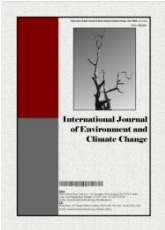

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Evaluation of Yield Performance of Potato (*Solanum tuberosum* L.) Varieties with Varied Dates of Planting under North Central Plateau Zone (NCPZ) of Odisha

N. Mishra[1], K. C. Sahoo[1], M. Ray[1], P. K. Majhi[1*], S. Das[1] and S. Tudu[1]

[1]Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology (O.U.A.T.), Keonjhar-758002, Odisha, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To identify the proper variety and suitable date of planting of potato for North Central Plateau Zone (NCPZ) of Odisha.
Study Design: The experiment was laid in a Factorial Randomized Block Design (FRBD) with three replications.
Place and Duration of Study: The field experiment was carried out at Field Experimental Block, Regional research and Technology Transfer Station (RRTTS), Keonjhar, Odisha University of Agriculture and Technology, Odisha. The investigation was conducted during *rabi*-2015-16 and *rabi*-2016-17.
Methodology: There were four high yielding potato genotypes used as sub-factor for the study such as V1: Kufri Jyoti, V2: Kufri Surya, V3: Kufri Ashoka and V4: Kufri Pukhraj. The materials were planted in three different dates (D1: 15th November, D2: 25th November and D3: 5th December) as main-factor to identify the superior variety with suitable dates of planting.
Results: The results of pooled analysis of variance (ANOVA) shown that the genotypes had significant differences for the dates of planting on yield. Higher tuber yield was recorded in the variety Kufri Pukhraj in both *rabi*-2015-16 (28.37 t ha^{-1}) and *rabi*-2016-17 (35.53 t ha^{-1}) along with

**Corresponding author: E-mail: prasanta.ouat21@yahoo.com;*

higher mean yield (31.95 t ha^{-1}). All the varieties have higher yield when planted on D1 (15th November) as compared to the other two date of planting.
Conclusion: The varietal and environmental variations as well as their interaction had a considerable influence on yield and its attributes. In this investigation, Kufri Pukhraj was identified as higher yielder and 15th November was found best suitable planting date for north central plateau zone of Odisha, as this date given higher yield as compared to the other two dated of plating. Therefore, if a specific window of date of planting can be ascertained to the farmers of this region then it would help to cultivate potato exactly when the climatic conditions are favorable for its growth and ultimately to get a high crop yield.

Keywords: Yield performance; Potato; date of planting; Odisha.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is considered to be an indigenous crop of South America [1] and has potential for adaptation to diverse climatic conditions of the tropics. Uttar Pradesh is the highest tuber producing state in the country, followed by West Bengal and Bihar [2]. In India, potato is not primarily a rural staple food, rather a cash crop that provides significant income to the small and marginal farmers. Potato fulfils all the criteria for a healthy food and offers a great potential for decreasing global food crisis. Potato produces more energy and protein per unit area and unit of time than most other major food crops, and it is fat-free [3]. Potato is also rich in several micronutrients and vitamin C, is a source of iron, vitamins B1, B3 and B6 and minerals [4]. It is a source of dietary antioxidants, which may play a part in preventing diseases related to ageing, and a good source of dietary fiber. Potato average yield is low (9.76 $t \cdot ha^{-1}$) in Keonjhar district of Odisha during the year 2015-16, which is far below than crop potential and national and state productivity as well (Fig. 1). Lack of well adapted varieties, inappropriate rate and application of fertilizer, unavailability and high cost of seed tubers, improper planting time, planting density, diseases, insect-pests, inadequate storage capacity, transportation and marketing facilities are major problems in potato production [5]. Potato is a temperate crop and grows well during *rabi* season, but under sub-tropical areas also it can be cultivated successfully. It prefers a pH ranging from 5.5 to 6.5 [6]. Since, potato is developed from the root system of the plant, it needs very porous fertile soil with high biological values for giving higher yield [2]. Potato yield is highest when average daytime temperatures are about 21^0C. Cool night temperatures are critical for the accumulation of carbohydrates and dry matter in the tubers [7]. Various researchers have reported the importance of effect of planting dates on the crop yield of potatoes [8,9]. Under favorable temperature condition potato can be planted under a wide range of dates in the fields. It can be planted from September onwards up to first week of January in different agroclimatic zones (Mishra and Mishra, 2021). Hence, if a certain specific window of date of planting can be ascertained to the farmers of this region then it would help to cultivate potato exactly when the climatic conditions are favorable for its growth and ultimately to get a high crop yield.

