

Original Research Article

Studies on the Shift of Planting Dates In view Of the Rising Temperature on Potato (*Solanum tuberosum* L.)

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ABSTRACT

The experiment entitled “Studies on the shift of planting dates in view of the rising temperature on potato (*Solanum tuberosum* L.)” was carried out during the *Rabi* season of 2013-14 and 2014-15 at Main Experimental Station (Vegetable Research Farm) of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The experiment comprising of five planting dates (17 October, 27 October, 7 November, 17 November and 27 November) and four varieties (Kufri Ashoka, Kufri Pushkar, Kufri Bahar and Kufri Arun) was laid out in a Randomized Block Design (factorial concept) with four replications. Keeping net plot size 3.0 x 3.0 m. Five competitive plants were selected randomly from each experimental treatments to record data on various parameters, which were influenced significantly by different planting dates and varieties. The per cent plant emergence at 30 DAP significantly maximum in 7 November planting. However, number of haulms per hill, plant height, number of leaves per plant at 45 and 60 DAP, total number of tubers per plant, total tuber yield, number of A and B grade, weight of A, B, C and D grade tubers and total yield of tubers (q/ha) was significantly highest with 17 November planting and number of C and D grade tubers was maximum in 27 November planting. Different varieties exhibited significant difference on growth and yield parameters. The maximum values for growth and yield traits were noted in variety Kufri Arun. Interaction effect of planting dates and varieties showed remarkable variation different parameters. Significantly highest values were registered for number of haulms, number of leaves at 45 DAP, number of tubers per plant, number and weight of A, B and D grade tubers per plant, total yield of tubers planting on 17 November of variety Kufri Arun.

Keywords

Rising
Temperature,
Potato (*Solanum
tuberosum* L.)

Introduction

Potato (*Solanum tuberosum* L.) an important food crop of the world is also a vegetable crop. India is one of leading potato producing countries. Uttar Pradesh is one of the highest potatoes producing state in the country. It provides staple food stuff for millions of people in many part of world. Because of its high quantity of starch and substantial amount of vitamins and nutrients it would also be a good substitute for major cereals like rice and wheat. Planting time of

potato in eastern Uttar Pradesh is 15th October to 15th November. In view of global warming the shifting of planting dates is expected and need to be identified and the literatures available on this aspect are not available. Hence, the present investigation entitled “Studies on the shift of planting dates in view of the rising temperature on potato (*Solanum tuberosum* L.)” was planted and executed during winter (*rabi*) season of 2013-14 and 2014-15 at Main Experiment

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Materials and Methods

The investigation was carried out during two consecutive years 2013-14 and 2014-15 to find out the suitable planting dates and varieties for growth, yield and economics of potato. Twenty treatment combinations consisting of five planting dates (17 October, 27 October, 7 November, 17 November and 27 November) and four varieties (Kufri Ashoka, Kufri Pushkar, Kufri Bahar and Kufri Arun) were arranged in Randomized Block Design with factorial concept, replicated four. The field was fertilized with recommended dose of nitrogen, phosphorus and potassium (150:100:120 kg/ha).

Almost similar size of tubers were planted in field at 60cm x 20cm spacing. All the cultural and plant protection measures were made as and when required. The response of potato to various treatments were measured in terms of quantitative expression i.e. plant emergence at 30 DAP, number of haulms per hill at 45 DAP, plant height at 45 and 60 DAP, number of leaves at 45 and 60 DAP, number of tubers per plant, weight of tubers per plant, number and weight of A, B, C and D grade tubers per plant and total yield (q/ha),

Results and Discussion

Effect of planting dates and varieties on growth parameters

In the present investigation the maximum plant emergence noted with 7 November planting significantly which is optimum time of potato planting in the region. It may

be due to the favourable climatic conditions that prevailed during the emergence of 7 November planting as compared to other dates of planting. High and low temperature recorded in early and later planting, respectively. At early stage of emergence temperature was not favourable for tubers emergence. The results of present investigation are in conforming with the findings of Ahmad and Rashid (1980) who reported that emergence was decreased from 98.6-100 per cent to 82.5 per cent by the later planting date. Wadhwa *et al.*, (2001) observed that germination was higher when planting on 28 October. Dubey *et al.*, (2011) also reported similar results.

