Evaluation of red & purple skinned advance clones suitable for Eastern Indo-Gangetic plains of India

ABSTRACT

An experiment was conducted at ICAR Central Potato Research Institute, Regional Centre,Patna,Bihar during the year 2020-2021 and 2021-2022 to evaluate 04 red skinned and 02 purple skinned advance potato clones with 05 control potatovarieties in confirmatory yield trials.Theperformance of advance clones was evaluated with respect to their yield and yield attributing traits, dry matter, nutritional status of the tubers and late blight resistance at field level. The experiment was planted in completely randomized design with 03 replications,plant to plant distance 20 cm and row to row distance 60 cm with three replications. The experiment was planted in two sets i.e. 75 days & 90 days crop. The potato clonesPS/16-02 & PS/16-17 were selected on the basis of their remarkable high marketable tuber yield (30.16 t/ha & 25.81 t/ha at 90 days respectively). The nutritional status of the tuberswere high, tuber shape ovoid to round, colour purple (PS/16-02) & red (PS/16-17), shallow eyes and good organoleptic qualities. The dry matter content of these selected clones was 20.17 & 20.42 respectively. The aim of the experiment was to evaluate the performance of advance clones for the above mentioned traits and to select suitable advance clones for introduction in All India Coordinated Research Project on Potato.

KEYWORDS: Advance clones, control varieties, dry matter, confirmatory yield trial, tuber yield, nutrients.

INTRODUCTION

Potato (*Solanum tuberosum* L) is starchy vegetable crop grown throughout the world. It is important vegetable crop accounted as third most important food crop after wheat and rice (Haverkort*et.al*, 2009) important constituent of our diet.Potatoes were introduced in Europe during 1570s within a short span of time. This important vegetable gained popularity and spread to whole Europe as well as different parts of the world (Hawkes and Francisco Ortega, 1993; Pandey and Kaushik 2003). It yields higher nutrition food per unit space and time under favourableclimatic conditions as compare to the other major food crops (Dalamu*etal.* 2019). That is very good source of carbohydrate, fibre, vitamin B6, C and minerals like iron, zinc, potassium, magnesium etc. Its dry matter, protein and energy make it extra ordinary as compared to other vegetables (Kabira and Lemaga, 2003).

In eastern Indo-Gangetic plains of India the duration of potato crop ranges from 75-100 days and it includes early, medium and late maturing varieties. The red skinned varieties are more preferred in this region over white skinned potato varieties. The crop is grown during *Rabi* season. The most preferred temperature for the growth of potato crop is 15-20°C with short photo period 10 to 12 hours a day from October to February (Hirdesh Kumar etal. 2023). The potato produces more energy and food per unit area than other important food crops. It is also a healthy food free from fats(Lutaladioand Castaldi, 2009). This crop is decorated with most of the nutrients like carbohydrate, proteins, vitamins, minerals, and dietary fibre (Mulatu *et al.* 2005). Potato is cultivated throughout India under diverse Agro climatic conditions varying from temperate high hills to subtropical plains.It was introduced by Europeans over 400 years ago during the beginning of 17th century by Portuguese traders as it was staple vegetable crop in the Europe. Nowadays, it occupies the rank of staple food crop in our country and become a common household item. It is economic in price, good source of energyavailable throughout the year. The crop is versatile food crop and it is able to fight with hunger and malnutrition. The year 2008 was declared as International Year of Potato by United Nations in highlight the importance of potatoes global food security and poverty eradication (https://www.un.org, 2021). In potato on weight basis, 80% is water, 2% is protein 18% is starch and minerals. The global potato production is 371.14 million tonnes. India approximately contributes 13% of global potato acreage with 48.56 milliontonnes of production (FAOSTAT, 2020).

There is a need of a time to develop nutrient rich varieties in order to fight with the hunger and malnutrition. As we know that potato is a staple vegetable crop in our country. A number of varieties, e.g. Kufri Neelkanth, Kufri Lohit, Kufri Manik were released and they are rich in Anthocyanin, ascorbic acid, carotenoids and zinc and Iron. The work of developing advance potato clones which are nutrient rich through conventional breeding, hybridization followed by phenotypic selection from F_1 to F_1C_5. The aim of the study was to evaluate advance potato clones, which are superior over control varieties in different

parameters like tuber yield, nutritionally rich (Zn & Fe) with high dry matter, resistance to diseases, shallow eyed and with coloured skin etc.