So far as Odisha is concerned, its potato requirement is far more than it produces. It has to depend on the neighboring states like West Bengal to procure about 90 per cent of its potatoes. The State Government did not take any special initiative for tuber production and achieve self-sufficiency. Hence, potato is cultivated at a limited scale in a very few areas, while the home grown ones are sweet potatoes [2]. Odisha is known to be river-based States. The soil of these lands is very porous and loose and there is a lot of scope for the root systems to travel in the soil and collect food for sustenance. There is a need for extensive cultivation of such annual economic crop. Odisha has diverse agroclimatic regions and potato planting dates for each region is one of the factors that have a significant role in the yield performance of this crop. Proper planting time makes all the environmental factors occurring at the time of emergence, and seedling establishment of appropriate. Each stage of growth coincide with favorable environmental conditions is desired for yield optimization. Yield difference in delayed planting dates is caused by reduction in number of tubers per plant and shrinkage of leaves [2]. Potato planting date can be determined based on its growth season duration in any region. Delayed planting dates cause yield reduction. Plant growth at delayed planting significantly reduced the vegetative growth of the potato plant because of lower temperatures in the end of November and earlier

December and ultimately reduces the yield [2]. Plant dry bio-mass was higher by planting the potato earlier. The physiological causes that led to yield reduction in delayed planting of potato had not been reported from Bangladesh. The farmers of North Central Plateau Zone (NCPZ) of Odisha are growing potato without proper knowledge of the variety, planting time and the agronomical management strategy. So, the productivity is very low in the Keonjhar district as well as state as compared to the national productivity (Fig.1). Therefore, an attempt was undertaken to study the growth, development indices and tuber yield of different potato varieties in relation to planting date to identify the proper variety with suitable date of planting for NCP zones of Odisha. This can improve the productivity of potato farmers in the State with higher income.

2. MATERIALS AND METHODS

2.1 Experimental Materials

There were four high yielding potato genotypes used for the study such as V1: Kufri Jyoti, V2: Kufri Surya, V3: Kufri Ashoka and V4: Kufri Pukhraj. The special features of all the experimental material are mentioned in Table 1. The materials were planted in three different dates (D1: 15th November, D2: 25th November and D3: 5th December) to identify the superior variety with suitable dates of planting. The materials were planted at the seed rate 2500 kg/ha with spacing 50 cm × 20 cm.

2.2 Experimental Site and Design

The field experiment was carried out at Field Experimental Block, Regional research and Technology Transfer Station (RRTTS), Keonjhar, Odisha University of Agriculture and Technology, Odisha. The investigation was conducted during *Rabi*-201-16 and *Rabi*-2016-17 and the experiment was laid in a Factorial Randomized Block Design (FRBD) with three replications. Soil texture of the experimental site was loamy sand and characterized by physical properties [sand (72.4%), silt (15.3%), clay (12.3%)] and chemical properties: pH (6.3), EC (0.05 dS/m). The rainfall during the cropping season was 70 mm. The fertilizer dose was basal application of N: P_2O_5: K_2O @ 60:60:60 kg/ha + 10 t FYM/ ha and top dressing with N: P_2O_5: K_2O @ 60:0:60 kg/ha and all the agronomical practices were followed to raise a good crop during the crop growth. The environmental variables such as temperature (^{0}C) and rainfall (mm) during the cropping season are graphically represented in Figs 2, 3 and 4.

