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Growth and Yield Performance of Potato Clones under Different Planting Dates

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Abstract

Potato (*Solanum tuberosum* L.) is the fourth most important crop of Nepal. However, variety and planting methods have been catered for its low productivity in the country. A field trial was conducted at Institute of Agriculture and Animal Science, Lamjung Campus, Nepal from October 2016 to February 2017 to identify the suitable planting time and the best genotype. The trial was laid out in two factorial RCBD with three replications. Planting factors included four planting dates (5th October, 20th October, 4th November and 19th November), while genotypes were two potato clones (Khumal Seto and Kufri Jyoti). The result revealed that the mean effect of planting date and clones both significantly affected percentage emergence, plant height, number of leaves/plant, number and weight of tuber/plant. The maximum yield was obtained from 5th October planting (31.55 t/ha) which was statistically similar to 20th October planting (30.94 t/ha), but the lowest yield was found on 19th November (22.27 t/ha) and was at par with 4th November (22.77 t/ha). The yield of clone Khumal Seto (27.68 t/ha) was at par with Kufri Jyoti (26.09 t/ha). However, interaction effect of two factors significantly influenced percentage emergence, plant height and number of small size (<25 g), medium size (25-50 g) and large size tubers (>50 g), but had no significant difference on overall yield. Delayed planting (19th Nov) of both clones produced the highest percentage of small size unmarketable tuber number. Thus, planting of both clones either on 5th October or 20th October helps to maximize the productivity.

***Keywords**:* Delayed planting, genotype, potato tuber size, unmarketable tuber

Introduction

Potato (*Solanum tuberosum* L.) is the fourth major cultivated food crop of the world (Camire, Kubow & Donnelly, 2009). South America is the place of origin of potato. At present, it includes the parts of Peru and Bolivia (Stephen et al., 2003). It is a solanaceous cool season tuber vegetable that can also supplement food

besides the cereals (Woolfe, 1987). Tubers are thickened stem high in starch. The underground stem known as stolon bears tubers at its tip (Ewing & struik, 1992). In collaboration of Nepal and India, the first step in improvement of potato production was made in 1962. Various potato farms and infrastructures were developed during 1960-75. National Potato Development Programme (NPDP) was established in 1972 at Kritipur with the mandate to conduct potato research and development activities. The productivity of potato in the world is 19.46 t/ha (FAO, 2014) whereas only 13.1 t/ha is in Nepal (ABPSD, 2015). In Nepal, out of total area under potato cultivation, 19% lies in high hills, 43% in mid-hills and 38% in terai (ABPSD, 2014). In our country, it ranks 4th in area and 5th in production.

Agro-climatic diversity of the country allows the potato cultivation from plains to high mountains. It is grown as cool season crop in plains and mid-hills but as summer season crop in high hills. Dwelle and Love (2003), classifies growth stages of potato plant as: (i) sprout development, (ii) Vegetative growth, (iii) Tuber set/initiation, (iv) Tuber bulking and (v) Maturation stages. The potato plant grows well at temperature 20-25^{0}C and there is very little tuber formation above 29^{0}C. Cool night temperature is the important factor for accumulation of starch. Night temperature is of great significance for tuberization. Below 21^{0}C favors tuberization whereas above 21^{0}C retards tuber formation. Low soil temperature and moisture result in delayed emergence (Beukema & Vander Zaag, 1990). Adjustment of planting time is important to suit the temperature and weather condition of the place. Day length also greatly affects growth, maturity and yield of potato crops. Long photoperiod leads to more vegetative growth resulting delayed tuberization and maturity. At the same time longer day length provides more time for photosynthesis that result more yield. Similarly, short day length and low temperature results early maturity and low yield (Chadha, 2003). In long day, intense sunlight and short and cool night condition, the potato plant gets more time for photosynthesis and more accumulation of energy and due to short and cool night, there will be less energy loss through respiration and this condition results production of larger size tuber and increased yield (Dhital & Khatri, 2006).

