Plant Archives Vol. 25, Supplement 2, 2025 pp. 2787-2794 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.356

EVALUATION OF ADVANCE CLONES OF POTATO (*SOLANUM TUBEROSUM* L.) FOR TUBER YIELD AND DRY MATTER CONTENT

Sarla Yadav[1], S.K. Luthra[2], Vinod Kapoor[3], S.P. Singh[1], R.K. Singh[1], Jagdev Sharma[3], Som Dutta[3] and Brajesh Singh[3]

[1] ICAR- Central Potato Research Institute Regional Station, Patna, Bihar- 801 506, India

[2] ICAR- Central Potato Research Institute Regional Station, Modipuram, Meerut, U.P.-250 110, India

[3] ICAR- Central Potato Research Institute, Shimla, H.P.- 171 001, India

*Corresponding author email: sarlayadavbhu@gmail.com

(Date of Receiving : 11-05-2025; Date of Acceptance : 12-07-2025)

ABSTRACT

An experiment was conducted at ICAR- Central Potato Research Institute Regional Station Patna, Bihar during the year 2020-21, 2021-22 & 2022-23. Thirteen advance clones viz. PS/16-02, PS/16-17, PS/16-19, PS/16-20, PS/16-22, PS/16-34, PS/17-09, PS/17-11, PS/17-12, PS/17-15, PS/17-19, PS/17-20, PS/17-22 along with five controls viz; Kufri Lohit, Kufri Manik, Kufri Lalit, Kufri Kesar and Kufri Neelkanth.In the present scenario Potato is most consumed vegetable crop in India. As per the nutritional profile, potatoes are rich source of carbohydrate, proteins, vitamins (vitamin C, B6) and minerals Fe, Zn and Folate (Robertson et al. 2018). Nowadays, coloured potato varieties are gaining people attention due to enhanced nutrient rich compounds like Anthocyanin, Carotenoids etc. The Anthocyanins gives attractive colour to the potato clones. The important anthocyanin pigments are red, purple pink, dark, purple, blue, reddish purple etc. The carotenoids are present in the flesh part of the potato, these may be white, light yellow, dark yellow, red, pink, purple, dark purple etc. potatoes also contain a significant amount of minerals like iron and Zinc (Burgos et al. 2007). The objective of this study was evaluation of these advance clones suitable for cultivation in eastern Indo Gangetic plains of India

***Keywords*:** Potato, Advance Clones, Control varieties, Anthocyanins, Carotenoids

Introduction

Potato is daily consumed vegetable crop in India. The important states involved in its cultivation are Uttar Pradesh, West Bengal and Bihar, Gujarat, Madhya Pradesh, Punjab, Assam, Haryana, Jharkhand and Chhattisgarh. In the 2021-22 agricultural year, India produced 53.03 million tons of potatoes from 2.16 million hectares, with an average yield of 24.55 tons per hectare (FAOSTAT, 2021). As per the nutritional profile, potatoes are rich source of carbohydrate, proteins, vitamins (vitamin C, B6) and minerals Fe, Zn and Folate (Lutha *et al.*, 2001). Nowadays, colored potato varieties are gaining people attention due to enhanced nutrient rich compounds viz., Anthocyanin and Carotenoids. The anthocyanin pigments give attractive skin colour to the potato clones. These pigments are red, purple, pink, dark purple, blue, reddish purple etc. The carotenoids Contribute colour to the fresh part of the potato and it varies from white, light yellow, dark yellow, red, pink, purple, dark purple etc. potatoes also contain a significant amount of minerals like iron and Zinc (Burgos et al. 2007). The advance clones under study were obtained after hybridization during the year 2016 and 2017. The hybridization work was done at ICAR Central Research Institute Kufri-Fagu Unit Shimla, Himachal Pradesh These were selected from seedling to initial clonal generations and evaluated in IET, PYT, CYT1 and CYT2. The experiment was planted in completely random block design with three replications at ICAR Central Research Institute, Regional station, Patna, the years 2020-21, 2021–22 and 2022–23. These clones were established and selected from initial generations to the advanced generations on the basis of their consistent better performance over popular potato control varieties under study. As we know that potato a cool season crop, so these were planted during *Rabi* season. The objective of this study was breeding and selection of superior advance potato clones suitable for cultivation in Eastern Indo Gangetic plains of India