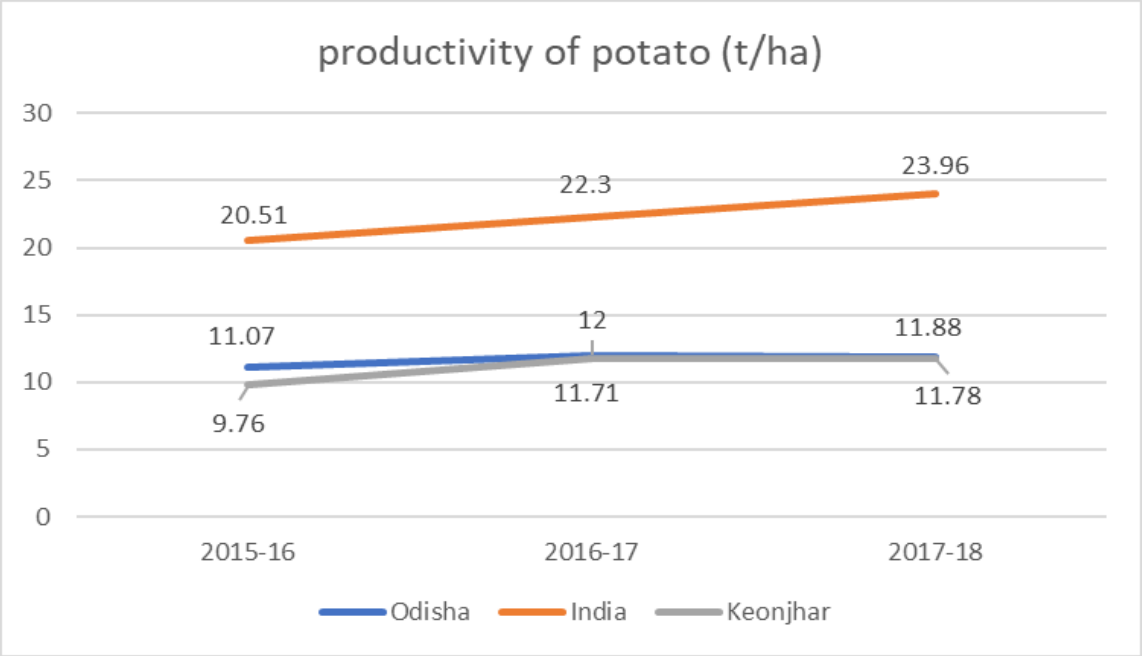

Fig. 1. Productivity (t/ha) of Potato (India, Odisha and Keonjhar district)
(Source: Horticulture statistics at a glance 2018, GoI and Directorate of Horticulture, Odisha)

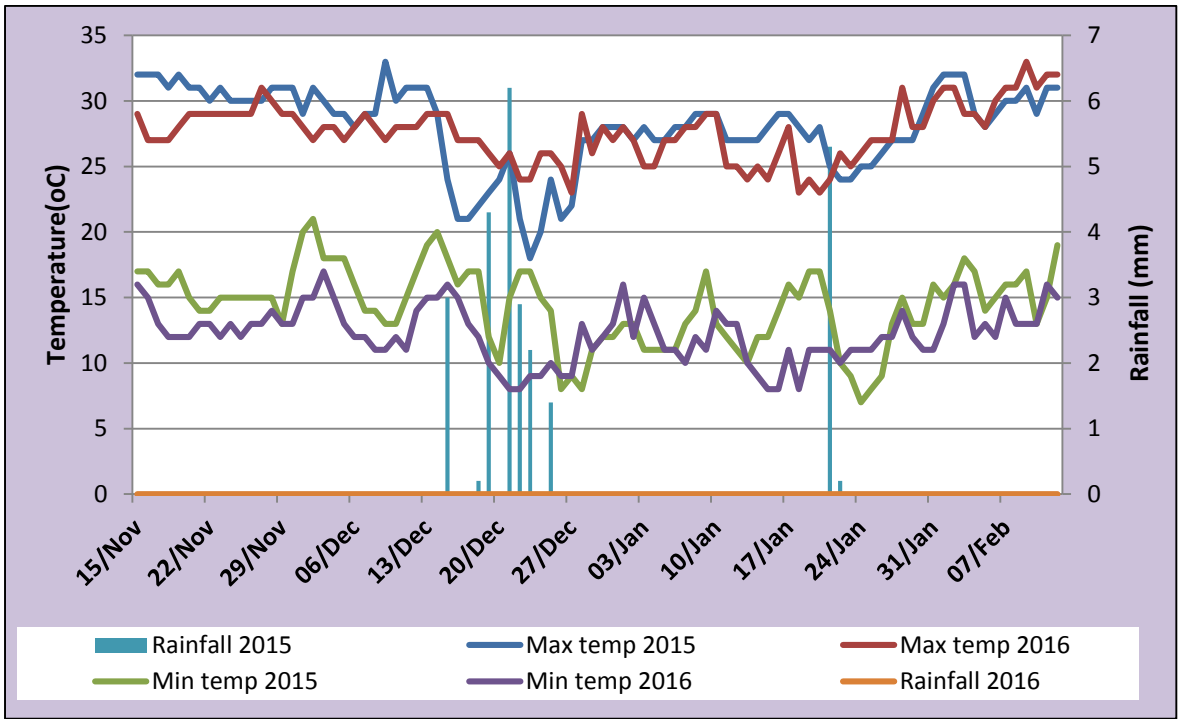

Fig. 2. Environmental variables such as temperature (^{0}C) and rainfall (mm) during the cropping season between 15th November to 07th February (D1)