The varieties had no significant difference on plant emergence. It might be due to the food material already stored in the seed tubers, which gave initial boost to the emerging plant. Kufri Arun recorded maximum plant emergence and minimum emergence was observed in Kufri Bahar. The difference in the varieties with respect to emergence of plant may be due to the differences in genetic constitution of varieties.

The number of haulms per hill at 45 days after planting was affected significantly by planting date and varieties. Maximum numbers of haulms were noted in delayed planting, while early planting recorded lesser number of haulms per hill. It may be owing to prevalence of higher temperature in early planting which reduced number of haulms per hill. The present results are in conformity with the findings of Bak and Aminpour (2001) who reported that the numbers of haulm per hill were lower in early planting than the delay in planting. Nandekar *et al.*, (1994) also reported that Kufri Badshah produced the maximum number of haulms per hill than Kufri Bahar with delayed in planting. Ahmad and Rashid

(1980) also noted that later planting had no significant effect on number of haulms per hill.

Effect of planting dates on plant height recorded at 45 and 60 days after planting was significant. The results indicate that the 17 November planting showed maximum plant height and decreased with delayed in planting.

It may be due to the fact that crop encountered favourable climate conditions whereas with preponing or postponing of planting the crop has to encounter rise or fall in temperature which reduced in retarded plant height. The allocation of assimilates for growth must have been poorer as compared to crop sown on 17 November.

The results are conformation of the findings of Ezekiel and Bhargava (1992) who reported that plant height decreased with delayed planting in Kufri Bahar and Kufri Badshah when planted on 21 October, 5 November and 20 December, respectively. On the contrary, Pandey and Ghai (1975) reported that delay in planting resulted in taller plant than early planted tubers.

Among different varieties, Kufri Arun showed maximum plant height at 45 and 60 days after planting followed by Kufri Ashoka, Kufri Pushkar and Kufri Bahar. The results confirm the findings of Nandekar *et al.*, (1994) who reported that Kufri Badshah had higher plant height than Kufri Bahar. Plant height decreased after 17 November.

Maximum number of leaves per plant at 45 and 60 days after planting observed with 17 November planting followed by 7 November. Brisk vegetative growth with delay in planting was favoured due to congenial temperature for growth of vegetative parts.

Number of leaves per plant increased with delay in planting in Kufri Arun, Kufri Pushkar and Kufri Bahar and decreased in Kufri Ashoka at 45 and 60 days after planting. The results conform to the findings of Ezekiel and Bhargava (1992) who reported that number of leaves per plant decreased in Kufri Badshah and Kufri Pukhraj. Pandey and Ghai (1975) observed more number of leaves in delayed planting varieties Kufri Badshah and Kufri Jyoti.

Effect of planting dates and varieties on yield and yield attributes

The total number of tubers per plant was recorded significantly higher with 17 November planting and was lowest in first planting date (17 October) and last planting date (27 November). Both the dates were outside the optimum planting window for potato planting in this region. More number of tubers is related to the availability of abundant photosynthesites which could be expected to be higher with 17 November planting than other planting dates.

The present study showed that total number of tubers decreased with delayed planting as compared to the optimum date of planting. The results confirm the findings of Gupta (1990) who stated that delay in planting date reduced total number of tubers per sq. m. Raj *et al.*, (1997) obtained highest number of tubers from 1st May planted potato crop compared to 15th April planting at CPRI, Shimla.

However, the present results are in contradiction to the findings of Ezekiel and Bhargava (1992) who observed that more total number of tubers with latest planting date. But this could be expected since the study was carried out under temperate conditions, where 15 April is optimum time of potato planting.

