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Identification of suitable planting time for growth and yield of potato varieties in Dun valley of Uttarakhand

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Abstract

An investigation was carried out at agriculture experimental block SGRR University Dehradun to know the suitable planting time of potato varieties for higher growth and yield. The treatment comprises six planting dates (05, 15, 25 October and 05, 15, 25 November) and two varieties (Kufri Jyoti and local Sata) and randomized thrice in factorial randomized block design. The experimental result showed a non significant difference between varieties for yield and yield contributing characters except plant height at 35 days after planting. The potato yield and its contributing characters showed significant difference among different planting times. Maximum yield of seed size tubers (30-80 g) and total yield were recorded 27.00 and 34.00 t/ha, respectively, in plants which were planted on 25th October. The plant height, number of leaves per plant and number of haulms per hill were also recorded highest when planted on 25th October, which were 43.50 cm, 44.00 cm and 5.33 cm respectively. The interaction effect of varieties and planting time for yield and yield contributing characters had significant difference. The maximum yield of seed size tubers and total yield were observed in local variety Sata when planted on 25th October. Although the variation was non significant between varieties but the yield potential of local variety Sata was 4% higher than Kufri Jyoti. Thus, on the basis of experimental finding it can be concluded that the local variety Sata and 25th October planting time is best for sowing of potato tubers in comparison to that of other treatments.

Keywords: Potato, Kufri Jyoti, planting time and yield

Introduction

Potato is one of the most important world's non cereal food crop. It is a unique crop, which can supplement the food needs of the country in a substantial manner. The commonly cultivated potato is an auto-tetraploid ($2n=4x=48$) and belongs to the genus *Solanum* and species *tuberosum*. The species *tuberosum* includes two subspecies viz. ssp. *tuberosum* adapted to long day conditions and ssp. *andigena* adapted to short day conditions (Pandey and Luthra, 2010)^[9]. Potato is an integral part of human diet. It produces more protein (524 kg/ha) as compared to wheat (254 kg/ha) (Sajid and Aftab, 2009)^[12]. Starch is the major component of the dry matter accounting for approximately 70% of the total solids. It produces more edible energy per unit area and time than wheat, rice and maize (Dutt, 2008)^[5].

Climate change and global warming is now an acknowledged fact and reality to disturbance of crop behavior. The rate of global warming in last 50 years is double than that for the last century. As many as 11 of the past 12 years were warmest since 1850, when records began. Based on NOAA data, in 2017 the average global temperature across land and ocean surface areas was 0.84°C (1.51°F) above the twentieth-century average of 13.9°C (57.0°F), making it the third-warmest year on record behind 2016 (warmest) and 2015 (second warmest) (NOAA, 2018)^[8]. The climate change and global warming will have a profound effect on potato growth story in India affecting not only production and profitability, but also seed multiplication, planting time, storage, marketing and processing of this semi perishable vegetatively propagated crop. A rise in temperature of above 1°C will raise soil temperature much earlier in spring hence, the planting time also will advance and requirement of annual irrigation will increase (Singh and Lal, 2009)^[13]. The higher temperatures will reduce the tuber initiation process and, increases the disease and pest pressure in potato production due to climate change.

The heat sensitive potato crop is mostly confined to Indo- Gangetic plains under irrigated conditions due to climatic constraints. A total of 90% of potato production in India is from the Indo-Gangetic plains, where the crop is harvested from January to March before on set of long hot summer (Brar and Rana, 2016)^[2]. The selection of high yielding varieties, the optimization of water levels, planting time to increase potato production under current and future climate

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change have to be evaluated. The choice of the best ones can conserve the agricultural resources by planting the pot ato crop in the best time for sustainable agriculture in northern parts of India. In this connection, the best planting time can improve productivity (Chandra *et al.*, 2017) [3-4]. The information about the exact time for planting the potato tubers in Dun valley region of Uttarakhand is not available. Thus it is necessary to identify the suitable variety with optimum planting time to obtained higher return from the crop produce.

Materials and Methods

To know the effect of varieties and planting time on growth and yield of potato, an experiment was conducted during 2017-18 and 2018-19 at agriculture experimental block, Department of Seed Science & Technology, School of Agriculture, SGRU University Dehradun. The experiment comprises six planting dates (05, 15, 25 October and 05, 15, 25 November) and two varieties (Kufri Jyoti and Local Sata) taken as treatments, which were randomized thrice in factorial randomized block design. Well-sprouted seed tubers of potato, size about 40-60 g were planted in ten days intervals from 05th October to 25th November in both the years. The potato crop was de hauled at 90 days after planting. Rest of the agronomic package of practices adopted as per requirements of potato crop during cultivation. Observations related to yield and yield contributing characters like plant height, number of haulms per hill, number of leaves per plant, tuber yield like number of tubers per hectare *etc.* were recorded. The tubers which we can use for seed purposes (30-80 g) and total yield/ha were estimated in each plot. The observed data were then subjected to statistical analysis of variance.