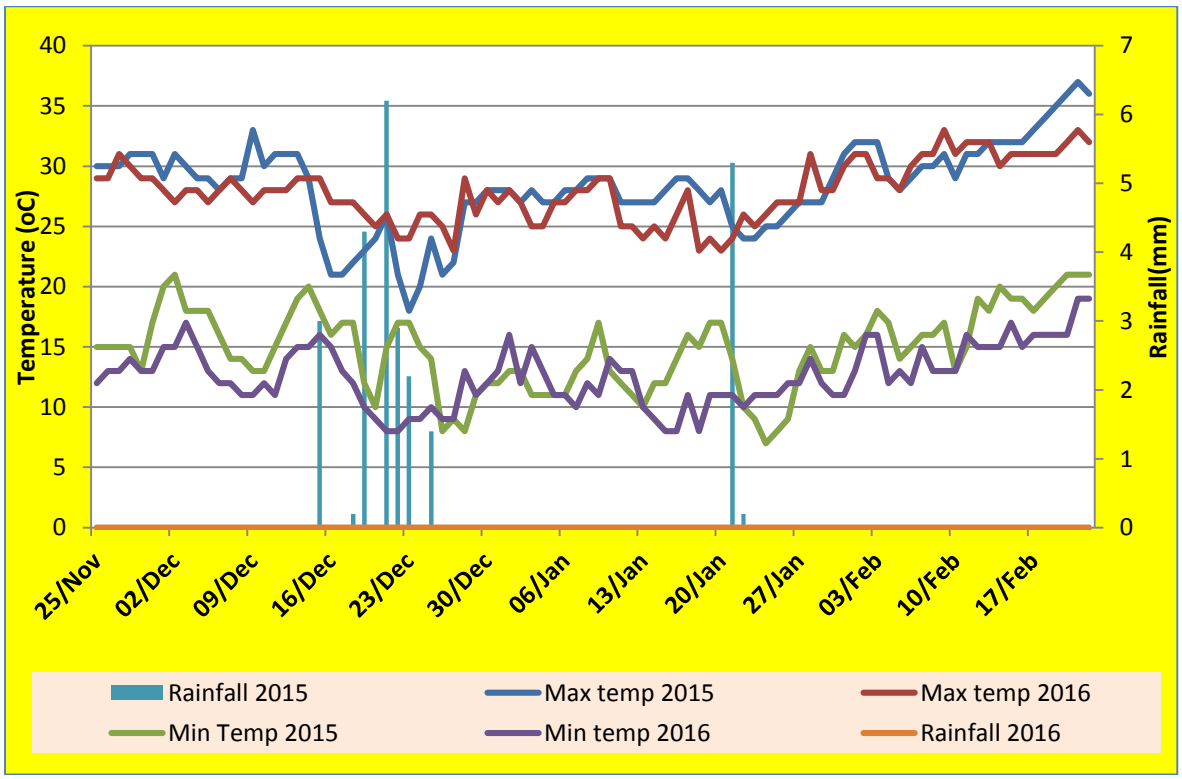

Fig. 3. Environmental variables such as temperature (^{0}C) and rainfall (mm) during the cropping season between 25th November to 17th February (D2)

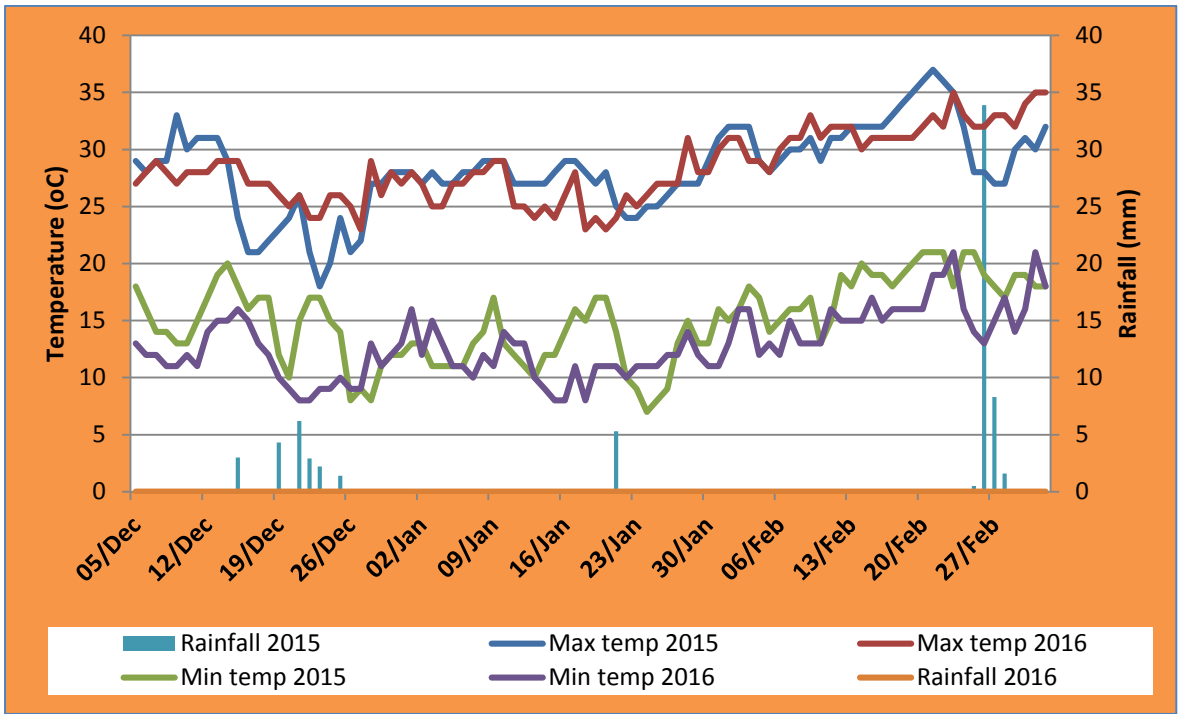

Fig. 4. Environmental variables such as temperature (^{0}C) and rainfall (mm) during the cropping season between 5th Dec to 27th February (D3)

