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Original Research Article

The Effect of Different Planting Dates and Varieties on Yield and Yield Attributes of Potato (*Solanum tuberosum* L.)

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A B S T R A C T

The field experiment was conducted for determination of most suitable planting dates for cultivation of potato during *Rabi* season of 2011-12 and 2012-13 at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). 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. Total tuber yield (q/ha), total number of tubers/plant, total number and weight of "A" grade (>75g), "B" grade (50-75g), "C" grade (25-50g) and "D" grade (0-25g) tubers/plant. The result revealed that planting on 17 November produced maximum tuber yield i.e. 391.59 quintal and 404.59 quintal per hectare during 2011-12 and 2012-13, respectively. However, the minimum total tuber yield i.e. 282.61 q/ha and 291.74 q/ha was recorded when planted on 27 November during both the years of investigation. Among the varieties the maximum total tuber yield was obtained i.e. 376.33 quintal per hectare in variety Arun followed by Kufri Pushkar. However the variety Kufri Ashoka and Kufri Bahar found to be at par during 2011-12 and 2012-13, respectively.

Keywords

Potato (*Solanum tuberosum* L.), yield, varieties

Introduction

Potato (*Solanum tuberosum* L.) belongs to family 'solanaceae' is one of the most important vegetable crops grown throughout India. The major state of the country growing potato are Uttar Pradesh, West Bengal, Bihar and Gujarat, however, the maximum productivity of the crop is found in West Bengal followed by Gujarat. Potato plays an important role in Indian diet since multifarious preparations are prepared from it. It is consumed as cooked vegetable and being versatile can be mixed with almost every cooked vegetable. It is also used for making chips, potato powder, French-fries and for the extraction of starch. In some areas, it is often consumed as a substitute of cereals. It is also used as thickener in soups and gravies. Potato starch has molding cast candies, such as jelly bens and gumdrops, as thickening agent in synthetic jellies and ice creams, as dusting agent mixed with powdered sugars, for candy gums, chewing gums etc. Potato is considered a protective food since potato supply a substantial

amounts of vitamin C and B group vitamins, which are essential for nervous system, normal digestion and skin health. Its consumption plays an important role in preventing teeth decay because of its lack of stickiness and cleaning effects. It is also used in the textile industry for sizing of cotton and spun rayon.

Potato plant is very sensitive to climate factors such as temperature and day length, which exert a considerable influence on its growth and development. A temperature of 15-20^{0}C is optimum for sprouting and emergence of tubers. Maximum tuberization taken place a mean temperature of about 20^{0}C. Soil has great influence on yield and quality of the potato tubers. Crop grown on coarse textured (light) soils produces better quality tubers with characteristic shape and bright skin colour, which fetches higher price in the market, however, tuber grown in loamy soils have comparatively better keeping quality than those grown in sandy soils, as the latter become too hot by the time of main and late crops are harvested (Anonymous, 1960).

The criteria for working out the optimum time of planting is that the temperature at planting should be below 32^{0}C, while minimum temperature should be less than 20^{0}C by about 25-30 days after planting and the available growing period with this temperature range should be more than 70 days so that economic yield could be obtained.

Potato crop planted on 10 20 September at Jalandhar and harvested on 24 November resulted in higher yield as compared to the crop planted on September, however, the per day yield was higher with delay in planting due to favourable environment during plant growth and development stages (Anonymous, 1974).

A number of factors like availability of quality seed of good variety, optimum time of planting, use of fertilizer, spacing, weed management etc. Play an important role in deciding the productivity and quality of produce. White (1980) noted that time of planting was important factor in deciding the potato yield. The result and studies conducted in India and abroad indicated that planting dates and selection of cultivars has great influence on growth and yield of potato. Therefore, selection of proper variety and suitable time planting is an important aspect to study.

