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## Varietal response to seed tuber cutting and fungicide treatment with respect to growth and productivity of potato (*Solanum tuberosum* L.)

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### Abstract

An experiment was conducted at All India Coordinated Research Project on Potato under Odisha University of Agriculture and Technology, Bhubaneswar, Odisha during rabi, 2020-21 to study the impact of cutting and chemical treatment to seed tuber on emergence, vigour and productivity of two promising potato hybrids, Kufri Pukhraj and Kufri Surya. The experiment was laid out in split plot design with eight treatments and three replications. The eight treatments comprised of two promising varieties of the state, namely Kufri Pukhraj and Kufri Surya; two seed types *viz.* whole and cut; and two fungicides for chemical treatment *viz.* copper oxychloride and mancozeb. Data on characters like plant height, shoots/ plant, leaves/ plant, shoot dry weight / plant and root dry weight / plant were recorded from ten randomly selected plants in each plot. The total and marketable tuber yield/ ha (number and weight) were estimated from the plot yield data. Analysis of variance revealed significant difference between the two varieties with respect to all the observed characters except shoots/plant. The variation between seed types was found to be non-significant with respect to plant height (at 45 and 60 DAP), leaves/plant, total and marketable tuber yield/ ha (number and weight) but significant for emergence, plant height at 30 days, and shoot and root weight. Similarly, there was no significant difference between two chemical treatments for characters like emergence, shoots and leaves /plant (at 30, 45 and 60 DAP) and dry shoot weight/ plant but significant variation for plant height (at 30, 45 and 60 DAP), root weight, and total and marketable tuber yield. No significant interaction was found among the three factors- variety, seed type and chemical treatment for any character. Kufri Surya was found to be a better yielding variety than Kufri Pukhraj for the agro- climatic condition of Odisha. Mancozeb treatment gave better result than copper oxychloride treatment and use of whole seed tubers was found superior to cut seed tubers.

**Keywords:** Potato, variety, whole seed tuber, cut tuber, chemical treatment

### Introduction

Potato (*Solanum tuberosum* L.), belonging to the nightshade family, Solanaceae, is the world's third most significant food crop in terms of human consumption (Haverkot *et al.*, 2009). According to food security, it is a critical crop (Birch *et al.* 2012) <sup>[1]</sup>. It is essential both nutritionally and agronomically. It is a short duration and starchy tuberous crop. It is widely used as a raw ingredient in the starch industry (Faberio *et al.* 2001) <sup>[4]</sup>. It contributes low cost energy to human meals by being a rich source of starch, vitamins, especially B<sub>1</sub> and C, and minerals and can replace cereals for human consumption to a great extent. It contains 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% crude fiber and 0.9% ash (Yadav and Srivastav, 2015) <sup>[14]</sup>. The essential amino acids like leucine, tryptophan, and isoleucine are also present in high amount.

Potato is one of the principal tuber crops of the world because of its high nutritional value and high cash crop value. In India, almost all the states cultivate potato with a total production of 508.57 lakh tons (Horticulture Statistics Division, 2020) <sup>[10]</sup>. This crop is more profitable due to its higher yield potential in addition to adaptability to the diverse agro-climatic conditions of India. Generally potatoes are grown from tubers known as "seed potatoes". Sprouted seed tubers are used for planting. Purity of cultivar and healthy seed tubers with high sprouting vigour are the principal requirements for a successful crop stand. Since seed tuber is the high cost input in potato cultivation, farmers use either small whole tubers of 20-40 g or cut the large tubers (50 g or more) into two or more pieces for planting to save money on cultivation and to ensure the uniform sprouting. Each cut piece must have at least two eyes from which the sprouting occurs. The plant growth and tuber yield are affected by seed size and number of eyes per tuber (Nolte *et al.* 2003) <sup>[11]</sup>. Tubers should be cut longitudinally through the crown

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eye and the weight of cut piece should be 30-40g. Use of cut tubers help the farmers in reducing the amount of seed tuber required. Cutting of tubers is recommended before sprouting to reduce the risk of sprout damage.

Being ignorant of the importance of seed potato quality, most of the farmers of Odisha use poor quality seed material for raising the potato crop to reduce the cost of cultivation. Seed potato treatment with boric acid to harvested tubers of previous season before cold storage is seldom practiced. They use the seed tubers after cutting into pieces and plant in the field with or without seed treatment. This results in low productivity and the incidence of diseases like virus, bacterial wilt, etc is very high. The tubers should be cut longitudinally with utmost care and treated with fungicides to avoid fungal infection.