2.3 Observations Recorded and Statistical Analysis

The yield and yield attributes were recorded before, during and after harvest of the crop. The observations recorded from five randomly selected plants from each replication on plant height (cm), number of branches per plant and tuber yield (t ha^{-1}). The tuber yield was calculated as the sum of the weights of marketable and unmarketable tubers from the net plot area and it transformed to ton per hectare (t ha^{-1}).

The benefit cost ratio (BCR) was calculated by using the following economic parameters adopting different cultivation practices:

Gross return = Tuber yield × local market price of potato tubers
Net return = Gross return – Cost of cultivation

$$\text{Benefit cost ratio (BCR)} = \frac{Gross\ return\ (Rs.ha^{-1})}{Cost\ of\ cultivation\ (Rs.ha^{-1})}$$

The Statistical data was analysed by applying the technique of analysis of variance (ANOVA) as described by Gomez and Gomez [10]. All data were subjected to separate analysis of variance (ANOVA) of individual season and a pooled ANOVA over seasons was determined by using SAS software version 9.3 applying a general linear model (GLM). Mean values were calculated and compared using F-test at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Analysis of Variance and Mean Performance of Yield and Yield Attributes of Potato Genotypes

The experiment was conducted consecutively two seasons *viz*., Rabi (2015-16) and Rabi (2016-17). The results of pooled analysis of variance (ANOVA) shown that the genotypes had significant differences for the dates of planting on yield (Table 2). Significant variations on the yield attributes were observed among the different potato varieties when planted on different date and the mean performance was mention in Table 3. The plant height was varied from 33.8 cm (Kufri Jyoti) to 36.4 cm (Kufri Pukhraj) among the varieties. The plant height of the variety Kufri Surya and Kufri Ashoka were at par *i.e*. 35.2 cm in *rabi* 2015-16. Whereas, the plant height in *rabi* 2016-17 was reduced in the same varieties as compared to the previous season. The mean

plant height was recorded 30.58, 30.50, 33.88 and 35.05 cm for the varieties Kufri Jyoti, Kufri Surya, Kufri Ashoka and Kufri Pukhraj respectively. Considering the dates of planting, it was observed that plant height was gradually reduced when the planting dates were delayed. Higher plant height was recorded 33.97 cm when planted on D1 (15th November), while it came to 31.17 cm when planted on D3 (5th December).

Higher number of branches was recorded in the variety Kufri Ashoka in both the seasons and the average number of branches was 6.14. A lesser amount of branching was observed in rabi 2016-17 in the varieties of Kufri Surya (3.96) and Kufri Pukhraj (3.89). Higher number of branching was on first date of planting as compared to the second date of planting. The number of branches per plant was found 4.93, 4.66 and 4.80 respectively for the dates of sowing on D1 (15th November), D2 (25th November) and D3 (5th December). Higher tuber yield was recorded in the variety Kufri Pukhraj in both *rabi*-2015-16 (28.37 t ha^{-1}) and *rabi*-2016-17 (35.53 t ha^{-1}) along with higher mean yield (31.95 t ha^{-1}). The mean tuber yield for the varieties; Kufri Surya, Kufri Jyoti, and Kufri Ashoka was 24.96, 26.95 and 29.15 t ha^{-1} respectively. Variety affected the number of stems per plant. The number of stems relate to numbers of branches and numbers of leaves which contributes to photosynthesis potential [4]. An increase in absorption of solar radiation can ensure a higher photosynthesis potential and promote synthesis and accumulation of reserve carbohydrates in the potato tuber which has a positive effect on the final tuber yield.

3.2 Interaction Effect of Treatments on Tuber Yield (t/ha) of Different Potato Varieties

The interaction effect was studied among the different dates of planting as main-factor and the varieties as sub-factor to identify the best variety for the concerned zone. It has been observed that the interactions between planting date and tuber yield were not significant statistically. Decreasing trend of yield was observed in all the four varieties under study, when the date of planting was delayed. All the varieties have higher yield when planted on D1 (15th November) as compared to the other two date of planting (Table 4 and Fig. 5). The comparison of tuber size of potato with different dates of planting were represented in Fig. 6. Kufri Jyoti has the tuber yield of 102.6, 98.4 and 85.5 t ha^{-1} on D1, D2 and D3 dates of planting respectively. The higher yield of Kufri Asoka was 108.9 t ha^{-1} on first date of planting. Kufri Pukhraj (112.8 t ha^{-1}) has highest yield among all the four varieties on different planting dates. Kufri Surya is a poor performer among the four varieties. The maximum yield of Kufri Surya was recorded 93.6 t ha^{-1} on first date of planting (D1: 15th November), which is less than the lowest yield of Kufri Pukhraj (100.8 t ha^{-1}) planted on third date of planting (D3: 5th December). The above study, confirmed that Kufri Pukhraj is a best performer for tuber yield in potato.