Table.1 Effect of planting dates and varieties on emergence (%) at 30 days and plant height at 45 and 60 days after planting

Treatments	Emergence %		Plant height 45 DAP		Plant height 60 DAP	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Planting Dates						
17 October	90.93	92.28	39.80	40.99	46.52	47.92
27 October	93.83	94.30	40.95	42.18	47.45	48.87
7 November	95.20	95.66	41.13	42.34	47.90	49.33
17 November	93.17	93.67	41.41	42.65	49.12	49.61
27 November	90.23	90.40	37.19	38.30	43.71	45.02
SEm±	1.306	1.272	0.565	0.626	0.723	0.771
C.D. (P=0.05)	3.698	3.602	1.600	1.773	2.047	2.183
Varieties:						
Kufri Ashoka	92.22	92.80	40.11	41.29	46.99	48.60
Kufri Pushkar	92.31	92.90	39.07	40.22	45.23	45.73
Kufri Bahar	91.72	92.31	37.95	39.10	44.41	45.32
Kufri Arun	94.44	95.03	43.26	44.56	51.13	52.95
SEm±	1.168	1.138	0.505	0.560	0.647	0.690
C.D. (P=0.05)	NS	NS	1.431	1.586	1.831	1.953

Table.2 Effect of planting dates and varieties on emergence (%) at 30 days and plant height at 45 and 60 days after planting

Treatments	Number of haulms at 45 DAP		Number of leaf 45 DAP		Number of leaf 60 DAP	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Planting Dates						
17 October	4.92	5.08	54.59	56.21	70.95	73.05
27 October	5.23	5.40	56.71	58.41	71.53	72.62
7 November	5.37	5.54	59.96	61.75	74.52	76.76
17 November	5.41	5.57	60.32	62.48	76.12	78.50
27 November	4.46	4.60	43.84	45.14	58.78	60.54
SEm±	0.090	0.087	0.840	0.874	1.170	1.110
C.D. (P=0.05)	0.255	0.246	2.379	2.475	3.313	3.143
Varieties:						
Kufri Ashoka	5.08	5.23	53.63	55.16	71.09	73.29
Kufri Pushkar	4.95	5.10	53.51	55.56	67.42	69.45
Kufri Bahar	4.99	5.14	53.35	54.25	66.81	68.81
Kufri Arun	5.31	5.47	59.84	62.23	76.19	77.63
SEm±	0.080	0.078	0.751	0.782	1.046	0.993
C.D. (P=0.05)	0.228	0.220	2.128	2.214	2.963	2.811

Table.3 Effect of planting dates, varieties and their interaction on number of A, B, C, D grade and total tubers/plant

	No of A Grade tuber		No of B Grade tuber		No of C Grade tuber		No of D Grade tuber		No of Total tuber	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
17 October	1.93	1.97	1.78	1.91	1.55	1.84	1.88	1.69	7.13	7.41
27 October	2.20	2.26	2.42	2.49	1.76	1.81	1.90	1.95	8.27	8.51
7 November	2.51	2.58	2.61	2.70	2.12	2.17	2.26	2.32	9.49	9.77
17 November	2.52	2.60	2.73	2.78	2.28	2.35	2.39	2.45	9.91	10.18
27 November	1.66	1.70	2.01	2.06	2.30	2.62	2.37	2.34	8.34	8.72
SEm±	0.033	0.036	0.037	0.038	0.031	0.033	0.034	0.036	0.130	0.138
C.D. (P=0.05)	0.093	0.102	0.105	0.108	0.088	0.092	0.097	0.103	0.368	0.391
Varieties										
Kufri Ashoka	1.97	2.03	2.11	2.16	1.86	2.11	2.12	1.98	8.06	8.28
Kufri Pushkar	2.16	2.23	2.34	2.44	2.04	2.29	2.12	1.97	8.66	8.93
Kufri Bahar	1.92	1.86	2.16	2.25	1.96	2.01	2.03	2.22	8.07	8.33
Kufri Arun	2.59	2.77	2.63	2.71	2.15	2.21	2.36	2.43	9.72	10.11
SEm±	0.030	0.032	0.033	0.034	0.028	0.029	0.031	0.033	0.116	0.123
C.D. (P=0.05)	0.084	0.091	0.094	0.097	0.079	0.083	0.087	0.092	0.329	0.350

