EFFECT OF GENOTYPES AND SPACING ON PROCESSING QUALITY TUBER PRODUCTION OF POTATO IN MID HILL AND INNER TERAI OF NEPAL.

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ABSTRACT

First set of experiment were conducted on seven promising genotypes of potato at Hattiban Farm, Khumaltar in mid hill and inner terai at farmers fieldChitwan during 2012/13 for evaluation and verification of processing genotypes of potato. Spacing experiments werealso conducted in both locations during 2012/13 and 2013/14 on genotype L-235.4 to study the effect of spacing for processing grades tuber production.In mid at Hattiban Farm, the genotypes differed significantly on emergence percentage at 30 DAP, plant uniformity, ground coverage percentage, plant height at 90 DAP, <30 and > 60 g tuber number distribution, and 30-60 g and > 60 g tuber weight and total yield . The genotype K. Jyotproduced the maximum weight of >60 g tuber yield while total yield was recorded the maximum in K. Jyoti followed by L-235.4. In inner terai atSaradanagar, Chitwan, genotypes BSU PO3 and CIP 389746.2 were found promising for higher yield of processing grades tuber yield but processing qualities were observed better in genotypes BSU PO3 and L-235.4. The results of spacing trial showed the significant differences on ground coverage,<30 and 30-60 g tuber weight in mid hill. The maximum yield of 30-60 g tuber was recorded in 60x 30 cm spacing and decreased linearly and produced the lowest yield in 90x 30 cm. In inner teraiChitwan, no significant variation was observed on yield of different grades tubers. However, it follows the same pattern on total yield as in mid hill at hattiban Farm. The processing qualities like dry matter and specific gravity increased gradually at wider spacing and reached the maximum in 90 x 30 cm in both locations. Allspacing had the reducing sugars below the limit for processing in to chips.

Key words: *Genotypes, potato, locations, spacing, processing grade tuber production*

Introduction

Potato (SolanumtuberosumL) is popularly known as 'the king of vegetables', has emerged as an important crop in Nepal. It is grown in all ecological zones ranging from 100 m asl to 4400m above sea level (Dhital and Khatri, 2004 and Gautam, 2013). It occupies the fifth position in area, second in production and first in productivity among the major food crops. The area, production and productivity of potato has been increased 41.52, 90.90 and 34.89 percentage respectively since 2000/01 to 2010/11 (MOAC, 2011) and contributes 9.4% Agriculture Gross Domestic Product (MOAC, 2013). At present, potato is being utilized for processing in to French fry and chips besides vegetable and food crops. Processing is an important value addition function of marketing and is considered as a major source of income and employment in Asia, Africa and Latin America. Processed

potato products have high demand in the markets (Khorana, 2005) and market value of processed products is far better than the value of raw products (Abbas, 2011). Among processed products, potato chips are gaining popularity among the Nepalese consumers due to the changing of food habits, rapid urbanization, and aptitude of new generations for easy to prepare and ready to serve fast food. This is likely to increase further more in the future.

The share of potato chips in Nepalese markets is fulfilled approximately 48% from Indian products, 32% from CG foods and only 20% from local cottage industries (MOAC, 2011). The imported quantity and value of potato chips was about 990 t with worth of NRs. 396 million during 2011/12 (MOAC, 2013). The high import amount could be due to the unavailability of suitable genotypes and low grade chips produced by local cottage industries.

Varieties recommended for table purpose may or may not be suitable for processing. Processing of potatoes into chips requires certain minimum quail attributes like oval to round tuber shape (Preferably more than 60 g tuber weight) with shallow eyes and low peeling losses,. Tuber should have 20% or more dry matter, high specific gravity (>1.070) and less than 200 mg sugars / 100 g fresh weight (Gautam, 2013).