Though the crop has huge importance in nutritional security and mitigation of poverty, the productivity of potato in Nepal is still low as compared to the world's average. Among many reasons, the unavailability of best performing potato clones, quality and quantity with affordable price is the major one. On the other hand, mainly the rice cropping pattern has delayed the planting time of potato. Farmers plant the potatoes in late November only after the harvest of paddy which is badly affected by the frost following the December.

Genotype and planting time specific variation of yield is the major reason for the low productivity of potato in Nepal. Rice cropping pattern has delayed the planting time of potato in Nepal. Farmers plant the potatoes in late November, only after the harvest of paddy which is badly affected by the frost following on the December and January. Growth and yield of potato is largely influenced by various climatic factors associated with planting time. Among them, thermal regime plays an important role in emergence, vegetative growth, photosynthesis, carbohydrate accumulation and tuber bulking. Difference in potato yield due to planting date is closely associated with day and night temperature, photo-period and photo-synthetically active radiations (Jones & Allen, 1983). Sandhu et al. (2013) reported 90.32% emergence on 22nd October and lowest 88.69% on 21st November at Haryana, India. Delayed planting caused reduction in number of leaves per plant (Begum et al., 2015). According to Sandhu et al. (2013) the percentage of A grade (>125 g) and B grade (75-125 g) tubers was highest with 1st November planting whereas higher percentage of smaller sized tubers were found in delayed planting. In an EVT trial in HRS, Malepatan, the clone LBR 40 planted on 1st November 2014 produced significantly highest yield of 35.9 t/ha (HRS, 2015) whereas 20.5 t/ha yield in 19th November 2013 planting (HRS, 2014).

Genetic improvement and agronomic management are the major two ways to enhance the productivity of any crop. So, this study aims to identify the best performing variety of potato along with suitable planting time as an alternative to escape the high thermal regime (in early planting) and frost (in late planting). This helps the crop to best utilize moisture, nutrient and solar radiation and maximize the yield so that farmers obtain good earning by producing more crop per unit area. The same genotype may perform differently in different planting dates. Hence, growing of best genotype on a suitable planting date is crucial to maximize the productivity.

This study aims to fulfil the following objectives:

- To investigate suitable planting time of potato in Sundarbazar, Lamjung and in similar ecological domains
- To find out the best performing potato clone in the location and in similar ecological domains
- To determine which variety of potato should be planted on which date to get maximum yield

Methods and Materials

This experiment was carried out in the horticultural farm of Institute of agriculture and animal science [IAAS], Lamjung Campus, Tribhuban University,

Nepal during the period of 5th October 2016 to February 2017. This site lies in mid-hill region of Nepal at the elevation of 725 m above the sea level and at the distance of 164 km west of Kathmandu. According to the global positioning system (GPS) the latitude and longitude of the place are 28.1332^0N and 84.412^0E respectively.

Representative soil sample of the field was collected and tested for routine analysis in Soil Management Directorate, Harihar-bhawan, Kathmandu and found pH (6.5), OM (2.87%), Total Nitrogen (0.14%), soil available Phosphorus (105.34 kg/ha) and soil available Potassium (439.67 kg/ha). The pH was detected by Beekman glass electrode pH meter. Modified Walky and Blackman method was used to evaluate organic matter. Similarly, NPK were examined by using Macro-Kjeldah's method, Olson's method and Neutral normal ammonium acetate method respectively. Tubers of potato clones were collected from National Potato Development Program (NPDP), Khumaltar, Lalitpur.

Characteristics of the potato clones

Clone 1: Khumal Seto

Developed in: INTA, Argentina

CIP no: 720088

Institutional source: CIP Lima, Peru

Botanical description: tall, erect, thick stem, plant does not look bushy in appearance, leaf surface little curved, white flowers, tubers are round and white.

Varietal characteristics: days to maturity 100-120 days; 5-7 stems per plant; 10 tubers per plant; 6-8 weeks of seed dormancy; 25.1 t/ha productivity; blight, wart and leaf roll virus resistant. Hail and drought tolerant. Recommended for high hill and mid hill of Nepal by NARC (Dhital and Khatri, 2006).