Result and Discussion

Emergence per cent

Emergence is the first developmental stage, when first leaf of the plant emerged from the soil. After two weeks of planting, the most of the plant start emerging out from the soil. Emergence count was done at 20 days after planting. The experimental results of two years pooled data show a non significant effect of varieties on emergence per cent at 20 days after planting, but the effect of planting times were observed significant. The maximum germination per cent 95% was recorded in 05th November planting (T₄), which was 21% higher than the minimum germination 75% observed in treatment T₁ (05th October planting). The critical observation shows there is a gradual increase in germination per cent as the planting time delay upto 05th November planting. It might be due to the favourable climatic conditions that prevailed during this planting time as compared to other dates of planting. Chandra *et al.*, (2017) [3-4] were recorded maximum emergence per cent on October 22nd date of planting in potato crop.

The interaction effect of variety and planting time also showed significant difference in relation to germination per cent of potato tuber. The maximum germination per cent was recorded 95% with the interaction of variety local Sata and 05th November planting (V₂T₄), where as minimum 72% with interaction of variety Kufri Jyoti and 05th October planting (V₁T₁). Earlier planted tubers produced lesser sprouts at planting while tubers planted later had already sprouted and produced maximum number of sprouts at planting time, which finally resulted fast emergence in late plantings. Haile *et al.*, (2019) [1] were recorded maximum germination per cent on 30th October of planting.

Plant height (cm)

The plants of local variety Sata showed higher plant height (17.78 cm) than the variety Kufri Jyoti (14.55 cm) at 35 days after planting, but the difference recorded non significant at maturity. Janagard *et al.*, (2009) [6] also observed significant effect of cultivars on plant height of potato.

The maximum plant height was recorded 21.50 cm and 43.50 cm at 35 days after planting and maturity (70 days after planting), respectively, in 25th October of planting (T₃). The minimum plant height was observed 12.83 cm and 35.00 cm at 35 days after planting and maturity, respectively, with 05th October of planting (T₁). All the planting dates the treatments differed significantly from each other with respect to plant height of potato during both the years and were also recorded maximum at planting on October 25th. A critical observation of the data indicated that the plant height was decreased with early or delay in planting than this planting time.

It may be due to the prevailing congenial temperature for the growth and development of vegetative parts during this time. Interaction of varieties and planting time were also showed a significant response to plant height. The maximum plant height was recorded 22.00 cm and 45.33 cm at 35 days after planting and at maturity, respectively, with treatment V₂T₃ (Local Sata and 25th October planting). At maturity the maximum plant height was statistically at par with treatments V₁T₄ (42.67 cm), and V₁T₅ (43.00 cm). The minimum plant height (34.00 cm) at maturity was recorded with treatment V₁T₁, which was 24.99% lower than the maximum plant height with treatment combination V₂T₃. Chandra *et al.*, (2017) [3-4] also recorded significantly higher plant height of potato on 22nd October planting.

Number of leaves per plant

Number of compound leaves per plant responds non significant differences to potato varieties but the response was significant to planting time and interaction of planting time and varieties. The maximum number of leaves per plant was recorded (44.00) with treatment T₃ (25th October planting) which was statistically at par to the treatment T₄ (41.17/plant). The minimum number of leaves per plant (28.67) was recorded with treatment T₁ (05 October planting). This significant increase in number of leaves per hill was recorded only upto T₃ (25th October planting) and after that it has decreased. This might be because of the number of leaves mainly depends upon plant stand, plant height and haulms per plant. As suitable planting time is responsible for vigorous growth of crop plants, it also increases the number of leaves per plant. The interaction of varieties and planting time show 41% higher number of leaves per plant with treatment V₂T₃ *i.e.* 44.34/ plant as compared to minimum number of leaves per plant (26.00) which was recorded with treatment V₁T₁ (Kufri Jyoti and 05th October planting). Sandhu *et al.*, (2014) [10] observed that the planting date had significant effect on vegetative characteristics like number of leaves per plant and recorded highest values at 1st November planting date.

Number of haulms per hill

The varieties showed non significant effect on number of haulms per hill but the effect of planting time was significant. The maximum number of haulms per hill was recorded (5.33) with 25th October planting *i.e.* treatment T₃, which was 40.71% higher than minimum number of haulms per hill (3.16) with treatment T₆ (25th November planting). The interaction of varieties and planting time was show a significant effect on number of haulms per plant and was

recorded maximum (5.67) with treatment V₂T₃ (local Sata and 25th October planting). It was statistically at par with the treatments V₁T₂ (4.67) and V₁T₃ (5.00). The minimum number of haulms per hill was recorded (3.17) with treatment V₂T₆ (local Sata and 25th November planting). Kumar *et al.*, (2009) [7] also reported the remarkable variation in number of haulms per hill with different planting dates and cultivars, and recorded maximum with 20th October planting with variety Kufri Badshah.

Seed size tuber yield

A non significant difference was recorded between varieties for yield of seed size tuber but the difference was significant among tuber planting dates and interaction of varieties and planting dates. The highest seed tuber yield was recorded (27.00 t/ha) with treatment T₃ (25th October planting) and lowest (16.50 t/ha) with treatment T₁ (05th October planting). It was observed that the number of seed tubers increases upto 25th October planting (T₃) and after this it decreased gradually, this may be because of high temperature during early planting and lower temperature during late planting time adversely affect this size of potato tubers. Sandhu *et al.* (2012) [11] also observed significantly higher yield in October planting potato crop.