Previous results conducted at Hattiban Farm Khumaltar showed potato genotypes PRP 25861.1, Khumal Seto-1 and L-235.4 were promising for chips making due to fulfillment of chips processing qualities. However, the processing grade tuber production is very low in genotype L-235.4 even though it produced maximum total yield among the tested genotypes (Gautam, 2013). Many factors influence the yield and potato size distribution including spacing, nutrient management, water management, seed size, genotypes, geographical location and climatic conditions. Arsenault et al.(2001)reported that intra-row spacing varies among the cultivars for tuber size production. The variation in intra-row spacing can affect the tuber size distribution (Kumar et al., 2001). There is also evidence that wider intra-row spacing reduced the specific gravity and higher incidence of hollow heart but no effect on chips colour (Zebarthet al., 2006).

It has been noted that the genetic characters of genotypes had influenced greatly by prevailing environment on growth, tuber size distribution, and yield of potato. Considering above facts and problems field experiments were conducted to evaluate and verify promising processing and to study the spacing trials for processing grade tuber production hill at Khumaltar and inner terai at Chitwan.

Materials and Methods

First experiment was conducted at Hattiban Farm of National Potato Research Program (NPRP), Khumaltar and at Farmers field in Saradanagar, Chitwan during the 2012/13 to

Verify the promising lines of potato for processing potato production in hill and terai conditions.The experiments were laid out in Randomized Block Design (RBD) with 3 replications both in on-station and farmers field. One farmer was taken as one replication at Saradanagar, Chitwan. The treatments consisted of seven genotypes (PRP 25861.1, BSU-PO3, L-235.4, CIP 389746.2, HPS 7/67, HPS II/67 and KufriJyoti). The plot size was maintained 11.25 m2(3.75x 3.0 m). Tubers were planted at a distance of 75 X 30 cm. Manure and fertilizers were applied at the rate of 20 t FYM and 150:100:30 kg NPK/ha. All FYM, phosphorus and potash and two third nitrogen was applied as basal application and remaining one third N was applied as top dress at the time of hilling (25-30 days

after planting)at Saradanagar, Chitwan and all fertilizers and manure were applied as basal dose at Khumaltar. The crop was planted on 22nd November, 2012and harvested on 22nd February, 2013 (92 DAP) at Saradanagar. At Khumaltar, the crop was planted on 28th January, 2013 January and harvested on 31st May, 2013 (124 DAP).Observation was recorded on emergence percentage, plant vigor, uniformity, ground coverage, number and weight of different grade tubers and total yield. Processing quality parameters like dry matter, specific gravity and reducing sugar was also recorded after harvesting the crop.

Second experiment was conducted to study the effect of spacing for processinggrades tuber production in genotype L-235.4. This experiment was conducted from 2012/13-2013/14 both in farmers field at Saradanagar, Chitwan and on-station at Hattiban Farm, Khumaltar. Field experiments were conducted in RBD with 4 replications both in on-station and farmers field. One farmer was taken as one replication at on-farm. The treatments consisted of 6 different inter and intra row spacing (60x25, 60x 30, 75x 25, 75x 30, 90x25 and 90 x 30 cm). manure and fertilizers were applied at the rate of 20 t FYM and 150:100:60 kg NPK/ha as per first experiment. The crop was planted on 21st and 8thNovember during2012 and 2013 and harvested at 92 and 100 DAP respectively in first and second years at Saradanagar.At Khumaltar, the crop was planted on 28th January, 2013 and harvested on21stMay, 2013(121 DAP). Observation was recorded on emergence percentage, plant vigor, uniformity, ground coverage, number and weight of different grade tubers, total yield and processing qualities. The dry matter content was determined by chopping and mixing of tubers in to small pieces and drying of 100 gram sample in hot air oven at 80°C for first six hours and then at 65°C till constant weight was obtained. Specific gravity was determined by weighing of randomly selected 10 tubers in Kern electric balance (0.1-6000 g) in air and water by using following formula:

$$\text{Specific gravity} = \frac{Weightinair}{Weightinair - Weightinwater}$$

Reducing sugars content was determined by using di-nitrosalicyclic colorimetric method (Miller, 1959). Spectrophotometer (Thermo Spectronic, USA modelGenesys 10 UV) was used for recording the reducing sugars at 575 nm . To calculate the milligram reducing sugars per 100 gram fresh weight of potato, a standard curve was plotted with different concentration of glucose (0.00125, 0.0025, 0.05, 0.01, 0.02, and 0.04 mg glucose ml-1 water) on x-axis and absorbent reading on y-axis. The absorbent reading of samples were recorded and calibrated on the basis of standard curve and presented as milligram reducing sugars per 100 gram fresh weight of potato.