There may also be difference among varieties to cutting and seed treating chemicals. Lot of work has been done earlier to assess the effect of seed treating chemicals on growth and productivity of potato. However, the response of whole or cut potato tubers to chemicals has been found to vary from region to region. Similarly, the varieties may also react differently to cutting and seed treatment with different chemicals. With this point of view, the present investigation was carried out to study the response of a variety to cutting for the use as seed material, response of whole and cut seed potato to seed treating chemicals, and interaction of seed type, variety and chemicals for tuber productivity.

## Materials And Methods

**Experimental site:** A field experiment was conducted at All India Coordinated Research Project on Potato, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha (India) during *Rabi*, 2020-21. Geographically the field of AICRP on Potato, OUAT is located at 20° 15'N latitude and 85° 52'E longitude, about 62 km. away from Bay of Bengal with an elevation of 25.5 m above sea level. The texture of the soil in experimental field was sandy-loam and acidic in reaction (pH 5.2). The soil had 319 kg/ha available nitrogen, 34.5 kg/ ha available phosphorous, 206 kg/ha available potassium and 0.276% organic carbon content.

**Agronomy:** The field was ploughed with MB plough followed by rotavator before planting, levelled and divided into small plots of 9.0 m<sup>2</sup> area. The trial was laid out in split plot design with three replications. There were eight treatments having two varieties (Kufri Pukhraj and Kufri Surya), two seed types (whole and cut seed tuber) and two fungicides (copper oxychloride and mancozeb at a concentration of 0.25%) used for chemical treatment before planting of tubers. Seed tubers were planted on the ridges with a 60cm row to row spacing and a 20cm plant to plant spacing. After that, the seed tubers were covered with soil and lightly irrigated up to two-third ridge height. The recommended fertilizer dose of 150 kg N, 80 kg P<sub>2</sub>O<sub>5</sub> and 100 kg K<sub>2</sub>O per ha was used. Before planting, the total amount of phosphorous and 50% of potash and nitrogen were applied to the soil as basal dose. At 25 days after planting, top dressing of nitrogen and potash @ 50% each was done. Urea and Diammonium phosphate (DAP) were used to add nitrogen and phosphorus, and Muriate of Potash to add potash to the soil. Standard agronomic practices were followed to raise the crop.

**Observation and data analysis:** Data on characters like

emergence percentage, plant height, shoots/plant, leaves/plant, shoot dry weight /plant and root dry weight / plant were recorded from ten randomly selected plants in each plot. Plant emergence percentage was recorded at 30 days after planting (DAP); plant height and shoots/ plant at 30, 45 and 60 DAP; and leaves/ plant at 45 and 60 DAP. Root and shoot biomass /plant were observed after harvest. The total and marketable tuber yield/ ha (number and weight) were estimated from the plot yield data.

Analysis of data was done following Gomez and Gomez (1976) [5].

## Results And Discussion

Analysis of variance revealed significant difference between the two varieties for all of the observed growth parameters except number of shoots/plant. The interaction among all the three factors, that is, variety, seed type and chemical treatment was non- significant for all observed characters. However, significant interaction was observed between two different factors for some characters. The effect of different treatments on individual characters is mentioned below:

### Emergence

A higher emergence percentage was recorded in case of whole tuber (91.417%) as compared to cut tuber (80.750%) when used as seed (Table 1a). Emergence percentage was significantly affected due to seed type, whole or cut. The mancozeb treated whole seed tubers exhibited significantly higher emergence than cut seed tubers. Hossain *et al.* (2011) [7] reported that large sized whole tuber had highest germination index than medium and small sized whole tuber. There was significant effect of variety on emergence in our study as the variety Kufri Surya (88.808%) had higher emergence percent than Kufri Pukhraj (83.358%). The interaction between seed type and chemical treatment was found to be significant.

