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Bijeta Thongam
 Department of Horticulture,
 College of Agriculture, Latur,
 Maharashtra, India

AS Kadam
 Department of Horticulture,
 College of Agriculture, Latur,
 Maharashtra, India

Atom Anil Singh
 Department of Horticulture,
 College of Agriculture, Latur,
 Maharashtra, India

Yanglem Herojit Singh
 College of Agriculture, Central
 Agricultural University, Imphal,
 Assam, India

Correspondence
Atom Anil Singh
 Department of Horticulture,
 College of Agriculture, Latur,
 Maharashtra, India

Influence of planting dates on growth and yield of potato (*Solanum tuberosum* L.)

Bijeta Thongam, AS Kadam, Atom Anil Singh and Yanglem Herojit Singh

Abstract

An experiment was conducted to assess the effect of planting dates on growth and yield response of potato Cv. Kufri Pukhraj at the Instructional Farm, Department of Horticulture, College of Agriculture, Latur, Maharashtra during September 2012 to March 2013. Eight planting times (September 30, October 10, October 20, October 30, November 10, November 20, November 30 and December 10) with a spacing of 60 x 15 cm were laid out in randomized complete block design with three replicates. The earliest planting date of 30th September recorded maximum emergence percentage (at 15 and 20 DAP). Data revealed that the maximum height (52.93 cm and 70.23 cm) at 45 and 75 DAP respectively and maximum number of leaves at both 45 and 75 DAP was recorded in the tuber planted on 10th October while the minimum values were observed on tuber planted on 10th December. Further, the maximum number of tubers (8.20) per plant was recorded in planting date of October 10 which was at par with planting on 30th October and 10th November, while the minimum number of tubers (4.00) per plant was obtained in planting date of 10th December. The highest yield (44.93 kg/plot and 27.74 t/ha) was recorded in planting date of 10th October which was statistically at par with 20th October planting. While, the lowest yield (17.45 kg/plot and 10.77 t/ha) was observed in planting date of 10th December. Study conclusively revealed that the potato crop planted on 10th October recorded maximum plant height, number of leaves and yield.

Keywords: Planting dates, growth, yield, plant height

Introduction

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world after rice, wheat and maize in terms of production (Razdan and Mattoo, 2005) [15-16]. Its botanical name *Solanum tuberosum* is given by the Swiss botanist Gaspard Bauhin in 1596 and belongs to the solanaceae family. Nutritionally potato is rich in complex carbohydrates (61.5-91.5%) which is essential for energy, protein (1.6 g), dietary fibre, vitamin C (25 mg), starch (16.3 g) and minerals and also contains vitamins like Niacin, Thiamin and vitamin-B group (Bose and Som, 1986) [2]. Besides these, it also contains calcium, phosphorus and iron. The total world potato production is estimated at 381,682,000 tonnes in 2014 (Source: FAOSTAT, 2017). China is now the biggest potato producer, and almost a third of all potatoes is harvested in China and India. Total production of potato is 41555 thousand MT with the productivity of 21.1MT/ha (IHB, 2015). Potato is a weather sensitive crop. Its growth and production is influenced by climate and several other factors like use of improved varieties, good quality seed, planting time, nutrition and irrigation, incidence of pest and diseases and weeds. Among these factors, planting time plays a very important role in potato production as manipulation of light and temperature can be done to a certain extent by altering planting time. For best yields, potato crop needs long day conditions during growth and short day conditions during tuberization (Chadha, 2009) [4]. The main climatic factors controlling tuber formation are night temperature and day length (Cutter, 1992; Struik and Ewing, 1995) [5, 18]. The information about the exact period for planting the potatoes in Marathwada region of Maharashtra is not available. There was a feedback from the farmers and also from the extension agencies to know the exact information about the period of planting of potatoes for getting higher yields and better quality tubers under Marathwada conditions. Hence, in order to find out the solution for the said problem, the present investigation was undertaken.

The present investigation was undertaken at the Instructional Farm, Department of Horticulture, College of Agriculture, Latur, Maharashtra during September 2012 to March 2013 to study the effects of different planting dates on yield and yield contributing factors. Experiment was laid out in Randomized Block Design (RBD) with eight treatments with three replications. The treatments comprised of eight planting dates viz., 30th September (D₁), 10th

October (D₂), 20th October (D₃), 30th October (D₄), 10th November (D₅), 20th November (D₆), 30th November (D₇) and 10th December (D₈). The variety 'Kufri Pukhraj' was used for the present study. The tubers were first treated with Copper oxychloride @ 2g/kg of tubers. The treated tubers were dried in shade and then treated with *Azotobacter* and *Trichoderma* @ 3g/kg of tubers. The MKV recommendations for RDF (120:60:80 kg NPK/ha) were used (Anonymous, 2008). The tubers were then planted in plots of size 3.6 m x 4.5 m at the side of ridges at a spacing of 60 x 15 cm. The data on different growth and yield attributes were recorded and analyzed statistically as per the standard procedures suggested by Panse and Sukhatme (1985) [13]. Meteorological data recorded during the crop growth period are given in Table 1.

