as of 30[th] April 2011, Means within the column followed by the same letter(s) are not significantly different at 5% level of significance by DMRT. SEm = Standard Error of Mean, LSD = Least Significant Difference and CV = Coefficient of Variance. * Significant at 5%, ** Significant at 1%

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