Table.4 Effect of planting dates, varieties and their interaction on weight of A, B, C, D grade and total tubers/plant(g)

	Wt of A Grade tuber		Wt of B Grade tuber		Wt of C Grade tuber		Wt of D Grade tuber		Total tuber Wt	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
17 October	185.12	190.66	126.57	130.36	56.85	58.56	32.09	33.05	400.62	412.64
27 October	191.43	197.18	151.62	156.26	62.84	64.64	33.38	34.38	439.28	452.47
7 November	211.55	217.90	168.07	173.11	64.84	66.79	37.96	39.09	482.42	496.90
17 November	242.18	251.16	183.19	188.38	60.32	59.51	39.09	40.25	524.78	539.30
27 November	168.88	173.94	120.28	123.90	66.48	68.57	35.44	36.51	391.08	402.92
SEm±	2.916	3.183	2.381	2.455	1.011	1.048	0.435	0.497	9.220	9.653
C.D. (P=0.05)	8.258	9.014	6.743	6.952	2.863	2.968	1.232	1.407	26.109	27.336
Varieties										
Kufri Ashoka	201.28	207.14	123.08	126.71	58.16	59.90	33.58	34.59	416.10	428.34
Kufri Pushkar	199.92	205.72	159.69	164.42	66.71	68.71	35.42	36.48	461.73	475.34
Kufri Bahar	183.44	188.77	129.06	132.95	59.13	60.90	35.36	36.42	406.99	419.03
Kufri Arun	214.69	223.05	187.95	193.54	65.08	64.94	38.00	39.14	505.72	520.67
SEm±	2.608	2.847	2.130	2.196	0.904	0.937	0.389	0.445	8.247	8.634
C.D. (P=0.05)	7.386	8.062	6.031	6.218	2.561	2.654	1.102	1.259	23.353	24.450

Table.5 Effect of planting dates, varieties and their interaction on total yield of tubers (q/ha)

Planting dates	Varieties				Mean
	Kufri Ashoka	Kufri Pushkar	Kufri Bahar	Kufri Arun	
	2013-14				
17 October	292.69	304.18	264.14	329.47	297.62
27 October	310.57	367.04	290.81	378.51	336.73
7 November	341.60	375.19	341.33	442.76	375.22
17 November	340.04	401.07	375.66	480.91	399.42
27 November	291.47	302.99	270.97	287.64	288.27
Mean	315.27	350.09	308.58	383.86	
	2014-15				
17 October	305.91	317.93	276.09	344.38	311.08
27 October	321.48	379.91	301.01	391.80	348.55
7 November	353.49	388.26	353.24	458.19	388.30
17 November	351.19	414.39	388.09	497.08	412.68
27 November	300.82	312.70	279.91	296.88	297.58
Mean	326.58	362.64	319.67	397.67	

2013-14

2014-15

SEm±

C.D. (P=0.05)

SEm±

C.D. (P=0.05)

Planting dates (D)

4.995

14.145

5.154

14.595

Varieties (V)

4.468

12.652

4.610

13.054

Interaction D×V

9.990

28.290

10.308

29.190

Among the varieties, Kufri Arun produced maximum number of tubers followed by Kufri Pushkar. The interaction effect revealed that all the varieties produced lowest total number of tubers in the earliest planted crop. Total number of tubers per plant and plot was decreased in all the varieties with the delay in planting time then optimum. The present results showed similarity to results reported by Samul (1982) who reported that delay in planting reduced the number of tubers per plant in all the cultivars.