### Shoot height

From the experimental data, it is evident that the whole seed tubers produced higher shoot height than that of cut tubers. The seed type had significant effect on the plant height recorded at 30 DAP; however the variation was non-significant at 45 and 60 DAP. The chemical treatments i.e. copper oxychloride and mancozeb showed significant variation in plant height at 30, 45 and 60 DAP. The mancozeb treated seed tubers had higher shoot height at all the three growth stages. The plant height was significantly affected by variety and chemical treatment. The interaction between variety and seed type was also found to be significant for plant height at all the three growth stages (30, 45 and 60 DAP). The variety Kufri Surya had significantly higher plant height than that of Kufri Pukhraj.

### Shoots per plant

The whole seed tubers always produced more number of shoots (3.500 at 60 DAP) than that of cut tubers (2.892 at 60 DAP) and there was a significant variation between seed types with respect to the number of shoots at 30, 45 and 60 DAP (Table 1b). No significant variation was observed due to variety at all the observed growth stages. Although copper oxychloride treatment resulted more number of shoots over mancozeb, the difference was non significant at all the three growth stages. The interaction between seed type and chemical treatment was found to be significant at 30 and 60

DAP but the interaction between variety and chemical treatments was not significant. The interaction among variety, seed type and chemical treatments was also non significant.

### Leaves per plant

The effect of variety on the number of leaves per potato plant was found significant at both the growth stages (45 and 60 DAP). More number of leaves per plant was recorded in the variety Kufri Surya at 45 and 60 DAP than that of Kufri Pukhraj. Although higher number of leaves was noticed from the whole tubers (49.667 at 60 DAP) as compared to cut tubers (47.083 at 60DAP), the variation was statistically non-significant. The number of leaves per plant of potato crop was also not affected significantly due to the chemical treatments. The interaction between variety and seed type was found to be significant with respect to number of leaves per plant at 45 and 60 DAP. However, no significant interaction was found between variety and chemical treatments as well as seed type and chemical treatments. The interaction among variety, seed type and chemical treatments was also non significant at both the growth stages (45 and 60 DAP) of crop. According to Kushwah and Grewal (1990) <sup>[9]</sup>, whole seed tubers had higher percent of emergence, plant height, number of leaves and stems per plant.

### Shoot and root biomass

Significant difference was found between two varieties with respect to both shoot and root dry weight (g). The variety Kufri Surya had significantly higher root dry weight (1.249g) and shoot dry weight (8.017g) than Kufri Pukhraj. The cut tubers gave higher shoot dry biomass (8.100g), whereas whole tubers gave higher dry mass of root (1.133g). Mancozeb treated tubers produced higher dry shoot weight and root weight. There was significant impact of seed type on shoot biomass but not on root biomass. The chemical treatment had no significant effect on shoot biomass although it affected the root biomass significantly. The interaction between variety and seed type was found to be significant for dry weight of shoot/ plant (shoot biomass) whereas it was non-significant for root biomass.

### Tuber yield

The cut tubers, when treated with mancozeb, exhibited more number of tubers (‘000/ha) than treatment with copper oxychloride in both the varieties and the variation was found to be significant (Table 2). In terms of total yield (tons/ ha), the mancozeb treated whole tubers produced higher yield in Kufri Surya. The variety Kufri Pukhraj produced more from the mancozeb treated cut seed tubers. However, the effect of seed type on total tuber yield (number and weight) was found to be non-significant.

Higher number of tubers was produced from the variety Kufri Surya as compared to variety Kufri Pukhraj. Kufri Surya had higher tuber yield (21.953 t/ha) as compared to variety Kufri Pukhraj (15.401t/ha). The varietal difference was significant with respect to total tuber yield (number and weight) per hectare. The effect of variety on number of marketable tubers and marketable tuber yield was also significant. The whole tubers of variety Kufri Surya gave the highest marketable tuber yield with mancozeb treatment. Marketable tuber yield in the variety Kufri Surya (19.363 t/ha) was significantly higher than Kufri Pukhraj (13.442 t/ha). Higher marketable tuber yield was reported in both varieties when mancozeb was used as seed treating chemical for the cut and whole seed tuber. There was no significant effect of seed type on number and yield of marketable tubers, whereas the significant variation due to chemical treatment was noticed.