Materials and Methods

The experiment was carried out during *Rabi* season of 2011-12 and 2012-13 at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). The experiment was laid out in randomized block design with factorial concept and replicated four times. There were twenty treatment combination involving five planting dates viz. 17th October, 27th October, 7th November, 17th November and 27th November and four varieties viz. Kufri Ashoka, Kufri Pushkar, Kufri Bahar and Kufri Arun were used for planting during 2011-12 and 2012-13. Tubers of 2.5-3.0 cm diameter disease free certified seed tubers were used and recommended package of practices for potato FYM @ 25tonnes ha^{-1} + 150: 100: 120 Kg ha^{-1} was used. At the last ploughing, the whole quantity of FYM @ 20 tonnes per hectare was incorporated in the soil. In addition to this half quantity of nitrogen and full phosphorus and potassium were applied in rows about 4-5 cm away from seed tubers and remaining quantity of nitrogen was top dressed in furrow at the time of earthing up. The tubers were planted on the surface of plots at a spacing of 60 cm

x 20 cm and covered with soil to make the ridges. Irrigations were applied by tube well at fortnightly interval. Earthing up was done at 30 days after planting of tubers with the help of *Kudal*. At the same time remaining dose of nitrogen was also applied. Application of Indofil M-45 @ 2.5 kg ha^{-1} was done against late blight disease of potato. The crop was dehaulmed after 110 days of planting after 10 days of dehaulming to allow tuber hardening (curing). For determining the size of tuber, the produce of each plot was graded and weighted separately. The tubers above 75 g were counted in 'A' grade, 50-75 g were placed in 'B' grade, 25-50 g were kept in 'C' grade and less than 25 g were noted in 'D' grade.

After harvesting of selected plants the total tubers were counted and calculated the number of tubers per plant on the basis of tubers number of five plants. The same number of tubers per plant was used for this purpose. Each grade of tubers were weighed and calculated on the basis tubers weight of five plants. Number of tubers per plant was used for number of A, B, C and D grade tubers per plant purpose. Each grade of tubers were separated and counted the number of tubers per plant grade wise. The same tubers graded for number of tubers per plant were used for Weight of A, B, C and D grade tubers per plant. Statistical analysis of data recorded in all observations were carried out by method of analysis of variance and treatments were compared with the help of critical difference, following the techniques described by Panse and Sukhatme (1961) and results were evaluated at 5% level of significance.

Results and Discussion

An examination of data presented that planting on 17 November produced maximum tuber yield i.e. 391.59 quintal and 404.59 quintal per hectare during 2011-12 and 2012-13, respectively (Table No. 1). However, the minimum total tuber yield i.e. 282.61 q/ha and 291.74 q/ha was recorded when planted on 27 November during both the years of investigation. Among the varieties the maximum total tuber yield was obtained i.e. 376.33 quintal per hectare in variety Arun followed by Kufri Pushkar. However the variety Kufri Ashoka and Kufri Bahar found to be at par during 2011-12 and 2012-13, respectively. The combination of planting dates and varieties have showed significant results on total tuber yield.

The maximum production was obtained i.e. 471.48 quintal and 487.33 quintal per hectare when variety Kufri Arun was planted on 17 November. However, the minimum production of total tubers was recorded in variety Kufri Bahar when planted on 17 October during both the years of experimentation.

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 photosynthetes 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.

Table.1 Effect of planting dates and varieties on yield and number of tubers of potato (2011-12 & 2012-13)