Clone 2: Kufrijyoti

Developed in: India

CIP no: 800258

Institutional source: CPRI Shimla, India

Botanical description: Tall and spreading type of foliage; stems are thick and less in number; smooth and shiny leaves; flowers are white; tubers are egg shaped, bigger in size, white in color and smooth.

Varietal characters: days to maturity: 100-120 days; 5-7 stems per plant; 7-11 tubers per plant; 6-8 weeks period of dormancy; 20-25 t/ha productivity; blight and

wart disease resistant, drought tolerant, recommended for high hills and mid-hills of Nepal by NARC (Dhital and Khatri, 2006).

The experiment was laid on two factorial RCBD with three replications. The treatment combination consisted of four dates of planting [5th Oct, 20th Oct, 4th Nov and 19th Nov]; and two potato clones [Khumal Seto and Kufri Jyoti]. The row to row and plant to plant distance was 60 cm and 25 cm, respectively. Individual plot size was 2.4 m*1.25 m with an area of 3 m^2. Fifteen days prior to tuber sowing and layout, the experimental field was thoroughly ploughed by tractor. Just a day before the tuber sowing the final land preparation and layout was done using spade, bamboo pegs and plastic ropes. Finally, total of 24 plots were prepared with 8 plots in each three replications. For each sowing dates, final land preparation was done a day before.

Fifteen days prior to tuber sowing well decomposed FYM was applied in each plot at the rate of 20 ton/ha. Similarly, major plant nutrients nitrogen, phosphorus and potash (NPK) in the form of Urea, Diammonium phosphate (DAP) and Murate of potash (MOP) were applied in rows just before tuber placement in each dates of sowing at the rate of 140:220:100 kg/ha (urea: DAP: potash) respectively. In the case of Nitrogen, half of the urea was applied as basal dose whereas remaining half was top dressed 40 days after sowing in each date. FYM and fertilizer doses were applied according to Nepal government recommendation in Krishi-Diary 2016 published by (AICC) Agriculture Information and communication Centre, Harihar-bhawan, Kathmandu.

Irrigation was scheduled for 30th and 60th days after sowing as per NARC recommendation. This schedule was followed for all dates of sowing. Irrigation was applied in between two rows up to the 2/3rd height of the ridges. Weeding was conducted 40th day after sowing. Half of the urea was top dressed and earthing up was done simultaneously on the same day in each date of sowing.

The crop was protected against late blight of potato by spraying Mancozeb at the rate of 2 gram/liter water in 7 days interval for 3 weeks for all planting dates. Similarly, at the time of field preparation Carbofuran 6 gram/ plot was well mixed to protect from red ant. Out of 20 plants per plot, middle 6 plants were used to observe emergence percentage, plant height (cm), no. of stems and leaves/plant, no. and weight of tubers/ plant, yield/ hectare, no. and weight of small (<25g), medium (25-50g) and large size (>50g) tubers. First of all, the data were entered in Microsoft Excel, whereas data analysis including ANOVA, LSD and DMRT at 5% level of significance was carried out using GENSTAT 15th edition.

Results

Effect of Potato Clones and Planting Date on Growth Attributes

Date of planting and clones both significantly affected emergence percentage at 30 and 45 DAP, plant height, and number of leaves/ plant, but not number of stems/ plant (Table 1). The highest emergence percentage (100%) was on 19th Oct, while the highest plant height (33.79 cm) and number of leaves/ plant (37.28) was found on 5th Oct planting. Khumal Seto showed significantly higher plant height (33.41 cm) while Kufri Jyoti showed higher number of leaves/ plant (37.81).