MATERIALS AND METHODS

1. Planting materials

The material in this study were 6 advance clones of potato namely PS/16-02, PS/16-17, PS/16-19, PS/16-20, PS/16-22 and PS/16-34 along and five control potato varieties Kufri Keshar, Kufri Lalit, Kufri Lohit, Kufri Manik and Kufri Neelkanth.

2. Location of Experiment

The experiment was conducted at experimental field of ICAR-CRPI RS Patna during the year 2021-22 & 2022-23. The advance clones were planted as per the standard experimental design during *Rabi* season. The cropping season starts from November and ends during last week of February with the harvesting of the crop.

3. Experimental Design& Planting details

The design of the experiment was completely randomized plot design and the planting details are given below –

Planting details:	**:**	**Crop Year 2021-22**	**Crop Year 2022-23**
Experiment Name	:	**CYT-1**	**CYT-2**
Date of planting	:	15/11/2021	13/11/2022
Date of harvesting	:	23/02/2022 to 25/02/2022	21/02/2023 to 22/02/2023
No. of total entries	:	8	6
No. of selected hybrids	:	6	2
Duration	:	75 & 90 Days	75 & 90 Days
Plot size	:	7.2 m^2	7.2m^2
Reps.	:	3	3
Controls	:	5	7

4. Field preparation

A well prepared field is pre-requisite for conducting an experiment. In case of potato a well prepared field obtained by deep ploughing (20-25 cm deep) with soil turning plough followed by 2-3 cross harrowing andleveling. It plays very important role in obtaining good tuberization in the crop. Leveling helps in moisture retention in the field obtained from the retreating rainfall. If the retreating monsoon is weak then the crop can be sown by giving by pre-sowing irrigation(*palava*).

5. Seed size, seed rate and spacing

Tubers with 30 to 50 g weight are most suitable for conducting the experiment. In this experiment, whole tubers of above mentioned size were planted on the ridges. The plant to plant distance 20 cm and row to row distance was 60 cm. The experiment was planted in 3 replications, 4 rows each of 3m length (plot size 7.2m^2). A shallow irrigation is required for even germination of the crop.

6. Manure and fertilizers

Potato crop requires 180: 60:80 (N: P: K) doses for good tuberization and better yield. Half doses of Nitrogen with full dose of Potassium & Phosphorous were applied at during land preparation as a basal dose. To maintain the level of micro fauna in the soil 22-25 tonnes/ha of well decomposed farmyard manure/compost is required in this crop. A healthy timely sown crop produces about 35 to 40 tonnes tubers per hectare (*Chhidda Singh, 2001*).

