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Effect of planting dates and varieties on potato yield

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Abstract

There is a huge gap in the demand and production of potato in the state of Odisha. One of the main causes of low potato productivity in the state is the short and mild winter during the growing period. In the present experiment with two planting dates and four varieties, 26th November emerged as the best planting date with a maximum tuber yield of 552.3 g./plant total yield of tubers. Kufri Pukhraj was found to be the best variety with 604.4 g./ plant total yield of tubers.

Keywords: Potato, yield, planting dates, variety

1. Introduction

Potato (*Solanum tuberosum* L.) a major food crop grown worldwide. It is used in the production of starch, foods like potato chips and stock feed. (Ahmadzadeh and Felenji 2011)^[1], Potatoes are a great source of carbohydrates and are utilized in both for table consumption and in processed foods. Potato tubers contain around 80% of water. 20% dry matter. More than 75% of the dry Starch, protein, fibres, and a negligible quantity of fatty acids make up matter (Prokop and Albert, 2008)^[10]. Additionally, it is abundant in minerals like potassium, phosphorus, magnesium with B1, B3, and B6 vitamins (Camire *et al.*, 2009)^[4]. The potato also includes Vitamin C and several phenolic compounds act as strong antioxidants (Brown, 2005)^[3].

Potato is the world's 4th important food crop after wheat, rice and maize because of its great yield potential and high nutritive value. China is the world's largest producer and consumer of potato, produce 78.24 mt in 4.21 m ha⁻¹ with a productivity of 18.55 t ha⁻¹ followed by India (51.30 mt production in 2.16 m ha⁻¹ with 23.78 t ha⁻¹ productivity) and Russia (19.61 mt in 1.18 m ha⁻¹ with a productivity of 16.65 t ha⁻¹) (According to the estimates of 2020, FAO 2021).

In India most of the potato production takes place in Uttar Pradesh (15892 thousand tonnes production in 622.50 thousand ha⁻¹ area) followed by West Bengal (12600 thousand tonnes in 447 thousand ha⁻¹) and Bihar (9125.80 thousand tonnes in 330 thousand ha⁻¹ area) According to the estimates of 2021, NHB2021.

Currently Odisha produce 308.22 thousand tonnes in 25.91 thousand ha⁻¹ area. (NHB 2021), potato is one of the major constituents of the daily diet in Odisha. It is cultivated all districts of the state in winter season and also in Phulbani and Koraput districts in kharif season.

2. Materials and Methods

The field experiment was conducted during Rabi season of 2021-2022 at the experimental plots of All India Coordinated Research Project on Potato, Odisha University of Agriculture and Technology, Bhubaneswar, located at 20° North latitude, 86° East longitude and at about 45 m above MSL consecutively for three years. The soil for the study was sandy loam in texture, acidic (pH 5.56) in reaction, low in organic carbon (0.51%) and available N (218.4 kg ha⁻¹), medium in both available P (20.8 kg ha⁻¹) and K (96.1 kg ha⁻¹). The treatments were a combination of two planting dates (D) and four varieties (V). The two dates of planting followed in the experiment were 26 November, 16 December, the varieties were Kufri Pukhraj, Kufri khyati, Kufri surya and kufri jyoti in the medium duration groups. The seed tubers of these varieties were kept in cold store till planting. Well sprouted foundation seed tubers were planted in 3 m x 2.4 m sized plots at 60 x 20 cm spacing in a Split Plot Design with five replications. The growth and yield attributes were recorded on five randomly selected plants in each treatment and replication 30 days after planting (DAP) at weekly interval.

During the investigation, the parameters like plant emergence % at 30 days, plant height of five tagged plants in centimetre at 30, 45, and 60 days after planting. Number of leaves per plants and number of shoots per plant were recorded using five sample plants at 30, 45, and 60 days after planting. Five random plants were taken to measure leaf area per plant using a LI-3000C leaf area meter. Total number of marketable and non-marketable tubers per five plants was recorded at harvest time from each treatment. Weight of rotten tubers, non-marketable and marketable tubers were done by using electric balance in gram for each treatment individually and samples for these tubers were collected from per five plants treatment.

3. Result and Discussion

The response dates of planting with respect to plant emergence was recorded significantly at the growth stage 30 DAP (Table 1). The maximum plant emergence was recorded 84.3% when planting on 26 November (Table1), which was significantly different from 16 December planting. The maximum emergence percentage could be attributed due to favourable climatic conditions in general and temperature. Similar findings agreed with the earlier reported by Gopalakrishnan (2007) [6]. Emergence of potato was not affected significantly with the variety. Higher plant emergence was obtained from the variety Kufri Pukhraj 79.2%. The Low plant emergence was observed in the variety Kufri Jyoti 70.7%.