Results and Discussion

Experiment 1. Evaluation ofpromising line for processing potato production in mid hill and inner teraiconditions

Emergence Percentage

The genotypes differed significantly on emergence percentage at 30 days after planting at Khumaltarbut non-signigicant in inner terai condition. At Khumaltar, genotypes KufriJyoti had the highest emergence percentage (85%) followed by BSU PO3 and HPS 7/67 (72%). The lowest emergence percentage at 30 DAP was recorded in CIP 389746.2 (23%). However, genotypes did not show significant variation on emergence percentage at 45 DAP at Khumaltar (Table 1)

Plant Vigor and Uniformity

The plant vigor and uniformity recorded at 90 DAP showed non- significant and significant results among the genotypes at Khumaltar. Genotypes K. Jyoti and L-235.4 showed more uniform plants (5 scale), whereas TPS progenies , HPS-2/67 and HPS 7/67 had less uniformity of plants (3.7 scale) heterogeneous plants. The heterogeneous plant in TPS progenies could be due to segregation of plants in second generation.Other genotypes lie between these two rages (Table 1).

Ground Coverage

The genotypes showed significant difference on ground coverage percentage at 90 DAP at Khumaltar. Genotype L-235.4 and HPS-7/67 were statistically at par and had highest ground coverage whereas the minimum ground coverage (61.7%) was observed in genotype CIP 389746.2. The detail of ground coverage of other genotypes is presented in Table 1.

Plant Height

There was significant variation on plant height among the genotypes at Khumaltar but data were not recorded in Chitwan.At, Khumaltar,genotypes HPS-II/67, PRP 25861.1 and HPS 7/67 had the tallest plant height and were statistically at par with each otherat .The minimum plant height (34.9 cm) was recorded in KufriJyoyi.Other genotypes had medium plant height and lies between above genotypes(Table 1).

Number of Stem Per Hill

Number of stems/ hill showed no significantdifference among the genotypesboth at Khumaltar and Chitwan .At Khumaltar, the genotype CIP 389746.2 had the lowest number of stems/ hill (3.3), whereas other genotypes were statistically at par and has more number of stems/ hill (Table-1). In inner terai at Chitwan, the genotype BSUPO3 produced the highest number of stems/hill (4.4). The lowest stem numbers (3.1) was recorded in genotypes L-235.4 and K.Jyoti and they were statistically at par with genotypes PRP 25861.1 and CIP 389746.2 (3.4). The detail is presented in Table 3.

Table 1. Vegetative parameters of promising genotypes of potato at Hattiban Farm, Khumaltar during 2012/13

Genotypes	Emergence percentage		Plant vigor (1-5 scale)	Plant uniformity (1-5 scale)	Ground coverage (%)	Plant height (cm)	No of stem/ hill
	30 DAP	45DAP					
PRP 25861.1	45 c	99	5.0	4.7ab	66.7 cd	59.5 a	5.1 a
BSUPO3	72ab	96	4.3	4.0bc	58.3 d	43.5bc	5.7 a
L-235.4	36 cd	97	4.3	5.0 a	85.0 a	48.5ab	4.9 a
CIP 389746.2	23 d	95	3.8	4.3abc	61.7 d	43.2bc	3.3 b
HPS 7/67	72ab	100	4.7	3.7 c	81.7 a	57.3 a	5.7 a
HPS II/67	57bc	95	4.7	3.7 c	80.0ab	60.7 a	5.4 a
K. Jyoti	85 a	99	4.0	5.0 a	71.7bc	34.9 c	6.3 a
Mean	55.6	98	4.40	4.33	72.1	49.7	5.2
F-test	***	NS	NS	**	***	**	*
LSD (0.05)	20.88	-	-	0.7764	8.97	11.42	1.658
CV (%)	21.1	2.8	13.6	10.1	7.0	12.9	17.9