Results and Discussion

A) Effect of different planting dates on growth attributes of potato:

1. Growth attributes: The data on different growth attributes of potato influenced due to different planting dates are presented in Table 2.

1.1. Emergence percentage: The results of the present investigation indicated that, there were no significant differences with respect to the emergence percentage in potato influenced due to different planting dates. However, at 15 and 20 DAP the maximum emergence (65.32% and 80.28% respectively) was obtained in planting date of D₁ while, the minimum (48.23% and 64.93% respectively) was found in D₈ planting date. The higher emergence percentage in planting date of D₁ as compared to the planting date of D₈ could be attributed to favourable climatic conditions in general and temperature in particular. Similar findings were in agreement with the earlier reported by Lal and Sahota (1983) [11] and Gopalakrishnan (2007) [7].

1.2. Height of plant: The data revealed that the maximum height (52.93 cm and 70.23 cm) at 45 and 75 DAP respectively was recorded in the planting date D₂ while the minimum values were observed in D₈. The better growth in planting date of D₂ might be due to prevalence of favourable temperature (15.6 to 27.9 °C) required for better vegetative growth. Similar findings were also reported by Modisane (2007) [12], who reported that plants grew taller at high temperature (27/17 °C) as compared with low temperature (22/14 °C).

1.3. Number of leaves per plant: The data regarding number of leaves per plant also showed significant differences in the different planting dates. The maximum number of leaves at both 45 and 75 DAP were recorded in planting date of D₂, while minimum number was recorded in planting date D₈. This could be attributed to the favourable temperature range (27.9/15 °C) available during vegetative growth phase of this planting date. While, the wider temperature range (30.7/12 °C) during the vegetative phase of planting date of D₈ might have resulted in reduction of number of leaves per plant. Khan *et al.* (2011) [10] also obtained similar findings which strongly supports the results of the present investigation.

2. Days required for different growth phases

2.1. Vegetative phase: The significantly minimum number of days (27) for completion of vegetative phase was required in planting date D₁ while, maximum days (42) were required in the planting date of D₈. These results indicated that, the higher

temperatures prevailing during vegetative phase (27.9 to 20.4 °C) of planting date of D₁ might have caused accelerated photosynthetic activities, thereby, reducing the period required for completion of vegetative phase. Lower minimum temperature (12 °C) during the vegetative growth of planting date D₈ might have resulted in retarding the photosynthetic as well as metabolic activities, thereby, resulting in increasing the period required for completion of vegetative phase in planting date of D₈. These results are strongly supported with the findings of Gopalakrishnan (2007) [7], who reported that, growth of potato plant is accelerated during long days and at high temperature.

2.2. Reproductive phase: The data clearly showed that, the days required for completion of reproductive phase were also significantly influenced due to different planting dates. The minimum days (36) for completion of reproductive phase were required in the planting date D₈ while, the maximum days (63) were required in D₁ planting date. The earliness in completion of reproductive phase in planting date of D₈ might be due to the regulatory principle formed in the long dark period that promoted early flowering (Hazra and Som, 2010) [8]. Likewise, crop maturity period may be reduced due to short photoperiod (Chadha, 2009) [4].

2.3. Period required for maturity: The period for maturity was also significantly influenced by different planting dates. The minimum days (78) were required in planting date of D₈ while, the maximum days (96) in D₄ planting date. This could be attributed to more number of days required for completion of vegetative growth and low humidity (46.7%) which retarded the growth and developmental processes of the plant or may be due to short photoperiod during the reproductive phase of the plant. Chadha (2009) [4] also reported earliness in maturity due to short photoperiod which supports the present findings.

B) Effect of different planting dates on yield parameters of potato:

3. Yield attributes: The data on different yield attributes are presented in Table 3.

3.1. Number of tubers per plant: It is revealed from the results that, the number of tubers per plant was significantly influenced due to different planting dates. The maximum number of tubers (8.20) per plant was recorded in planting date of D₂ which was at par with D₄ and D₅, while, the minimum number of tubers (4.00) per plant was obtained in planting date of 10th December (D₈). More number of tubers in planting date of D₂ could be attributed to significantly strong growth in terms of height and number of leaves per plant which has produced more photosynthetic area resulting in production of high quantity of photosynthates, subsequently their translocation to the formation of more number of tubers coupled with the favourable temperatures with required humidity might have resulted in production of more number of tubers in the plants of this planting date. These results are in conformity with the earlier findings of Khan *et al.* (2011) [10] and Sharma and Verma (1987) [17].