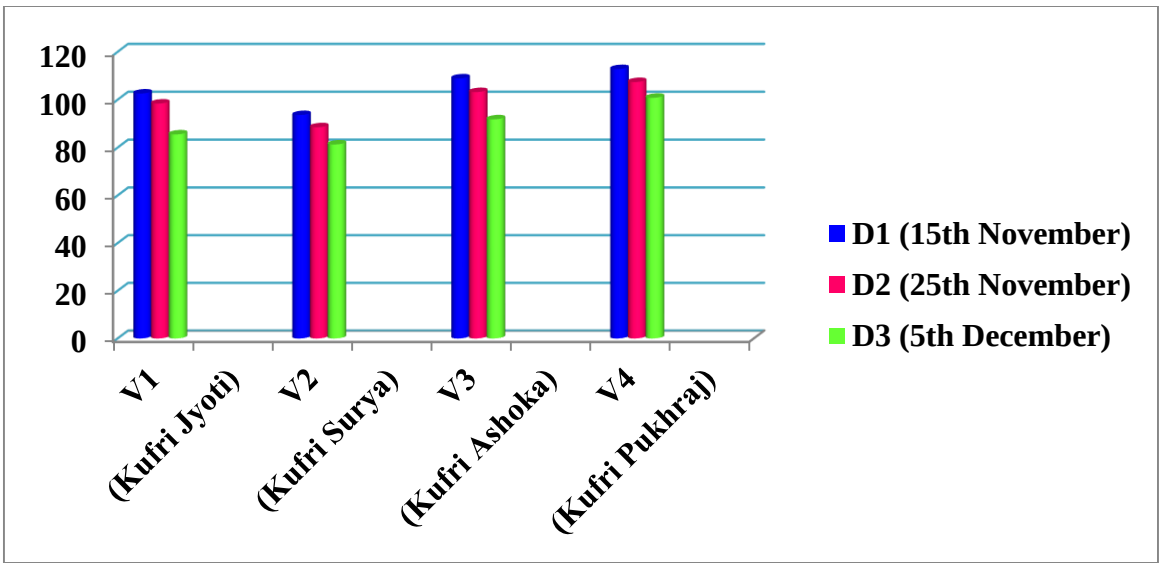

Fig. 5. Interaction effects of treatments on tuber yield of potato

Table 1. Potato genotypes and their desirable features used in the experimental studies

Sl. No.	Genotypes	Yield (t/ha)	Maturity (days)	Other features
1.	Kufri Jyoti	30	90-100 (Medium)	**Diseases:** Moderately resistant to late and early blight. Resistant to wart. Slow rate of degeneration. **Tubers:** White, large, oval, smooth skin, fleet eyes, white flesh. Tendency to crack.
2.	Kufri Surya	40	75-90 (Early)	**Diseases and pests:** Resistance to wart, hopper burn; and moderate resistance to late blight and mite. **Abiotic stress:** Heat tolerant, can be grown in areas having night temperatures up to 22^0C. **Tuber:** Medium to large, oblong, skin white, smooth, eyes shallow, eyebrows normal, flesh color pale yellow, **Dormancy:** Medium (8-10 weeks)
3.	Kufri Ashoka	30	75-80 (Early)	**Diseases:** susceptible to late blight, however it escapes late blight due to earliness. **Tuber:** Large, smooth, oval long with white skin with fleet eyes. It has waxy texture and is easy to cook.
4.	Kufri Pukhraj	40	70-90 (Early)	**Disease:** Resistant to early blight and moderately resistant to late blight. **Tubers:** White, large, oval, slightly tapered, smooth skin, fleet eyes, yellow flesh. **Dormancy:** Medium (6-8 weeks)

Table 2. Pooled analysis of variance (ANOVA) for tuber yield in potato

Source	DF	SS	MSS	F-Test	F-Tab	Significance
Total	23	415.02	18.04	8.14		
D	2	146.94	73.47*	33.15	3.44	S
V	3	202.14	67.38*	30.40	3.04	S
D × V	6	6.07	1.01	0.45	2.38	NS
Replication	2	11.11	5.55	2.50	3.44	NS
Error	22	48.74	2.21			