Grade Wise Tuber Distribution and Yield

In mid hill at Khumaltar, the genotypes showed a significant variationsin distribution of less than 30 and more than 60 g tubers number distribution whereas the weight of 30-60 g and > 60 showed significant variation among the genotypes. The genotype KufriJyoti showed only significant for production of > 60 g tuber yield and had the maximum processing grade yield (12.77 t/ha). Total tuber yield also varied among the genotypes. The genotype KufriJyoti had the highest tuber yield (28.85 t/ha) followed by L-235.4 (22.76 t/ha). The lowest tuber yield (15.40 t/ha) was recorded in genotype CIP 389746.2 and it was statistically at par with genotype PRP 25861.1 (15.94 t/ha). It could be due to low number of stems/plant and early harvesting of crops.The detail of grade wise tuber number distribution, yield and total yield is presented in Table - 2.

In Chitwan at Saradanagar, significant difference was observed in distribution of more than 60 gram tuber numbers and weight. The highest percentage of > 60 g tubers number distribution was recorded in genotype CIP 389746.2 (25%) and it was atpar with K. Jyoti (22.3%0 and BSUPO3 (21%) whereas, the lowest tuber numbers of .60 g was recorded in genotype L-235.4 (7%). Similarly, the highest tuber weight of > 60 g was recorded in genotype CIP 389746.2 (13.5 t/ha) and it was followed by BSUPO3 (12.44 t/ha) and K. Jyoti (11.68 t/ha) and the lowest in genotype L235.4 (3.72 t/ha). However, total tuber yield was not significant among the genotypes (table 3).

Table 2. Yield parameters of promising genotypes of potato at Hattiban Farm, Khumaltar during 2012/13

Genotypes	Numbers of tubers distribution (%)			Weight of tubers distribution (t/ha)			Total yield (t/ha)
	<30 g	30-60 g	>60	<30 g	30-60 g	>60 g	
PRP 25861.1	33.3 bc	58.7	8.0bc	1.94	10.12abc	3.90 b	15.94 c
BSUPO3	49.0 a	43.3	7.7bc	3.36	9.27 c	4.37 b	16.99bc
L-235.4	43.7ab	51.3	4.7 c	4.64	14.51 a	3.57 b	22.76 b
CIP 389746.2	42.7ab	44.7	12.7ab	2.12	7.48 c	5.80 b	15.40 c
HPS 7/67	38.7abc	51.3	10.0abc	2.10	9.70bc	5.50 b	17.41bc
HPS II/67	39.3abc	50.3	10.3abc	2.40	10.21abc	6.13 b	18.73bc
K. Jyoti	28.3 c	54.0	17.3 a	2.08	13.99ab	12.77 a	28.85 a
Mean	39.2	50.5	10.10	2.68	10.76	6.0	19.44
F-test	*	NS	*	NS	*	**	**
LSD (0.05)	10.68	-	7.016	-	4.255	4.127	5.533
CV (%)	15.3	10.9	39.1	37.3	22.2	38.6	16.0

Table 3. Yield and yield parameters of promising genotypes of potato at Farmers field Chitwan during 2012/13

Genotypes	Emergence percentage At 30 DAP	No of stem/ plant	Numbers of tubers distribution (%)			Weight of tubers Distribution(t/ha)			Total yield (t/h)
			<30g	30-60g	>60g	<30g	30-60g	>60g	
PRP 25861.1	47.3	3.4 b	27.3	57.7	14.3 b	1.19	11.55	8.06bcd	20.80
BSUPO3	48.0	4.4 a	20.3	58.7	21.0 a	0.97	12.85	12.44ab	26.25
L-235.4	39.7	3.1 b	22.7	70.3	7.0 c	1.18	14.22	3.72 d	19.12
CIP389746.2	46.0	3.4 b	21.0	54.0	25.0 a	0.74	8.67	13.50 a	22.91
HPS 7/67	42.0	3.8ab	32.3	56.7	11.3bc	1.93	13.92	7.74 cd	23.59
HPS II/67	37.0	3.6ab	41.3	50.0	8.7bc	1.85	12.92	6.0 d	20.78
K. Jyoti	43.7	3.1 b	23.7	53.7	22.3a	0.97	11.26	11.68abc	23.90
Mean	43.4	3.536	27.0	57.3	15.67	1.26	12.20	9.02	22.48
F-test	NS	*	NS	NS	***	NS	NS	**	NS
LSD (0.05)	-	0.7987	-	-	5.784	-	-	4.318	-
CV (%)	10.7	12.7	35.1	14.5	20.8	40.2	24.0	26.9	20.3