Table 1

Effect of Date of Planting and Clones on Growth Attributes of Potato at Institute of Agriculture and Animal Science, Lamjung, Nepal during Oct 2016 to Feb 2017

Treatments	EM% 30DAP	EM% 45DAP	Plant height (cm)	No of stems/ plant	No of leaves/ plant
Date of planting					
D_1 (5th Oct)	28.33^{c}	55.83^{b}	33.79^{a}	2.388	37.28^{a}
D_2 (20th Oct)	70.83^{b}	97.50^{a}	33.94^{a}	2.557	34.39^{ab}
D_3(4th Nov)	97.50^{a}	100^{a}	31.05^{a}	2.500	31.67^{b}
D_4(19th Nov)	100^{a}	100^{a}	25.11^{b}	2.777	25.83^{c}
$LSD_{0.05}$	22.01**	6.32**	3.426**	NS	4.988**
Clones					
V_1 (Khumal Seto)	60.42^{b}	76.67^{b}	33.41^{a}	2.36	26.78^{b}
V_2 (Kufri Jyoti)	87.92^{a}	100^{a}	28.53^{b}	2.75	37.81^{a}
$LSD_{0.05}$	15.57**	4.47**	2.422**	NS	3.527**
CV %	24%	5.8%	8.9%	28.9%	12.5%

Interaction effect of date of planting and clones was significant on emergence percentage at 30 and 45 DAP and plant height. The highest plant height (39.72 cm) was found in Kufri Jyoti planted on 5th Oct which was at par with Khumal Seto planted on 20th Oct (Table 2).

Table 2

Interaction Effect of Date of Planting and Clones on Growth Attributes of Potato at Institute of Agriculture and Animal Science, Lamjung, Nepal from Oct 2016 to Feb 2017

Treatments	EM% 30DAP	EM% 45DAP	Plant height (cm)	No of stem/ plant	No of leaves/ plant
$D_1 \times V_1$ (5th Oct × Khumal Seto)	0.00[c]	11.67[b]	27.85[d]	2.223	30.11
$D_1 \times V_2$ (5th Oct × Kufri Jyoti)	56.67[b]	100[a]	39.72[a]	2.553	44.45
$D_2 \times V_1$ (20th Oct × Khumal Seto)	46.67[b]	95[a]	38.49[ab]	2.333	29.11
$D_2 \times V_2$ (20th Oct × Kufri Jyoti)	95.00[a]	100[a]	29.40[cd]	2.780	39.67
$D_3 \times V_1$ (4th Nov × Khumal Seto)	95.00[a]	100[a]	34.41[bc]	2.667	26
$D_3 \times V_2$ (4th Nov × Kufri Jyoti)	100[a]	100[a]	27.70[d]	2.333	37.33
$D_4 \times V_1$ (19th Nov × Khumal Seto)	100[a]	100[a]	32.89[cd]	2.220	21.89
$D_4 \times V_2$ (19th Nov × Kufri Jyoti)	100[a]	100[a]	17.32[e]	3.333	29.78
$LSD_{0.05}$	31.13*	8.94**	4.845**	NS	NS
CV (%)	24%	5.8%	8.9%	28.9%	12.5%

Effect of Potato Cones and Planting Date on Growth Yield Attributes and Yields

Table 3

Effect of Planting Date and Clones on Yield Attributes and Yields of Potato at Institute of Agriculture and Animal Science, Lamjung Campus from Oct 2016 to Feb 2017

Treatments	No of tubers/ plant	Tuber wt/ plant (g)	Tuber wt/ plot (g)
Date of planting			
D_1 (5th Oct)	9.945[a]	466.2[a]	2840[a]
D_2 (20th Oct)	8.500[ab]	439.4[a]	2785[a]
D_3(4th Nov)	8.223[b]	363.5[b]	2049[b]
D_4(19th Nov)	5.945[c]	334.1[b]	2005[b]
$LSD_{0.05}$	1.611**	75.163**	313.345**
Clones			
V_1 (Khumal Seto)	9.53[a]	420.83	2491.39

V_2 (Kufri Jyoti)	6.78[b]	380.78	2347.91
$LSD_{0.05}$	1.139**	NS	NS
CV %	16%	15.1%	10.5%

Date of planting significantly affected number of tubers/ plant, tuber weight/ plant and per plot as well as yield/ hectare, while clones significantly affected only number of tubers / plant. Significantly the highest tuber number/ plant (9.945), tuber weight/ plant (466.2 g), tuber weight/ plot (2840 g) and yield/ hectare (31.55 t/ha) was obtained from 5th Oct planting which were at par with 20th October planting. Significantly, higher number of tubers/plant was observed in Khumal Seto as compared to Kufri Jyoti (Table 3).