The effect of dates with respect to plant height was recorded significantly at all the growth stages of 30, 40, 45 DAP (Table 1). The maximum plant height was recorded when planted on 26 November at all growth stages and the minimum plant height was recorded on 16 December. The better growth in planting on 26 November 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) [8]. Decreasing trend in plant height with the delay in planting under Bhubaneswar conditions was also reported by Dash *et al.* (2018) [6]. Kufri Surya recorded tallest plant 42.7cm, 50.4cm, and 54.4cm at 30, 45 and 60 DAP. Which is significantly different from the other variety.

Number of shoots per plant were 4.4, 5.2, and 5.7 at 30, 45, and 60 DAP on 26 November planting, may be due to optimum environmental condition for growth (Table 1). Least numbers of shoots per plant were observed on 16 December planting. Dash *et al* (2018) [6] observed Number of shoots per plant was significantly maximum (4.2) in 15 November planting and minimum (3.5) on 5 December. The varieties did not differ significantly over 30, 45, and 60 days of the planting with respect to number of shoots per plant.

The maximum number of leaves per hill at 40.2, 46.1, and 48.9 respectively at 30, 45, and 60 DAP were recorded on 26 November planting (Table 1). Dash *et al* (2018) [5] observed the number of leaves per plant was highest (50.2) under 15 November and a distinctly lowest (42.2) under 5 December. The crop was exposed to favourable temperature range (27.9/15 °C) during its growth stages when planted on 26 November might have resulted in most number of leaves per plant. The varieties did not differ significantly over 30, 45, and 60 days of the planting with respect to number of leaves per hill.

The maximum leaf area index per plant was 0.17 when planted 26 November at 45 DAP, which it was at par with on 16 December planting date 45 days after planting (Table 1).

Similar findings were also reported by Begum *et al.* (2015) [2]. Differences in LAI among these two varieties at different growth stages were due to cumulative effects of number of green leaves/plants. Delayed planting resulted in lower LAI. Kufri Pukhraj recorded maximum LAI 0.22 at 45 DAP which is significantly different from the other variety.

The fresh weight of shoots per plant showed significant variation among treatments (Table 1). Highest weight was recorded under date of planting on 26 November 239.4 g per plant, minimum weight was found in date of planting on 16 December 180 g per plant. Among four varieties Kufri Jyoti recorded maximum fresh weight of shoots 314.4 g per plant than other varieties.

The fresh weight of root per plant showed significant variation among dates of planting (Table 1). Highest fresh root weight was recorded under 26 November 18.9 g per plant. Among four varieties Kufri Surya showed significant highest fresh weight of root 20.3 g per plant than other varieties.

The fresh weight of shoot + root per plant showed significant variation among dates of planting. maximum weight 259.8 g per plant was recorded under planting 26 November which was significantly different from planting 16 December (Table 1). Among variety Kufri Jyoti recorded significant highest fresh weight of shoot + root 326.2 g per plant than other varieties.

Planting on 26 November recorded longest root length 18.5cm which was significantly different from 16 December planting (Table 1). Among variety Kufri Jyoti recorded longest root length 19.6cm per plant. Which was at par with than Kufri Pukhraj and Kufri Surya significantly different from Kufri Khyati.

There is significant difference between two dates of planting with respect to nonmarketable tuber per plant (Table 1) The highest number of nonmarketable tuber (13.5) was recorded on 26 November planting and lowest number (11.5) observed on 16 December planting. Number of nonmarketable tubers per plant different significantly among varieties. Kufri Surya recorded significantly more number (14) than Kufri Pukhraj (12.5), Kufri Khyati (11.5) and Kufri Jyoti (11.5).

The highest number of marketable tubers (4.4) was found on 26 November planting which different significantly from 16 December planting (Table 1). The varieties different significantly with respect to number of marketable tubers per plant. Kufri Pukhraj recorded significantly more number (5.3) than Kufri Khyati 3.5, Kufri Surya (3.5) and Kufri Jyoti (3.0). The effect of dates of planting on yield of non-marketable tubers per plant significantly recorded difference (Table 2). However, the highest yield of non-marketable tuber 220.9 g per plant was found when planted on 26 November and lowest yield of non-marketable tuber 212.7 g per plant observed when planted on 16 December. The effect of varieties on yield of non-marketable tuber per plant different significantly. Kufri Surya recorded significantly more yield 267.7 g per plant, than Kufri Pukhraj 232.9 g per plant, Kufri Khyati 204.5 g per plant, and Kufri Jyoti 162.1 g per plant. It is revealed from the data that the dates of planting different significantly with respect yield of marketable tubers per plant. However, the highest yield of marketable tuber 331.4 g per plant. was found on 26 November planting and lowest yield of marketable tuber 256.5 g per plant. observed when planted on 16 December. The effect of varieties on yield of marketable tuber per plant different significantly. Kufri

Pukhraj recorded significantly more yield 371.5 g per plant than Kufri Khyati 287.2 g per plant, Kufri Surya 231 g per plant and Kufri Jyoti 286 g per plant. Tubers planted at earlier dates received more time of optimum moisture and temperatures than the late plantings, which resulted in higher marketable tuber yield. The phenomenon is well supported by Khan *et al.* (2011) [7] who recorded reduced marketable yield with delay in planting due to unfavourable climatic condition for tuber growth. 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) [11].