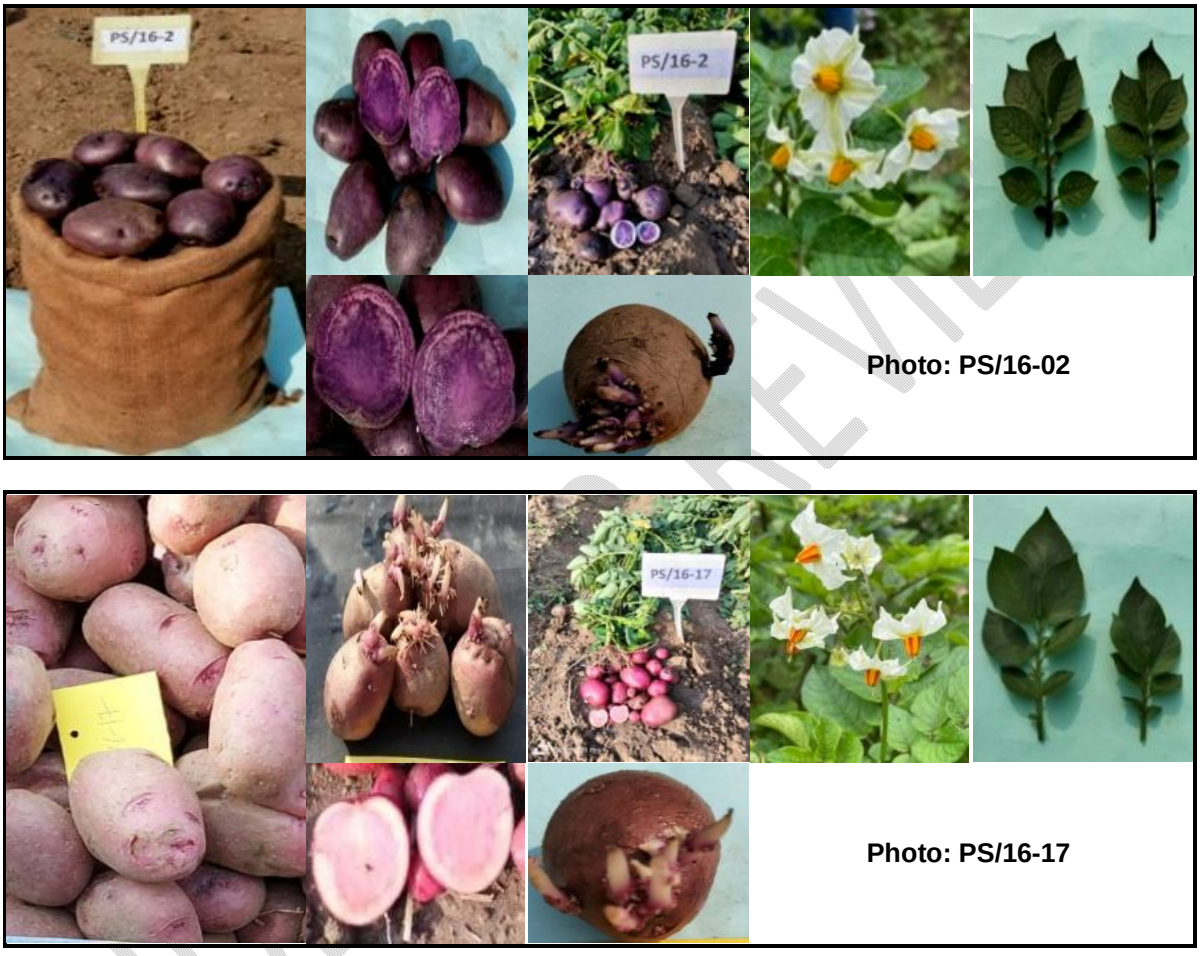
7. Method of planting

The experiment was planted as per the layout. Tubers were planted on the ridges, made with the help of tractor driven ridge-maker. The planting of potato tubers was done manually with the help of *khurpi*at a depth of 7-8 cm followed by covering with the soil and light irrigation.

8. Inter culture operations

Inter culture operations play important role in this crop, timely operations help better tuberization in the crop. Early stage weeds are controlled by weedicide Oxflurofen 23.5% EC (500 ml/ha) spray

during pre-emergence stage. Hand weeding was done 25 days after planting followed by remaining half dose of Nitrogen in the form of urea in side of the furrows.Earthing up operation was done after application of urea in order to get better tuberization in the crop. In this crop 4-5 irrigations 10-15 days interval were given as per the requirement. To control the incidence of late-blight during month of December & January one prophylactic spray of Mancozeb 75WP followed by 2 sprays of Cymoxanil 8% + Mancozeb 64% WP were done. As sucking pest like aphids and white flies are the prime vectors for spread of viral diseases in this crop, were controlled by spray of Imidacloprid 17.8% SL 45-50 days after planting.



Pic 1-Photographs of red & purple skinned advance stage hybrids introduced in AICRP (P) trials

DATA COLLECTION AND RECORDING

The important observations were recorded for plant emergence (%), foliage maturity (%), total tuber yield (t/ha), marketable tuber yield (t/ha), dry matter (%) and disease reaction (%) were recorded at different physiological stages of the crop. The primary observations before planting of the crop were counting of tuber numbers required per plot were done. Then seed wt. per plot (in kg) was calculated at planting. Plant emergence (%) at 30 days after planting by counting of total number of tubers germinated per plot, incidence of major viral diseases were recorded time to time as per their appearance. Foliage senescence data was recorded from 60 days after planting to 90 days after planting at interval of 10 days. At the time of harvesting of the crop tuber rottage (kg) per plot was recorded. Total & marketable tuber yield (kg/plot) with marketable tuber yield consisting big-medium tubers haulms weight (%) & tuber dry matter (%) were estimated within a week after harvesting in both 75 & 90 duration crops.