Dry Matter Content

There was variation on dry matter percentage among the genotypes at Farmers field in Chitwan. The genotype BSUPO3 had the highest dry matter percentage (19.7%) followed by L 235.4 (19.5%), whereas the genotype KufriJyoti had the lowest dry matter percentage (18.3%). Other genotypes had dry matter with in these values (Fig 1).

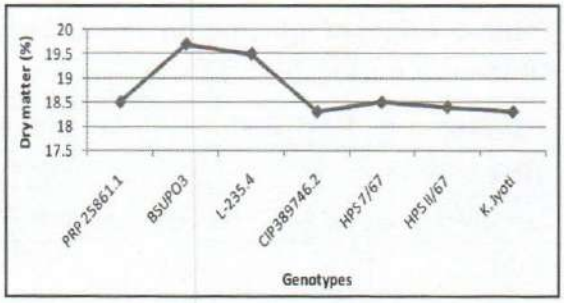

Figure 1. Effect of genotypes on dry matter percentage at Saradanagar during 2012/13

Specific Gravity

The specific gravity of genotypes ranged from minimum (1.065) in genotypes K.Jyoti and HPS II/67 to the maximum (1.0750) in genotype BSUPO3. The specific gravity was directly related to dry matter percentage of genotypes. The detail specific gravity of all genotypes is presented in Fig. 2.

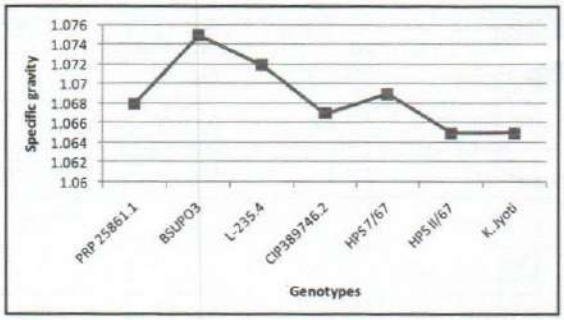

Figure 2. Effect of genotypes on specific gravity content at Saradanagar during 2012/13

Reducing Sugars

The reducing sugar ranged from the minimum (30 mg/ 100 g fresh wt.) to the maximum (69.0) mg/100 g fresh weight) in genotype TPS progeny HPS 7/67.However, all genotypes had the reducing sugar below the acceptable limit (150-200 mg/100 g fresh wt.)for processing into chips (Ezekiel et al., 2003).The detail reducing sugars content in genotypes is presented in Fig 3.

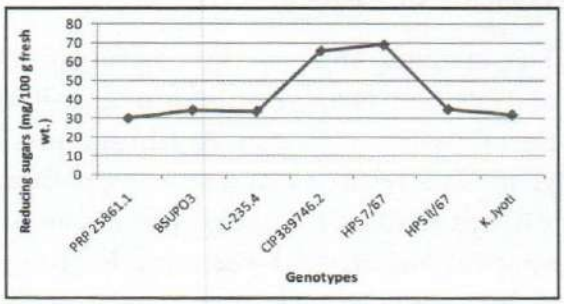

Figure 3. Effect of genotypes on reducing sugars content (mg/100 g fresh wt.) atSaradanagar during 2012/13

Experiment 2. Study the effect of spacing for processing grades tuber production in genotype L-235.4.