Interaction effect of date of planting and clones did not significantly affect number of tubers/ plant, tuber weight/ plant and per plot as well as tuber yield/ hectare. But non-significantly higher values of these parameters were found from Khumal Seto planted on 5th Oct (Table 4).

Table 4

Interaction Effect of Date of Planting and Clones on Yield Attributes and Yield at Institute of Agriculture and Animal Science, Lamjung Campus from Oct 2016 to Feb 2017

Treatments	No of tubers/ plant	Weight of tubers/ plant (g)	Weight of tubers/ plot (g)	Tuber yield (t/ha)
$D_1 \times V_1$ (5th Oct × Khumal Seto)	11.557[a]	486.9[a]	2840[a]	31.66[a]
$D_1 \times V_2$ (5th Oct × Kufri Jyoti)	8.333[bc]	445.4[ab]	2839[a]	31.55[a]
$D_2 \times V_1$ (20th Oct × Khumal Seto)	9.223[ab]	438.1[ab]	2784[a]	30.93[a]
$D_2 \times V_2$ (20th Oct × Kufri Jyoti)	7.777[bc]	440.7[ab]	2786[a]	30.95[a]
$D_3 \times V_1$ (4th Nov × Khumal Seto)	9.890[ab]	389.4[abc]	2128[b]	23.64[b]
$D_3 \times V_2$ (4th Nov × Kufri Jyoti)	6.557[cd]	337.7[bc]	1971[b]	21.90[b]
$D_4 \times V_1$ (19th Nov × Khumal Seto)	7.447[bc]	368.9[abc]	2213[b]	24.59[b]
$D_4 \times V_2$ (19th Nov × Kufri Jyoti)	4.443[d]	299.3[c]	1796[b]	19.95[b]

$LSD_{0.05}$	NS	NS	NS	NS
CV (%)	16%	15.1%	10.5%	10.5%

Effect of Potato Clones and Planting Date on Tuber Size and Numbers

Date of planting significantly affected percentage of number and weight of small as well as large size tubers. Highest percentage of small size tuber number (52.58%) was found on 19th Nov while highest percentage of large size tuber number was on 5th Oct planting. In case of clones, significantly highest percentage of small size tuber number was obtained from Kufri Jyoti while the highest percentage of large size tuber number was from Khumal Seto (Table 5).

Table 5

Effect of Planting Dates and Clones on Tuber Size Distribution According to Number and Weight at Institute of Agriculture and Animal Science, Lamjung Campus from Oct 2016 to Feb 2017

Treatments	% of small size (<25g) tuber number	% of small size (<25g) tuber weight (g)	% of medium size (25-50g) tuber number	% of medium size (25-50g) tuber weight (g)	% of large size (>50g) tuber number	% of large size (>50g) tuber weight(g)
Date of planting						
D_1 (5th Oct)	28.81^{d}	6.75^{c}	24.43	21.81^{ab}	46.77^{a}	71.37^{a}
D_2 (20th Oct)	37.29^{c}	7.24^{c}	25.60	17.10^{bc}	38.28^{b}	75.66^{a}
D_3(4th Nov)	47.72^{b}	14.72^{a}	27.19	24.65^{a}	25.09^{c}	60.63^{b}
D_4(19th Nov)	52.58^{a}	11.83^{b}	22.77	12.09^{c}	24.65^{c}	76.08^{a}
$LSD_{0.05}$	4.077**	2.724**	NS	6.035**	4.473**	5.692**
Clones						
V_1 (Khumal Seto)	38.35^{b}	10.24	25.57	23.38^{a}	36.66^{a}	66.35^{b}
V_2 (Kufri Jyoti)	44.84^{a}	10.03	24.43	14.45^{b}	30.73^{b}	75.52^{a}
$LSD_{0.05}$	2.883**	NS	NS	4.267**	3.163**	4.025**
CV %	7.9%	21.7%	15.5%	25.8%	10.7%	6.5%

Interaction effect of date of planting and clones was significant on percentage of small size tuber number as well as percentage of number and weight of large size tubers (Table 6).