*Where, D= Date of planting, V= Variety, DF= Degree of freedom, SS= Sum of Square, MSS= Mean sum of square, S= Significant, NS= Non-significant and *-represents significant at 5% probability*

(a) **(b)** **(c)**

Fig. 6. The tuber size of potato after 90 days of planting with combination of varied dates of planting (D1, D2 and D3) and variety (V1, V2, V3, and V4)

The mean squares being significant are also clear evidence for the significant influence of the varying dates of planting on potato varieties. Mishra *et al*. [11] also reported similar significant differences among genotypes in their phenological and growth traits, tuber yield. Similar results were also confirmed by Fantaw *et al*. [4] and Patel *et al*. [12] on potato on yield loss increased with delay in planting because plants were subjected to lower temperature range in early period and also very short photo period as reported by Khan et al. [13] and Sandhu *et al*. [14] on planting dates of potato. Tuber yield was negatively correlated with the delayed time of planting resulting significant loss of yield (Figs 2, 3, 4, 5). The beneficial effect of early planting might be associated with the prevalence of low temperature during the tuber development stage.

3.3 Yield Economics: A Study on Benefit Cost Ratio (BCR)

The effect of different treatment combinations on yield, cost of cultivations, gross return, net return and benefit-cost ratio were discussed in Table 5. Significant variation was observed among the different treatment combinations. Higher yield (37.6 t ha^{-1}) was found in the D1V4 treatment combination, whereas lower yield (27.1 t ha^{-1}) was observed in the combination D3V2. As equal agronomical management and crop protection practices followed for all the varieties the cost of cultivation remained same for all the treatment combinations *i.e*. Rs. 118930.00. Highest gross (Rs. 300800.00) and net (Rs. 181870.00) income was obtained from the variety Kufri Pukhraj when planted on D1: 15th November with high benefit cost ratio of 2.53 as compared to the other varieties. Gog oi and Ray [1] was conducted same research on potato and recorded maximum gross return, net return and BCR when planted on 11th November as compared to the other two (11th November and 1st October) delayed time of planting. The present finding is also in accordance with the results of Baishya *et al*. [15] and Srivastava *et al*. [9] on Benefit: Cost (B: C) ratio.

Table 3. Mean performance of yield and yield attributes of potato genotypes as affected by different dates of planting

Treatments	Plant height (cm)			No. of branches/ plant			Yield (t ha^{-1})		
	2015-16	2016-17	Mean	2015-16	2016- 17	Mean	2015-16	2016-17	Mean
Genotypes:									
V1 (Kufri Jyoti)	33.8	27.36	30.58	4.3	4.22	4.26	23.37	30.54	26.95
V2 (Kufri Surya)	35.2	25.81	30.50	4.7	3.96	4.33	20.73	29.19	24.96
V3 (Kufri Ashoka)	35.2	32.56	33.88	6.1	6.19	6.14	25.97	32.33	29.15
V4 (Kufri Pukhraj)	36.4	33.71	35.05	5.0	3.89	4.44	28.37	35.53	31.95
CD (0.05)	3.35	1.38		0.58	0.9		2.56	1.58	
Dates of Planting:									
D1 (15th November)	35.9	32.05	33.97	5.3	4.56	4.93	26.25	32.13	29.19
D2 (25th November)	35.0	29.79	32.39	4.5	4.83	4.66	24.13	30.01	27.07
D3 (5th December)	34.6	27.74	31.17	5.3	4.31	4.80	23.45	33.56	28.50
CD (p=0.05)	2.12	1.2		0.37	0.78		2.272	1.37	

Table 4. Interaction effect of treatments on tuber yield (t/ha) of different potato varieties

Treatment (Main/Sub)	V1 (Kufri Jyoti)	V2 (Kufrsi Surya)	V3 (Kufri Ashoka)	V4 (Kufri Pukhraj)	Total yield	Mean yield
D1 (15th November)	102.6	93.6	108.9	112.8	417.9	34.825
D2 (25th November)	98.4	88.5	103.2	107.4	397.5	33.125
D3 (05th December)	85.5	81.3	91.8	100.8	359.4	29.95
Total yield	286.5	263.4	303.9	321	1174.8	97.9
Mean yield	31.83	29.26	33.76	35.66		