The number of 'C' grade (25-50g) and 'D' grade (<25g) tubers increased significantly with delay in planting and was maximum with 27 November planting and minimum with 17 October planting, respectively. However, number of 'A' grade (>75g) tubers was significantly poor with delayed planting (27 November). The maximum number of tubers of this grade was observed with 17 November planting closely followed by planting on 7 November. 17 November planting also produced maximum number of 'B' grade (50-75g) tubers followed by 7 November. The present investigation showed that the number of 'A' and 'B' grade tubers decreased with delay in planting whereas the number of 'C' and 'D' grade tubers increased with delayed planting. The results confirm the findings of Torres (1979) who reported that late planting dates resulted in more number of smaller tubers due to early initiation of tuber formation. Similar results were also achieved by Plooy *et al.*, (1979) found that percentage of 1st grade tuber increased with delay in planting from August to November planting.

The varieties also showed significant difference among each other along with their interaction with planting dates. Among the varieties, Kufri Arun produced maximum

number of 'A', 'B', 'C' and 'D' grade tubers whereas, the number of 'B' and 'C' grade tubers was lowest in variety Kufri Ashoka. Maximum number of 'D' grade tubers was counted in variety Kufri Arun followed by Kufri Bahar and Kufri Ashoka. These results are similar findings of Torres (1979) and Pateal *et al.*, (2000) who reported varietal difference of different grade of tubers in Kufri Badshah, Kufri Laukar and Desiree. Interaction effect of planting and cultivars showed considerable variation in number of tubers of different grades. In general, Kufri Arun produced maximum number of tubers of different grades when planted on 17 November.

Significantly maximum weight of 'A' grade (>75g) and 'B' tubers was recorded with 17 November planting and minimum with 27 November. Planting on 17 November also produced more weight of 'C' and 'D' grade tubers closely followed with 7 November planting and lowest weight of same grade tubers found in early planting (17 October). The present investigation showed that weight of 'C' and 'D' grade tubers increased with delay in planting.

The results were conforming to Bhatti *et al.*, (1984) who reported that maximum weight of tubers was recorded on 15 October planting. Patel *et al.*, (2000) also reported that weight of (0-25g) tubers was significantly lowest in third week of November than third week of December which might be due to the different agro-climatic conditions.

Total yield of tubers was significantly influenced by planting dates. It is evident from the results that maximum total tuber yield was respond significantly with early planting being maximum on 17 November followed by 7 November. The total yield was obtained low in earlier and late planting

than 17 November. The results confirm the findings of Ezekiel and Bhargava (1997) who reported that low yield in the early crop was mainly due to a small short canopy leading to reduced interception of solar radiation. Further high temperature during early crop season lowest total tuber yield through reduced partitioning of photosynthates to the tubers. Das (1976) also reported that there was increase in total tubers yield with delay in planting. Similar results were also achieved by Nandeker and Sharma (1997) also found that from yield point of view highest yield was obtained from 20 October planting followed by 30 October and 10 November plantings. They further reported that the variety Kufri Badshah has potential to give good yield. White and Sanderson (1983) also found that delayed planting reduced the total tuber yield significantly of potato cv. Russet Burbank. Sharma and Prasad (1999) observed total tuber yield was highest from potatoes planted on 30 October and lowest when planted on 20 November in Kufri Badshah under Delhi conditions. Patel *et al.*, (2000), Khan *et al.*, (2002), Khan *et al.*, (2011), Mukherjee *et al.*, (2008) and Bak and Aminpour (2001) found similar results.

Among the varieties Kufri Arun produced maximum yield of tubers followed by Kufri Pushkar, Kufri Ashoka and Kufri Bahar. Interaction effect revealed that all the varieties produced maximum tuber yield with 17 November except Kufri Asoka on 7 November. However, after 17 November it was observed that delayed in planting gradually reduced the total tuber yield in all the varieties, while lower tuber yield was recorded on earlier and later planting than 17 November. The results confirm the findings of Ezekiel and Bhargava (1992) and Sharma and Prasad (1999) who reported that Kufri Badshah gave maximum tuber yield on 20 October planting. The results are in

agreement with the findings of Perumal (1981), Taja *et al.*, (1984) and Kabir *et al.*, (1991).

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