Table 6

Interaction Effect of Planting Dates and Clones on Tuber Size Distribution (based on number and weight) at Institute of Agriculture and Animal Science, Lamjung Campus from Oct 2016 to Feb 2017

Treatments	% of small size (<25g) tuber number	% of small size (<25g) tuber weight	% of medium size (25-50g) tuber number	% of medium size (25-50g) tuber weight	% of large size (>50g) tuber number	% of large size (>50g) tuber weight
$D_1 \times V_1$ (5^{th} Oct × Khumal Seto)	28.50^{c}	8.08	28.59^{a}	28.62^{ab}	42.91^{b}	63.17^{c}
$D_1 \times V_2$ (5^{th} Oct × Kufri Jyoti)	29.11^{c}	5.42	20.26^{bc}	15.00^{c}	50.62^{a}	79.58^{a}
$D_2 \times V_1$ (20^{th} Oct × Khumal Seto)	30.04^{c}	6.78	28.33^{a}	20.47^{bc}	43.96^{b}	72.75^{ab}
$D_2 \times V_2$ (20^{th} Oct × Kufri Jyoti)	44.54^{b}	7.71	22.86^{abc}	13.72^{c}	32.60^{c}	78.57^{a}
$D_3 \times V_1$ (4^{th} Nov × Khumal Seto)	43.15^{b}	14.97	28.84^{a}	32.66^{a}	28.01^{cd}	52.37^{d}
$D_3 \times V_2$ (4^{th} Nov × Kufri Jyoti)	52.28^{a}	14.47	25.55^{ab}	16.65^{c}	22.17^{de}	68.90^{bc}

$D_4 \times V_1$ (19th Nov × Khumal Seto)	51.72[a]	11.13	16.50[c]	11.76[c]	31.78[c]	77.10a[b]
$D_4 \times V_2$ (19th Nov × Kufri Jyoti)	53.44[a]	12.54	29.04[a]	12.42[c]	17.52[e]	75.05[ab]
$LSD_{0.05}$	5.766**	NS	6.764**	8.536*	6.325**	8.050**
CV (%)	7.9%	21.7%	15.5%	25.8%	10.7%	6.5%

Discussion

Emergence affects final plant population and yield of potato. Bhatia et al. (1992) stated that reserved food material in tuber affects emergence percentage. There was slower emergence during early planting dates. This might be due to low temperature at storage. This is in line with Vander Zaag (1992) who reported that decreasing the storage temperature to 10^0C sprout growth is lengthened by 2 weeks while decreasing to 4.4^0C is lengthened by 9 weeks. Earlier planted tubers produced lesser sprouts before planting while tubers planted later had already sprouted and produced maximum number of sprouts before planting, which finally resulted in fast emergence in late plantings (Haile et al., 2015). According to Beukema and Vander Zaag (1990), haulm grows more abundant under higher temperature and long-day condition (early planting), whereas it remains small under lower temperature and short-day condition (delayed planting). They also reported that low soil temperature and moisture results in delayed emergence. The variation in plant height is also due to initial food reserve, clonal characters, soil moisture and environment. At low temperature, vegetative growth is slow, hence, delayed planting caused reduction in crop duration, plant height, leaf area and number of leaves per plant (Begum et al., 2015). The reason for the increased number of stem with delay in planting date could be aging of seed tubers used for planting, which were stored and got sufficient time and sprouted before planting. These results are supported by Darini et al. (2013).