Vegetative Parameters

The effect of spacing showed a non-significant results on vegetative parameters like emergence percentage, plant vigor, uniformity, height and number of stems per hillexcept ground coverage percentage at 90 DAP at Hattiban Farm, Khumaltar. The highest ground coverage percentage (86.2%) was recorded at a spacing of 60x 25 cm and the lowest (61.25) in 90 x 30 cm. The lowest ground coverage percentage was statistically at par with the spacing of 75x 30, and 90x 25 cm (Table 4). At Saradanagar, the data recorded at on plant uniformity, ground coverage, plant height and number of stems/ hill showed non-significant results among the treatments (Table 6).

Number of Tubers

The number of different grades tuber distribution showed a non-significant variation among the different spacing both in mid hill at Hattiban Farm and Farmers field in inner terai at Saradanagar, Chitwan (Table 5 and 7). It could be due to genetic character of genotype. Similar findings was reported by Abbas, 2011 and many other researchers in past.

Table 4. Effect of spacing on vegetative growth of potato genotype L-235.4 at Hattiban Farm, Khumaltar during 2012/13

Spacing (RR x PP in cm)	Emergence (%)		Plant vigor (1-5 scale)	Plant uniformity (1-5 scale)	Ground coverage %	Plant height (cm)	No of stems/ plant
	30 DAP	45 DAP					
60x 25	14.6	90.4	4.8	4.6	86.2 a	41.6	4.4
60x30	17.7	96.9	4.5	4.5	77.5 ab	43.0	4.6
75x25	18.0	93.0	5.0	4.6	78.7ab	45.2	4.6
75x30	10.6	85.0	4.3	4.4	62.5 b	42.3	4.0
90x25	13.1	93.1	4.5	4.8	62.5 b	44.3	4.4
90x30	14.1	89.9	4.4	4.8	61.2 b	41.9	4.8
Mean	14.7	91.4	4.56	4.604	71.5	43.03	4.43
F-test	NS	NS	NS	NS	*	NS	NS
LSD (0.05)	-	-	-	-	18.44	-	-
CV (%)	71.6	13.0	10.9	9.6	17.1	6.8	15.4

Weight of Tubers

The spacing showed the significant difference on weight of < 30 and 30-60 g tubers at Hattiban farm, Khumaltar and had no effect of different grades tuber production at Saradanagar, Chitwan. At Khumaltar, The highest yield (19.55 t/ha) of medium size tuber yield was recorded at a spacing of 60x 30 cm and the lowest (12.41 t/ha) in spacing of 90 x30 cm (Table 5). Though there was no significant variation in total yield among different spacing higher yield was recorded in spacing of 60x 30 cm. At Saradanagar also, the same spacing produced higher weight of medium size tubers and total yield even though no significant difference results among the difference spacing (Table 7)

Table 5. Effect of spacing on different grades tubers production in potato genotype L-235.4 at Hattiban Farm, Khumaltar during 2012/13

Spacing (RR x PP in cm)	Numbers of tubers distribution (%)			Weight of tubers distribution (t/ha)			Total yield (t/ha)
	<30 g	30-60 g	>60	<30 g	30-60 g	>60	
60x25	43.5	49.0	7.25	4.66 a	16.53abc	6.56	27.75
60x30	40.7	53.0	6.50	4.61 a	19.55 a	5.95	30.11
75x25	45.5	48.0	6.0	4.41ab	17.50ab	5.92	27.83
75x30	35.2	54.7	10.0	3.08bc	14.22bc	7.08	24.39
90x25	42.2	49.2	8.50	3.73abc	13.74bc	6.48	23.95
90x30	38.5	52.5	9.50	2.90 c	12.41 c	6.14	21.45
Mean	41.0	51.1	7.96	3.90	15.66	6.35	25.91
F-test	NS	NS	NS	*	*	NS	NS
LSD (0.05)	-	-	-	1.282	4.312	-	-
CV (%)	13.6	11.0	30.0	21.8	18.3	26.6	16.4

Table 6. Effect of spacing on vegetative growth of potato genotype L-235.4 at farmer's field in Chitwan during 2012/13