Formulas:

1. Plant emergence (%) = $\frac{\text{No. of germinated plants per plot}}{\text{Total no. of plants per plot}}$ x 100

2. Foliage senescence (%) = $\frac{\text{No. of plants with 75\% foliage maturity per plot}}{\text{Total no. of plants per plot}}$ x 100

3. Total tuber yield (t/ha) = $\frac{\text{Total wt. (kg) of all sized tubers per plot}}{\text{Plot size } (m^2)}$ x 10

4. Marketable tuber yield (t/ha) = $\frac{\text{Total wt. (kg) of large to medium sized tubers per plot}}{\text{Plot size } (m^2)}$ x 10

5. Tuber dry matter (%) = $\frac{\text{Wt. of sliced potatoes after 72 hrs oven dried followed by shade drying}}{\text{Wt. of fresh harvest potatoes}}$ x 100

6. Haulm dry wt. (%) = $\frac{\text{Fresh wt. of haulms per plot after dehaulming}}{\text{Wt. of dried haulms per plot at harvesting}}$ x 100

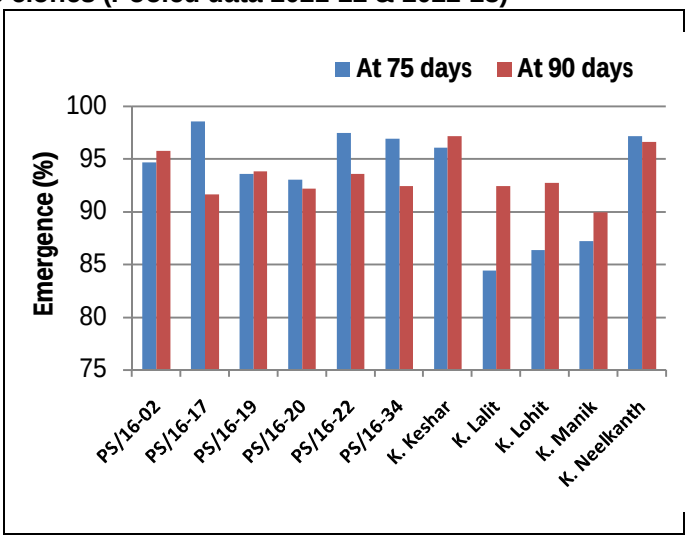
Foliage maturity was recorded at 60 days after planting and continues up to 90 days after planting. The data on this parameter was recorded atan interval of 10 days. To determine the marketable yield, very small tubers were sorted out from the total tuber yield.The marketable tuber yield consists of Big (≥80g) medium (79-50g) and small (49-25g)tubers.

RESULT AND DISCUSSION

1. **Plant Emergence:** Data were recorded for plant emergence, 25 days after planting (Table-1). The plant emergence ranged from 98.61% (PS/16-17) to 84.45% (K.Lalit) in 75 days crop. In the experiment planted for evaluation in 90 days crop the range was 97.23% (K.Keshar) to 90.00% (K.Manik).

Table &Fig.1: Plant Emergence of advance clones (Pooled data 2021-22 & 2022-23)

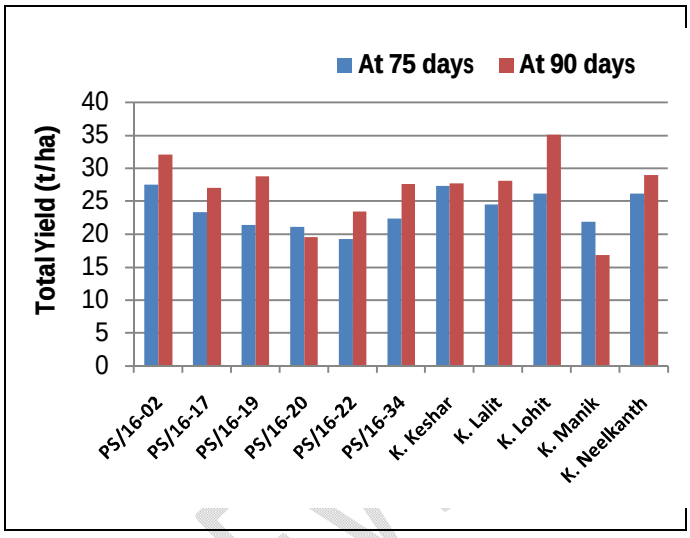
Advance clones /Varieties	Emergence (%)	
	At 75 days	At 90 days
PS/16-02	94.73	95.83
PS/16-17	98.61	91.67
PS/16-19	93.61	93.89
PS/16-20	93.06	92.22
PS/16-22	97.50	93.62
PS/16-34	96.95	92.50
K. Keshar	96.11	97.23
K. Lalit	84.45	92.50
K. Lohit	86.39	92.78
K. Manik	87.23	90.00
K. Neelkanth	97.22	96.67
CD (0.05)	4.40	4.28
CV (%)	2.74	2.66