The interaction between variety and seed type was found to be significant for both total and marketable tuber yield but non-significant for number of tubers. The interactions between variety and chemical treatments, and seed type and chemical treatments were found non-significant for marketable tuber number and yield. The mancozeb treated whole and cut seed tubers of Kufri Surya gave higher yield than Kufri Pukhraj. The effect of variety, chemical treatments and the interaction between variety and seed type were found to be significant which corroborates the findings of Ing (1966), Strange and Blackmore (1990) <sup>[13]</sup>, Singh (1993) <sup>[12]</sup>, Hamouz (1996) <sup>[6]</sup> and Diop *et al.* (2019) <sup>[2]</sup>. The interaction among variety, seed type and chemical treatments was also non significant at all growth stages of crop.

**Table 1a:** Effect of variety, seed cutting and chemical treatment on potato crop growth

Treatments	Emergence percentage	Plant height at 30 days (cm)	Plant height at 45 days (cm)	Plant height at 60 days (cm)
K. Pukhraj (V1)	83.358	20.753	29.810	30.816
K. Surya (V2)	88.808	25.188	36.270	36.833
Whole seed (T1)	91.417	24.867	32.935	33.974
Cut seed (T2)	80.750	21.074	33.145	33.675
Copper Oxychloride (C1)	84.333	21.919	31.348	32.366
Mancozeb (C2)	87.833	24.022	34.732	35.283
Mean	86.08	22.97	33.04	33.82
<b>C.D. (0.05)</b>				
Variety (V)	1.168	2.469	5.327	3.771
Seed type (T)	4.233	1.575	NS	NS
Interaction V X T	NS	2.228	2.301	2.281
Chemical (C)	NS	1.575	1.627	1.613
Interaction V X C	NS	NS	NS	NS
Interaction T X C	5.987	NS	2.301	2.281
Interaction V X T X C	NS	NS	NS	NS

**Table 1b:** Effect of variety, seed cutting and chemical treatment on potato crop growth

Treatments	No. of shoots per plant at 30 days	No. of shoots per plant at 45 days	No. of shoots per plant at 60 days	No. of leaves at 45 days	No. of leaves at 60 days	Shoot weight (g) per plant	Root weight (g) per plant
K. Pukhraj(V1)	2.725	2.983	3.017	44.500	46.000	7.234	0.997
K. Surya (V2)	3.150	3.350	3.375	50.000	50.750	8.017	1.249
Whole seed (T1)	3.325	3.458	3.500	48.333	49.667	7.151	1.133
Cut seed (T2)	2.550	2.875	2.892	46.167	47.083	8.100	1.113
Copper Oxychloride(C1)	2.992	3.183	3.217	46.917	48.083	7.370	1.080
Mancozeb (C2)	2.883	3.150	3.175	47.583	48.667	7.881	1.166
Mean	2.93	3.16	3.19	47.25	48.37	7.62	1.12
<b>C.D. (0.05)</b>							
Variety(V)	NS	NS	NS	3.272	2.885	0.184	0.013
Seed type(T)	0.236	0.284	0.253	NS	NS	0.685	NS
Interaction V X T	0.334	0.401	0.358	3.919	4.029	0.969	NS
Chemical(C)	NS	NS	NS	NS	NS	NS	0.069
Interaction V X C	NS	NS	NS	NS	NS	NS	NS
Interaction T X C	0.334	NS	0.358	NS	NS	NS	NS
Interaction V X T X C	NS	NS	NS	NS	NS	NS	NS

**Table 2:** Effect of variety, seed cutting and chemical treatment on potato yield

Treatments	Total tuber yield ('000 /ha)	Total tuber yield (t/ha)	Marketable tuber Yield ('000 /ha)	Marketable tuber Yield (t/ha)
K. Pukhraj (V1)	320.833	15.401	214.121	13.442
K. Surya (V2)	420.024	21.953	300.693	19.363
Whole seed (T1)	364.699	18.522	251.852	16.239
Cut seed (T2)	376.158	18.832	262.963	16.565
Copper Oxychloride (C1)	346.065	17.459	241.666	15.316
Mancozeb (C2)	394.793	19.894	273.148	17.488
Mean	370.42	18.67	257.4	16.4
<b>C.D. (0.05)</b>				
Variety(V)	34.734	2.922	25.790	2.334
Seed type(T)	NS	NS	NS	NS
Interaction V X T	NS	1.428	NS	1.238
Chemical(C)	18.055	1.010	11.737	0.876
Interaction V X C	NS	NS	NS	NS
Interaction T X C	NS	NS	NS	NS
Interaction V X T X C	NS	NS	NS	NS

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