Spacing (RR x PP in cm)	Plant uniformity (1-5 scale)	Ground coverage (%)	Plant height (cm)	No of stem/ plant
60x25	3.75	66.2	34.8	2.8
60x30	4.00	75.0	33.9	2.9
75x25	4.00	68.8	38.5	3.3
75x30	4.00	70.0	37.9	2.6
90x25	4.50	70.0	37.8	2.7
90x30	4.00	65.0	38.2	3.0
Mean	4.042		36.83	2.871
F-test	NS	NS	NS	NS
LSD (0.05)	-	-	-	-
CV (%)	11.0	8.7	12.7	12.9

Table 7. Effect of spacing on different grades tubers production in potato genotype L-235.4 at farmer's field in Chitwan during 2012/13 and 2013/14

Spacing (RR x PP in cm)	Numbers of tubers distribution (%)			Weight of tubers distribution (t/ha)			Total yield (t/h)
	<30 g	30-60 g	>60	<30 g	30-60 g	>60	
60x 25	49	44.1	6.9	2.51	7.69	2.26	12.47
60x30	43.9	50.5	5.6	2.35	8.23	2.24	12.82
75x25	42.8	49.6	7.6	1.81	6.49	1.86	10.15
75x30	38.2	51.2	10.6	1.68	6.71	2.57	10.96
90x25	33.0	57.2	9.8	0.91	6.22	2.37	9.50
90x30	35.7	55.9	8.4	0.83	4.94	1.99	7.76
Mean	40.5	51.4	8.17	1.68	6.71	2.21	10.61
F-test	NS	NS	NS	NS	NS	NS	NS
LSD (0.05)	-	-	-	-	-	-	-
CV (%)	39.4	26.9	53.5	65.2	38.1	57.7	33.0

Dry Matter Percentage

Spacing showed the great variation on dry mattercontent in mid hill at Khumaltar and inner terai at Saradanagar, Chitwan. The dry matter percentage ranged from the minimum (17.0%) in spacing of 60x 25 cm to the maximum (22.0%) in 90x 30cm at Khumaltar and the minimum (18.5%) in spacing of 60x 25 cm to the maximum (21.1%) in 90x30 cm at Saradanagar (Fig .4). The highest dry matter content in wider spacing in both location could be could be due to higher photosynthesis and translocation of more photosynthase to the tubers.

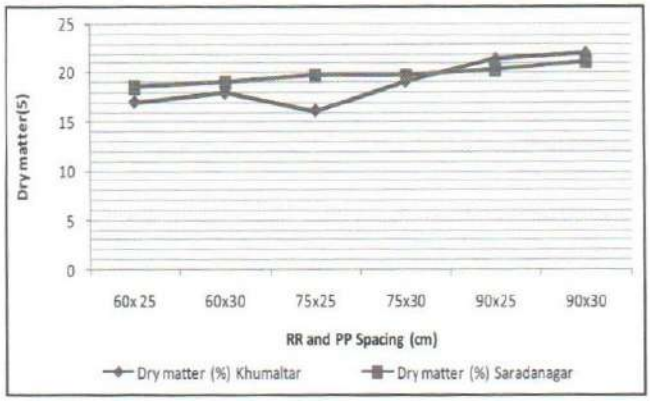

Figure 4. Effect of spacing on dry matter percentage at Khumaltar during 2012/13 and Saradanagarduring 2012/13 and 13/14

Specific Gravity

The specific gravity showed the variation among the different spacing bothin mid hill at Khumaltar and inner terai at Saradanagar, Chitwan. The specific gravity percentage ranged from the minimum (1.0684) in spacing of 60 x 25 cm to the maximum (1.0850) in 90 x 30cm at Khumaltar and the minimum (1.071) in spacing of 60x 25 cm to the maximum (1.0775 in 90 x 30 cm at Saradanagar (Fig . 5). Like in dry matter spacing gravity also increased with increasing of row to row and plant to plant spacing.