It is revealed that highest total tuber yield of 552.3 g per plant was recorded when planting on 26 November (Table 2). Which was significantly different from 16 December planting with 469.2 g total tuber yield per plant. Kufri Pukhraj recorded highest total tuber yield of 604.4 g per plant. Which was significantly different from other varieties. 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) [9].

Table 1: Emergence (%) and growth characters of potato plant and tuber number as affected by planting dates

Treatment (D/V)	Growth attributes															Tuber number plant ¹	
	Emergence (%)	Plant height (cm)			Number of shoots per plant			Number of leaves			Leaf area index (LAI)	Fresh shoots weight (g plant ¹)	Fresh root weight (g. plant ¹)	Fresh shoot + root weight (g. plant ¹)	Root length (cm plant ¹)	Non marketable tube number (plant ¹)	Marketable tuber (plant ¹)
		30 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP							
Main plot																	
26 Nov.	4.3	45.8	50.1	54.9	4.4	5.2	5.7	40.2	46.1	48.9	0.17	239.4	18.9	259.8	18.5	13.5	4.4
16 Dec.	65.8	34.5	43.6	47.4	3.3	4.2	4.9	28.8	33.4	38.6	0.16	180.0	12.8	192.8	16.6	11.5	3.3
SE(m)±	2.0	0.45	1.29	1.27	0.22	0.24	0.16	1.21	2.18	1.39	0.01	1.84	0.40	2.15	0.73	0.3	0.12
CD (0.5)	8.2	1.82	5.24	5.13	0.89	0.97	0.65	4.89	8.78	5.61	N/S	7.42	1.62	8.67	N/S	1.21	0.50
Sub plot																	
Kufri Pukhraj	79.2	37.8	44.9	52.1	3.5	4.2	4.9	34.2	38.2	42.3	0.22	201.8	16.8	221.6	19.2	12.5	5.3
Kufri Khyati	74.9	40.4	48.1	51.2	4.4	4.9	5.3	32.1	37.7	41.3	0.17	204.6	14.5	219.1	16.2	11.5	3.5
Kufri Surya	75.5	42.7	50.4	54.4	3.6	4.7	5.5	33.4	40.2	43.9	0.14	118.0	20.3	138.3	15.1	14.0	3.5
Kufri Jyoti	70.7	39.4	44.1	46.9	3.8	4.8	5.6	38.3	42.8	47.6	0.15	314.4	11.8	326.2	19.6	11.5	3.0
SE(m)±	3.3	1.05	1.69	1.05	0.26	0.25	0.338	2.03	2.84	2.56	0.01	3.87	0.91	3.79	0.68	0.36	0.12
CD (0.5)	N/S	3.07	4.95	3.07	N/S	N/S	N/S	N/S	N/S	N/S	0.02	11.37	2.66	11.14	2.00	1.06	0.34

Table 2: Influence of date of planting on tuber yield

Treatment (D/V)	Yield of tubers		
	Yield of non-marketable tuber (g plant ¹)	Yield of marketable tuber (g. plant ¹)	Total yield of tubers (g. plant ¹)
Main plot			
26 Nov.		220.9	331.4
16 Dec.		212.7	256.5
SE(m)±		1.43	2.07
CD (0.5)		5.77	8.36
Sub plot			
Kufri Pukhraj		232.9	371.5
Kufri Khyati		204.5	287.2
Kufri Surya		267.7	231.0
Kufri Jyoti		162.1	286.0
S.E(m)±		4.92	4.70
CD (0.5)		14.44	13.80

4. Conclusion

From the findings of the present investigation, it can be concluded that 26th November planting was preferable for okra planting then 16th December planting. Kufri Pukhraj recorded highest total tuber yield of 604.4 g per plant. Which was significantly different from other varieties.

5. Contribution

Ankit Kumar Meena: Investigation, Data curation, Writing-Original draft preparation. A.K.B. Mohapatra:

Conceptualization, Methodology, Visualization. Curie Parhi: Visualization, Writing- Reviewing and Editing. Ashok Mishra: Conceptualization, Resources, Supervision. Ashutosh Nanda: Supervision, Investigation, Writing- Reviewing and Editing. Neeraj Kumar: Conceptualization. Brijesh Kumar Yadav: Investigation, Data curation.

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