Table 5. Analysis of benefit to cost ratio for tuber yield in potato

Treatments	Yield (t/ha)	Cost of cultivation (Rs)	Gross income (Rs)	Net income (Rs)	B:C ratio
D1V1	34.2	118930.00	273600.00	154670.00	2.30
D1V2	31.2	118930.00	249600.00	130670.00	2.10
D1V3	36.3	118930.00	290400.00	171470.00	2.44
D1V4	37.6	118930.00	300800.00	181870.00	2.53
D2V1	32.8	118930.00	262400.00	143470.00	2.21
D2V2	29.5	118930.00	236000.00	117070.00	1.98
D2V3	34.4	118930.00	275200.00	156270.00	2.31
D2V4	35.8	118930.00	286400.00	167470.00	2.41
D3V1	28.5	118930.00	228000.00	109070.00	1.92
D3V2	27.1	118930.00	216800.00	97870.00	1.82
D3V3	30.6	118930.00	244800.00	125870.00	2.06
D3V4	33.6	118930.00	268800.00	149870.00	2.26
Season (Year)					
Rabi (2015-16)	34.8	118930.00	278400.00	159470.00	2.34
Rabi (2016-17)	30.5	118930.00	244000.00	125070.00	2.05

4. CONCLUSION

The present investigation revealed the existence of significant variability among different potato varieties in their tuber yield and other yield related traits. The varietal and environmental variations as well as their interaction had a considerable influence on yield and its attributes. Odisha has a sufficient command area for cultivation of potato, especially during the winter, when the climate is very suitable for the crop as the temperature of the climate remains within 30^0C. Thus, intensive efforts for cultivation of tuber are needed to resolve this crisis. The administration after consideration of the market of the agricultural products and capacity of production in local environment, should adopt measures to boost tuber cultivation. Hence, varietal performance study of potato at a certain time interval for tuber yield and other important traits should be part of the potato research program to identify the potential varieties that perform better under a wide range of agro-ecological condition. In this study, Kufri Pukhraj was identified as higher yielder and 15th November was found the best suitable planting date for north central plateau zone of Odisha, as this date given higher yield as compared to the other two dated of plating. Therefore, if a specific window of date of planting can be ascertained to the farmers of this region then it would help to cultivate potato exactly when the climatic conditions are favorable for its growth and ultimately to get a high crop yield.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCE

1. Gogoi M, Ray LIP. Performance of Winter Potato with varied dates of planting under Mid Hills of Meghalaya. Indian J Hill Farming. 2019;19-26.
2. Kanungo NC. Odisha climate, soil ideal for potato farming; 2013. Available:https://www.dailypioneer.com/2013/state-editions/odisha-climate-soil-ideal-for-potato-farming.html
3. Lutaladio N, Castaldi L. Potato: The hidden treasure. Journal of Food Composition and Analysis. 2009;22(6):491-493.
4. Fantaw S, Asrat A, Daniel T, Zenebe G, Eshetu A. Evaluation of potato (*Solanum tuberosum* L.) varieties for yield and yield components. J Hortic For. 2019;11(3):48-53.
5. Adane H, Miranda PMM, Agajie T, Willemien JML, Alfons OL, Admasu T, Paul CS. Analysis of Seed Potato Systems in Ethiopia. Am J Potato Res. 2010;87(6): 537-552.
6. Prasad R. Textbook of field crops production commercial crops volume II. Directorate of knowledge management in agriculture. ICAR, Krishi Anusandhan Bhavan I, Pusa, New Delhi. 2015;110012.
7. Belanger G, Walsh JR, Richards JE, Milburn PH, Ziadi N. Yield response of two potato cultivars to supplemental irrigation and N fertilization in New Brunswick. Am J Potato Res. 2000;77:11-21.
8. Muthuraj M, Ravichandran G. Effect of date of planting on potato seed yield in the Indian Southern Hills. Potato J. 2014;41(1): 91-93.
9. Srivastava AK, Yadav SK, Diegdoh LC, Rai R, Bag TK. Effect of varieties and planting dates on productivity of potato (*Solanum tuberosum* L.) in north eastern hill region. Environ Ecol. 2016;34(1):141-145.
10. Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley & Sons, New York., USA; 1984.
11. Mishra N, Sahoo KC, Ray M, Tudu S, Mohapatra A. Performance of potato (*Solanum tubersoum* L.) genotypes during kharif season in Keonjhar district of Odisha. Int J Chem Stud. 2020;8(5):1-4.
12. Patel DB, Patel NA Modi VM. Influence of different dates of potato planting on stem necrosis disease. Int J Plant Protec. 2010; 3(2):404-405.
13. Khan AA, Jilani MS, Khan MQ and M Zubair. Effect of seasonal variation on tuber bulking rate of potato. J Animal Plant Sci. 2011;21(1):31-37.

14. Sandhu KS, Chinna GS, Marwaha RS, Pandey SK, Kumar P, Singh RK. Effect of staggered planting and dehaulming schedule on yield and processing quality of potato cultivars in Punjab. Potato J. 2012; 39(1):39-47.

15. Baishya LK, Kumar M, Ghosh M, Ghosh DC. Effect of integrated nutrient management on growth, productivity and economics of rainfed potato in Meghalaya hills. Int J Agric Environ Biotechnol. 2013;6 (1):69-77.

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