Treatments	Tubers Yield (q/ha.)		Total No. of tubers/plant		No. of tubers/plant "A" grade (>75g)		No. of tubers/plant "B" grade (50-75g)		No. of tubers/plant "C" grade (25-50g)		No. of tubers/plant "D" grade (0-25g)	
	2011-12	2012-13	11-12	12-13	11-12	12-13	11-12	12-13	11-12	12-13	11-12	12-13
Planting dates (D)												
17 October	291.78	304.98	6.99	7.27	1.91	1.97	1.77	1.90	1.53	1.58	1.78	1.83
27 October	330.13	341.72	8.11	8.35	2.17	2.24	2.40	2.47	1.74	1.80	1.80	1.85
7 November	367.86	380.68	9.31	9.58	2.49	2.56	2.59	2.67	2.10	2.16	2.14	2.19
17 November	391.59	404.59	9.71	9.98	2.50	2.58	2.70	2.76	2.26	2.33	2.26	2.32
27 November	282.61	291.74	8.18	8.55	1.64	1.69	2.00	2.05	2.28	2.35	2.39	2.46
SEM	5.322	5.591	0.140	0.141	0.034	0.035	0.038	0.038	0.032	0.033	0.33	0.035
C.D. (P=0.05)	15.073	15.834	0.395	0.398	0.097	0.098	0.109	0.108	0.091	0.092	0.094	0.100
Cultivars (V)												
Kufri Ashoka	309.09	320.18	7.90	8.12	1.95	2.01	2.09	2.14	1.84	1.90	2.02	2.08
Kufri Pushkar	343.23	355.53	8.49	8.76	2.15	2.21	2.32	2.41	2.02	2.07	2.00	2.06
Kufri Bahar	302.53	313.40	7.91	8.17	1.90	1.84	2.14	2.24	1.94	2.00	2.04	2.10
Kufri Arun	376.33	389.87	9.53	9.92	2.56	2.76	2.61	2.69	2.13	2.19	2.23	2.28
SEM	4.761	5.001	0.125	0.126	0.031	0.031	0.034	0.034	0.029	0.029	0.030	0.032
C.D. (P=0.05)	13.481	14.162	0.353	0.365	0.087	0.088	0.097	0.097	0.081	0.082	0.084	0.089
Interaction (DxV)												
SEM	10.645	11.182	0.279	0.281	0.069	0.069	0.077	0.076	0.064	0.065	0.066	0.071
C.D. (P=0.05)	30.145	31.667	0.790	0.797	0.194	0.196	0.217	0.217	0.182	0.184	0.188	0.200

Table.2 Effect of planting dates and varieties on weight of tubers per plant of potato (2011-12 & 2012-13)

Treatments	Total weight of tubers/plant (g)		weight of tubers/plant (g) "A" grade (>75g)		weight of tubers/plant (g) "B" grade (50-75g)		weight of tubers/plant (g) "C" grade (25-50g)		weight of tubers/plant (g) "D" grade (0-25g)	
	2011-12	2012-13	11-12	12-13	11-12	12-13	11-12	12-13	11-12	12-13
Planting dates (D)										
17 October	392.77	404.55	183.28	188.78	125.32	129.07	59.40	61.19	27.88	28.72
27 October	430.67	443.60	189.53	195.23	150.12	154.72	62.81	64.70	28.79	29.65
7 November	472.96	487.15	209.46	215.75	166.41	171.40	64.20	66.13	32.90	33.88
17 November	514.49	528.73	239.78	248.68	181.37	186.52	64.73	66.67	33.61	34.62
27 November	383.41	395.02	167.21	172.22	119.09	122.67	62.13	64.00	31.29	32.23
SEM	6.914	7.231	3.043	3.208	2.490	2.535	1.007	1.055	0.498	0.504
C.D. (P=0.05)	19.607	20.477	8.617	9.086	7.052	7.178	NS	NS	1.410	1.428
Cultivars (V)										
Kufri Ashoka	407.94	419.94	199.29	205.09	121.86	125.46	57.58	59.31	29.21	30.09
Kufri Pushkar	452.68	466.01	197.94	203.69	158.11	162.69	66.05	68.03	30.59	31.50
Kufri Bahar	399.01	410.82	181.63	186.90	127.78	131.63	58.54	60.30	31.06	31.99
Kufri Arun	495.81	510.45	212.56	220.94	186.09	191.62	68.44	70.50	32.72	33.70
SEM	6.193	6.468	2.722	2.870	2.227	2.267	0.901	0.943	0.445	0.451
C.D. (P=0.05)	17.537	18.315	7.708	8.127	6.308	6.420	NS	NS	1.261	1.278
Interaction (DxV)										
SEM	13.847	14.462	6.086	6.417	4.981	5.069			0.996	1.009
C.D. (P=0.05)	39.214	40.955	17.235	18.172	14.105	14.356	NS	NS	2.820	2.857

However, the present results are in contradiction to the findings of Ezekil 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. 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 (Table No. 1). 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.

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 (Table No. 2). 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 Ezekil 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. Sharma and Prashad (1999) observed total tuber yield was highest from potatos planted on 30 October and lowest when planted on 20 November in Kufri Badshah under Delhi conditions. Patel *et al.,* (2000) and Khan *et al.,* (2011) 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 Ezekil and Bhargava (1992) and Sharma and Prasad (1999) who reported that Kufri Badshsh gave maximum tuber yield on 20 October planting.

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