The interaction effect showed maximum yield of seed tuber (27.33 t/ha) with treatment combination V₂T₃ (variety local Sata and 25th October planting), which is statistically at par with treatment V₁T₃ (Kufri Jyoti and 25th October planting) *i.e.* 26.67 t/ha. The minimum yield of seed tuber was recorded (16.33 t/ha) with treatment V₁T₁ (Kufri Jyoti and 05th October planting). A significant decrease in seed size tuber yield was

observed in early and late planting than October 25th planting. Kumar *et al.*, (2009) [7] reported the interaction effect of planting dates and cultivars showed remarkable variation for growth and yield parameters. They were found that the variety Kufri Pushkar produced highest tuber yield when planted on 20th October.

Total yield

The varieties showed non significant effect on total yield of potato but the effect of planting time was significant. The maximum yield of potato was recorded (34.00 t/ha) with treatment T₃ (25th October planting), which was 23.53% higher than the minimum yield (26.00 t/ha) with treatment T₁ (05th October planting). The environmental conditions particularly temperature during the crop cultivation is highly influenced the crop growth and yield. The crop characters like plant height, number of leaves, number of haulms per plant etc. plays a dominant role in yield contribution (Thongam *et al.*, 2017) [14]. The higher vegetative growth characters in 25th October planting might favoured in getting higher yield in this planting date.

The interaction of varieties and planting time were also showed significant effect on yield of potato tuber. The maximum yield was recorded (35.67 t/ha) with treatment combination V₂T₃ (Local Sata and 25th October planting), which was statistically at par with the treatment V₁T₃ (34.33 t/ha) and V₂T₄ (32.67 t/ha). The minimum yield of potato was recorded (27.00) with treatment combination V₁T₁ (Kufri Jyoti and 05th October planting). These finding were also in agreement with findings of Chandra *et al.*, (2017) [3-4].

Table 1: Effect of planting time on growth and yield of potato tuber

Treatments	Emergence per cent (after 20 days)	Plant height (cm) after 35 days	Plant height (cm) at maturity	No. of Leaves per plant at maturity	No. of haulms per hill at maturity	Yield of tuber seed (t/ha) (30-80 g)	Total yield (t/ha)
Variety							
V ₁	84	14.55	40.22	35.33	3.05	21.78	29.61
V ₂	87	17.78	39.88	37.16	4.89	21.89	30.89
S.Em±	1.03	0.35	0.38	0.63	0.16	0.39	0.43
Cd (at 5%)	NS	1.04	NS	NS	NS	NS	NS
Planting time							
T ₁	75	12.83	35.00	28.67	3.50	16.50	26.00
T ₂	78	13.83	40.00	34.50	4.16	23.33	30.67
T ₃	84	21.50	43.50	44.00	5.33	27.00	34.00
T ₄	95	17.67	41.83	41.17	4.33	24.17	31.67
T ₅	88	15.50	40.17	37.83	3.33	21.00	30.50
T ₆	90	15.67	38.83	31.33	3.16	19.00	28.67
S.Em±	1.79	0.62	0.67	1.09	0.28	0.69	0.74
Cd (at 5%)	5.24	2.55	1.95	3.19	0.83	2.01	2.17
Variety x Planting time							
V ₁ T ₁	72	13.67	34.00	26.00	3.33	16.33	27.33
V ₁ T ₂	79	14.00	39.33	32.67	4.67	23.33	32.00
V ₁ T ₃	84	21.00	41.67	44.00	5.00	26.67	34.33
V ₁ T ₄	94	19.67	42.67	40.67	4.33	24.33	30.67
V ₁ T ₅	83	20.67	43.00	35.33	3.33	20.66	30.33
V ₁ T ₆	90	21.33	40.67	33.33	3.67	19.33	29.00
V ₂ T ₁	78	12.00	36.00	31.33	3.67	16.67	24.67
V ₂ T ₂	78	13.67	40.67	36.33	3.67	23.33	29.33
V ₂ T ₃	84	22.00	45.33	44.34	5.67	27.33	35.67
V ₂ T ₄	95	15.67	41.00	41.67	4.33	24.00	32.67
V ₂ T ₅	94	10.33	39.33	40.33	3.33	21.33	30.67
V ₂ T ₆	90	10.00	37.00	29.33	3.17	18.67	28.33
S.Em±	2.53	0.87	0.94	1.54	0.40	0.97	1.04
Cd (at 5%)	7.41	9.32	2.76	7.34	1.17	2.85	3.06

Conclusion

Although the variation between varieties was non significant but the yield potential of local Sata was observed 4% higher than variety Kufri Jyoti. Thus on the basis of experimental finding, it can be concluded that local variety Sata when planted on 25th October gave higher tuber yield among all other treatments. This local variety can be used for the Northern Himalayan areas by which we can get satisfactory level of potato yield.

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