2. **Total tuber yield:** The total tuber yield was recorded maximum in PS/16-02 (27.62 t/ha) followed by K.Kesar (27.35 t/ha) in 75 days crop experiment. In the 90 days crop experiment the total tuber yield was highest in K.Lohit (35.14 t/ha) followed by PS/16-02 (32.14 t/ha) (Table-2).

Table & Fig. 2: Total tuber yield of advance clones (Pooled data 2021-22 & 2022-23)

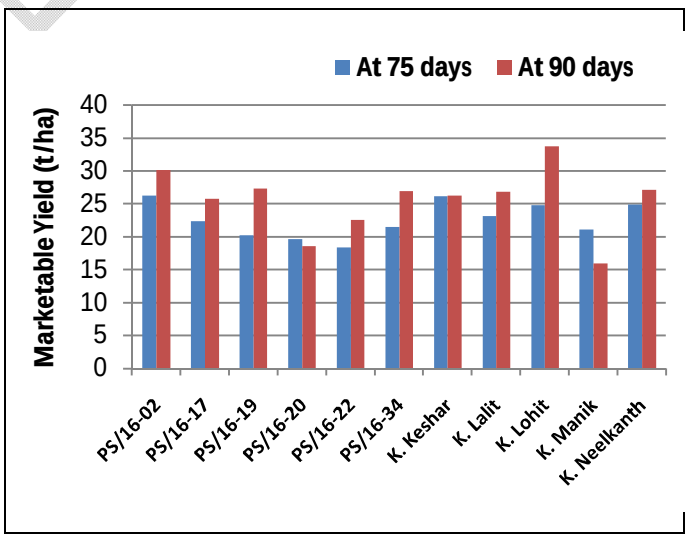
Advance clones /Varieties	Total tuber Yield (t/ha)	
	At 75 days	At 90 days
PS/16-02	27.62	32.14
PS/16-17	23.44	27.10
PS/16-19	21.45	28.88
PS/16-20	21.19	19.63
PS/16-22	19.29	23.53
PS/16-34	22.41	27.67
K. Keshar	27.35	27.72
K. Lalit	24.61	28.15
K. Lohit	26.23	35.14
K. Manik	21.92	16.87
K. Neelkanth	26.25	29.03
CD (0.05)	3.82	5.68
CV (%)	9.52	12.59



3. **Marketable tuber yield:** The marketable tuber yield was recorded after subtraction of weight of very small tubers from the total tuber yield. In 75 days crop marketable tuber yield was maximum in PS/16-02 (26.29 t/ha) significantly superior over planted control varieties. In the 90 days crop highest marketable tuber yield was recorded in PS/16-02 (31.16 t/ha) followed by PS/16-19 (27.41 t/ha), PS/16-34 (26.41 t/ha), PS/16-17 (25.81 t/ha) & PS/16-22 (22.61 t/ha), significantly at par with the most of the control varieties (Table-3).