Potato is best grown in regions with mean temperature of 18^0C, 15-25^0C being optimum temperature. Night temperature is of great significance for tuberization. Below 21^0C favors tuberization whereas above 21^0C retards tuber formation. There is very little tuber formation above 29^0C (Chadha, 2003). Earlier planting produced more number of medium and large size tubers which resulted higher yield whereas on delayed planting yield was reduced. It is due to the faster plant growth owing to favorable environmental condition like temperature. Similar

findings were reported by Khan et al. (2011) and Sandhu et al. (2013). Earlier planting allowed tuber initiation earlier and could transform sufficient energy to the tubers and hence large size tubers are formed whereas in delayed planting sub-optimal environmental condition formed small sized tubers. Optimum temperature and sunshine resulting in good vegetative growth and photosynthesis helped to increase size of tubers in early planting. Delayed planting and earlier harvesting resulted in higher number of small sized tuber. On the other hand, earlier planting and late harvesting produced higher number of larger and medium sized tubers. The results are in accordance to Khan et al. (2011). The frost occurred in December along with the symptoms of late-blight which badly affected the tender plants of 4th November and 19th November planting compared to 5th October and 20th October planted well grown crops that were less affected by late blight is the major cause of low yield in delayed planting. Khan et al. (2011) also reported that tubers planted at earlier dates received more time of optimum moisture and temperatures than the late plantings, which resulted in longer crop cycle consequently leading to longer tuber bulking period and higher marketable tuber yield.

Total number of tubers and yield is the linear function of stem density, variety and environment. Production of required size of tubers is of economic value for the consumers and processing industries. Size may be measured in terms of weight or diameter (Beukema & Vander Zaag, 1990). Differences in tuber size distribution are due to the stem density. Higher stem density produces more number of small sized tubers (Wilcox & Hoff, 1970). According to Sandhu et al. (2013) the percentage of A grade (>125 g) and B grade (75-125 g) tubers was highest with 1st November planting whereas percentage of C grade tubers (25-75 g) and D grade tubers (<25 g) were found on 21st November i.e. delayed planting. Total tuber yield was highest (310.2, 312.2 Q/ha) on 1st November planting in Kufri Badshah variety in Haryana, India. Main stems growing directly from seed tuber or emerging out below soil near seed tuber are productive and form roots, stolons and tubers. But the lateral stems are little productive. Stem density determines number and size of tubers. A high stem density increases yield upto a certain level but reduces average tuber size. Physiologically old tubers produce more sprouts than young tubers. If tubers are too old, sprouts are weak (Wiersema, 1987).

In an EVT trial in HRS, Malepatan, the clone LBR 40 planted on 1st November 2014 produced significantly highest yield of 35.9 t/ha (HRS, 2015) whereas 20.5 t/ha yield in 19th November 2013 planting (HRS, 2014). Planting on 3rd week of November gave highest tuber yield and number of large sized tubers in Gujrat when compared with 1st and 3rd week of December (Patel et al., 2000). Lakra (2003) planted five varieties at fifteen days interval in 2001 and 2002 which produced maximum yield in 1st Nov sown crop due to lower disease incidence and lower vector activity. According to Begum et al. (2015), Potato crop when sown on 1st and 16th November was ready to harvest 90 DAS whereas it took 74 days

to mature when planted on 16th December. This is because of high temperature leading to shortened growth period. Late planted varieties increased the heat sum requirement. Due to availability of higher thermal units over a short period of time, the phenological stages rapidly advanced (Bishnoi & Taneja, 1990). This might be the reason behind the forced maturity.

Conclusion

The result revealed that the main effect of planting date and clones both significantly affected emergence percentage, plant height, number of leaves per plant, number and weight of tuber per plant. The maximum yield was obtained from 5th October planting (31.55 t/ha) which was statistically similar with 20th October planting (30.94 t/ha). Hence, both the 5th October to 20th October was the suitable time of potato planting in Sundarbazar, Lamjung. Planting of either Khumal Seto or Kufri Jyoti had similar yield. Interaction of planting date and clones did not significantly affect the yield. However, Khumal Seto planted on 5th October produced higher yield. Delayed planting (19th November) of both clones produced the highest percentage of small size unmarketable tuber number. Thus, early planting helps to obtain the quality and quantity of marketable potato tuber.

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