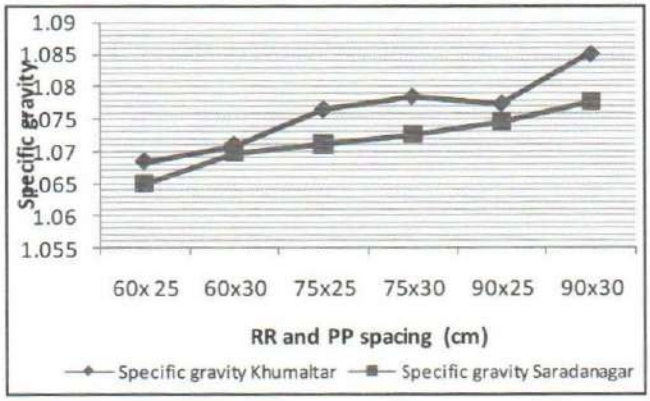

Figure 5. Effect of spacing on specific gravity at Khumaltar during 2012/13 and Saradanagarduring 2012/13 and 13/14

Reducing Sugars

There was not much variation on reducing sugars among the different spacing in both locations and all the spacing had below the lower limit of reducing sugars for processing into different products. The detail content of reducing sugars in different spacing in both location is presented in Fig. 6.

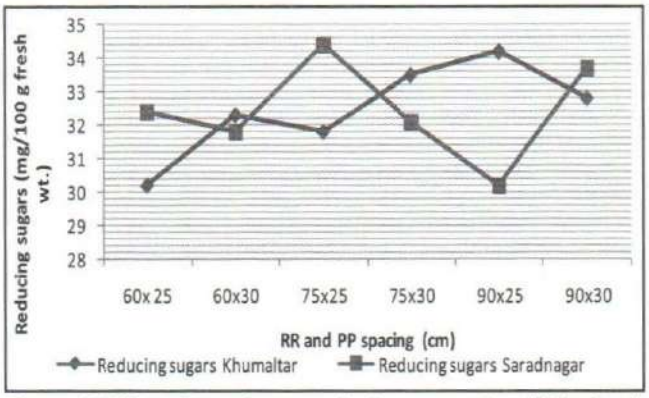

Figure 6. Effect of spacing on reducing sugars (mg/100 g fresh wt.) at Khumaltar during 2012/13 and Saradanagarduring 2012/13 and 13/14

References

Abbas G. 2011. Evaluation and selection of potato genotypes for better yield, storage and processing attributes. Ph. D. Dissertation. PirMehr Ali Shah Arid Agriculture University, Dept. of Horticulture, Faculty of Crop and Food Sciences, Pakistan. 301pp.

Arsenaulu WJ, DA LeBanc, CT Georgeand PBoswall. 2001. Effect of nitrogen application and seed piece spacing on yield and tuber size distribution in eight potato cultivars. Am. J. Potato Res. 78:301-309.

Dhital BK and BBKhatri. 2004. Potato production in Nepal (Nepali Version). Shrdha Press, Lagankhel ,Lalitpur, Nepal. 166 pp.

Gautam IP.2013.Study on yield, storability and processing quality ofpotato (SolanumtuberosumL.).Ph D Dissertation submitted to the Institute of Agriculture and Animal science, Dept. of Horticulture, Rampur, 314pp.

Khurana SMP. 2005. Indian potato exports: An overview. J. Indian Potato Assoc. 33 (1-2): 1-10.

Kumar D, SV Singh and SK. Pandey. 2001. Potato processing quality as influenced by date of haulm cutting. Khurana, S. M. P and Pandey, S. K. (ed). J. of the Indian Potato Assoc. 28 (1):167-168.

Miller GL. 1959. Use of dinitrosalicyclic acid reagent for determination of reducing sugars. Anal. Chem. 31: 426.

MOAC. 2011. Ministry of Agriculture and cooperatives. Agri- Business Promotion and Statistics Division, Singha Durbar, Kathmandu, Nepal.

MOAC. 2013. Ministry of Agriculture and cooperatives. Agri- Business Promotion and Statistics Division, Singha Durbar, Kathmandu, Nepal.

Zebarth BJ, WJ Arsenault.andJB Sanderson. 2006. Effect of seed piece spacing and nitrogen fertilization on tuber yield, yield components and nitrogen use efficiency parameters to two potato cultivars. Am. J. Potato Res. 83: 289- 296.