3.2. Weight of tubers (g): Significant variations ranging from 97 to 250 g with respect to weight of tubers was observed among the different planting dates. The highest weight of tubers (250 g) was recorded in planting date of D₂ while,

minimum (97 g) was recorded in planting date of D₈. The higher tuber weight in planting dates of 10th October (D₂) and 20th October (D₃) could be attributed to overall strong vegetative structures of plants raised during this period which might have supplied the required quantum of photosynthates towards the development of tubers over a long period of time that might have resulted in gaining higher weight of individual tuber. Further, the lower temperature (12 °C) and short days might have resulted in better growth of the tubers. Similar results were obtained by Sharma and Verma (1987) [17].

3.3. Tuber yield: The significant variations in tuber yield per plot and per hectare were observed among the different planting dates studied. The highest yield (44.93 kg/plot and 27.74 t/ha) was recorded in planting date of D₂ which was statistically at par with D₃. While, the lowest yield (17.45 kg/plot and 10.77 t/ha) was observed in planting date of D₈.

The yield of potato is significantly influenced due to environmental factors in general and temperature in particular. The crop factors like height of the plant, number of leaves, number of tubers and weight of tubers plays a dominant role in yield contribution. The strong vegetative growth in terms of height and number of leaves and better reproductive growth in terms of more number of tubers and higher tuber weight in planting date of D₂ might have favoured towards getting higher yield in this planting date. Further, as the temperature is the most dominating factor in yield contribution of potato, the required temperatures during vegetative as well as reproductive growth phase might have contributed towards getting better vegetative growth and higher yield in this planting date. Similar findings were also reported by Perumal (1981) [14], who recorded higher yield due to persistence of foliage and high rate of uninterrupted tuber bulking under Shillong conditions.

Table 1: Mean weather conditions during crop growth period in different planting dates.

Treatments	Vegetative phase			Reproductive phase		
	Max. temperature (°C)	Min. temperature (°C)	Average R.H. (%)	Max. Temperature (°C)	Min. temperature (°C)	Average R.H. (%)
30 th September (D ₁)	27.9	20.4	76.0	29.8	15.3	65.3
10 th October (D ₂)	27.9	15.6	70.4	30.7	12.0	61.9
20 th October (D ₃)	27.9	15.6	70.1	30.7	12.0	55.6
30 th October (D ₄)	29.8	15.3	65.0	30.7	12.0	50.4
10 th November (D ₅)	29.8	15.3	66.7	30.7	12.0	49.0
20 th November (D ₆)	29.8	15.3	64.7	30.7	12.0	46.5
30 th November (D ₇)	30.7	12.0	61.7	30.7	12.0	45.8
10 th December (D ₈)	30.7	12.0	55.5	30.7	12.0	46.7

Table 2: Effect of different planting dates on growth attributes of potato.

Planting dates	Emergence percentage at		Plant height (cm)		No. of leaves at		Days required for completion of		
	15 DAP	20 DAP	45 DAP	75 DAP	45 DAP	75 DAP	Vegetative phase	Reproductive phase	Maturity
30 th September (D ₁)	65.32	80.28	48.80	68.80	36.00	46.40	27	63	90
10 th October (D ₂)	55.07	71.81	52.93	70.23	39.08	55.63	30	60	90
20 th October (D ₃)	65.04	77.89	43.43	67.60	30.93	40.83	33	60	93
30 th October (D ₄)	63.24	79.63	41.47	63.93	30.47	40.77	35	61	96
10 th November (D ₅)	64.60	78.53	39.93	63.43	34.73	44.63	36	57	93
20 th November (D ₆)	65.07	74.33	40.13	62.77	31.00	41.20	38	53	91
30 th November (D ₇)	64.72	78.17	39.67	62.70	25.53	35.43	38	48	86
10 th December (D ₈)	48.23	64.93	32.67	50.37	23.60	33.80	42	36	78
S.E. ±	5.71	5.22	1.98	3.10	2.15	2.26	2.30	2.30	3.30
C.D. at 5 %	NS	NS	6.00	9.40	6.53	6.84	6.96	6.96	10.00

Table 3: Effect of different planting dates on yield parameters of potato.

Planting dates	Number of tubers per plant	Weight of tubers per plant (g)	Tuber yield	
			(kg/plot)	(t/ha)
30 th September (D ₁)	5.80	159.15	28.65	17.68
10 th October (D ₂)	8.20	249.63	44.93	27.74
20 th October (D ₃)	6.50	227.34	40.92	25.26
30 th October (D ₄)	7.30	216.84	39.03	24.09
10 th November (D ₅)	7.67	215.28	38.75	23.92
20 th November (D ₆)	6.30	169.68	30.54	18.85
30 th November (D ₇)	5.20	133.65	24.06	14.85
10 th December (D ₈)	4.00	96.93	17.45	10.77
S.E. ±	0.31	8.68	1.56	1.00
C.D. at 5 %	0.95	26.33	4.74	3.00

Conclusion

It can be concluded that, the planting time of potato significantly influenced the different growth and yield parameters. The present investigation revealed that planting should be done from 10th October to 20th October for getting optimum growth and higher marketable tuber yield of potato in Marathwada region of Maharashtra. The earlier or delayed planting decreased the growth and yield.

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