Table & Fig. 3: Marketable tuber yield of advance clones (Pooled data 2021-22 & 2022-23)

Advance clones /Varieties	Mkt. Yield (t/ha)	
	At 75 days	At 90 days
PS/16-02	26.29	30.16
PS/16-17	22.45	25.81
PS/16-19	20.30	27.41
PS/16-20	19.69	18.62
PS/16-22	18.48	22.61
PS/16-34	21.59	26.97
K. Keshar	26.21	26.28
K. Lalit	23.17	26.86
K. Lohit	24.88	33.78
K. Manik	21.19	16.04
K. Neelkanth	24.98	27.17
CD (0.05)	3.62	5.29
CV (%)	9.53	12.31



4. **Dry Matter:** The dry matter content plays very important role in selection of clones. The range varies from 18.92% (PS/16-19) to 15.25% (K. Lohit). In 90 days crop it varies from 20.42 (PS/16-17) to 17.17% (PS/16-20). The dry matter performance of PS/16-17 was at par with PS/16-02 and these were significantly superior over the planted control varieties.

Table & Fig. 4: Dry Matter content of advance clones (Pooled data 2021-22 & 2022-23)

Advance clones /Varieties	Dry Matter(%)	
	At 75 days	At 90 days
PS/16-02	16.84	20.17
PS/16-17	17.84	20.42
PS/16-19	18.92	19.00
PS/16-20	16.00	17.17
PS/16-22	17.48	18.59
PS/16-34	18.67	19.08
K. Keshar	17.33	18.34
K. Lalit	18.42	19.92
K. Lohit	15.25	17.25
K. Manik	16.92	18.33
K. Neelkanth	16.42	18.17
CD (0.05)	0.88	1.01
CV (%)	3.02	3.22

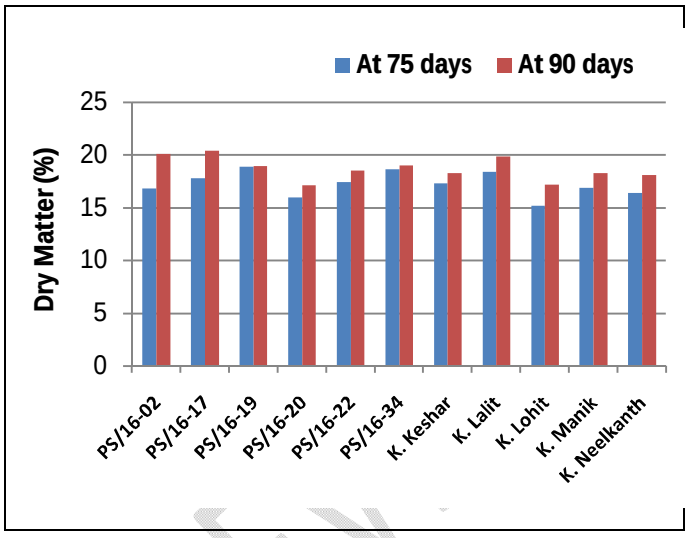


Table 5: Nutritional components in advance clones (Pooled data 2021-22 & 2022-23)

Advance Clone/ varieties	Zn (ppm)	Fe (ppm)	Carotenoid (g/100 gram fresh weight)	Anthocyanin (mg/100 gram fresh weight)	Vitamin C (mg/100 gram fresh weight)
PS/16-02	28.71	42.57	67.10	29.38	52.67
PS/16-17	24.41	48.40	73.85	7.79	50.65
PS/16-19	25.29	49.51	67.50	11.48	43.76
PS/16-22	27.28	50.87	109.50	22.07	42.35
PS/16-34	27.65	49.13	73.70	5.75	31.64
K.Kesar	31.70	41.88	150.80	0.46	39.71
K.Lalit	27.48	34.85	136.90	0.94	24.12
K.Lohit	26.15	41.40	124.00	0.84	28.89
K.Manik	26.55	44.79	79.05	0.93	31.54
K.Neelkanth	25.25	38.64	85.30	1.00	30.81

CONCLUSION

Medium maturing red and purple skinned advanced clones PS/16-02 and PS/16-17 were suitable for table potato with attractive, red &purple colour, with purple flesh and light red flesh colours respectively. The yieldperformance of these clones were significantly superior or at par with the planted control varieties during 75 & 90 days crop. The tubers were round in shape with shallow eyes. The organoleptic qualities of these clones were mealy texture; pleasant flavour and the colour retention of these clones were excellent after boiling of the tubers. The average cooking time of these clones were 15-18 minutes. High Anthocyanincolourationwill promote the acceptance of these clones among the consumers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that no generative AI technologies such as large language models (chat, GPT, COPILOT etc) and text-to-image generators have been used during writing or editing of this manuscript.

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