Materials and Methods

Potato is a cool season crop (Khurana *et al*., 2003). It performs best in cool reasons with sufficient moisture and fertile soil. The well-prepared field is required for conducting the successful experiment. It performs well if soil temperature range is between 17-19^{0}C because this temperature is favourable for crop growth as well as favours the tuber initiation and development (Luthra *et al*., 2001). Potato can be grown on wide range of soils from sandy loam, silt loam and clayey soils. The well drained field is prerequisite for conducting the experiment as well for planting of the crop. The soil pH ranges from 5.0-6.5 are suitable for potato crop cultivation (Chhidda Singh, 2001).

Planting Materials

The material in this study were thirteen advance clones of potato viz. PS/16-02, PS/16-17, PS/16-19, PS/16-20, PS/16-22, PS/16-34, PS/17-09, PS/17-11, PS/17-12, PS/17-15, PS/17-19, PS/17-20, PS/17-22 along with five control varieties of potato viz; Kufri Lohit, Kufri Manik, Kufri Lalit, Kufri Kesar and Kufri Neelkanth.

Location of Experiment

The experiment was conducted at crop improvement experimental field of ICAR-CRPI RS Patna during the year 2020-21, 2021-22 & 2022-23. The advance clones were planted as per the standard approved technical programme of Institute Research programme "Breeding for Table Potatoes", Project entitled "Breeding medium maturing red skinned potato varieties for eastern plains" from November 10-15, 2020-21 & November 8-12, 2021-22 and 10-15 November, 2022-23 during *Rabi* season. The cropping season starts from November and ends during last week of February with the harvesting and storage of seed tubers of the crop.

Experimental Design

The design of the experiment was Completely Randomized Block Design with three replications in two experiments varying in days of harvesting i.e. experiment harvested with 75 days after planting and 90 days after planting. All advance clones along with control varieties were planted in 5 rows of 12 tubers (3.0 m x 2.4 m) with the area 7.8 m^2.

Field preparation **Planting of advance clones** **Crop stand** **Harvesting**

Plate 1: Interculture operations

Field Preparation

A well-prepared field is mandatory for good crop growth and development. Potato crop is planted as early, medium (Timely) and late (Rukundo *et al*., 2020). This experiment was done to evaluate medium maturing red and purple skinned potato advance clones. For successful experiment field was prepared by deep ploughing (20-25 cm deep) with the help of soil turning plough, followed by 2-3 cross harrowing and 2-3 shallow ploughing with leveling of the field. Good tuberization of the potato crop needs a well-prepared field during cultivation of the crop. Planking is very important cultural practices to retain the available moisture in the field, which plays important role at the time of sowing and helps better and even germination of the crop (Singh *et al*., 2014).

Seed Size, Seed Rate and Spacing

Tubers with 30 to 50 g weight are ideal for planting of the crop (Hirdesh *et al*., 2003). In this experiment, whole tubers of standard size were planted on the ridges. The plant-to-plant distance was 20 cm and row to row distance was 60 cm. After planting of the crop, light irrigation was given in the field in order to promote good and even germination of the tubers (Luthra *et al*., 2001)

Manure and Fertilizers

Potato crop is a heavy feeder crop, it requires high doses of fertilizers i.e. 180:80:100 (N: P: K). Along with these fertilizers farm yard manure plays important role to maintain this soil structure and population of beneficial microflora and fauna (Luthra *et al.*, 2001). In the potato crop 25-30 tones/ha well decomposed farmyard manure was applied for getting better crop growth and tuber yield. This FYM was applied during land preparation and given enough time to mix well in the soil. Whereas chemical fertilizers like Nitrogen in the form of Urea, Phosphorous in the form of DAP and Potassium in the form of MOP were applied as basal dose (1/2 N: P: K). the remaining dose of nitrogen was applied after earthing up operation that is 25-30 days after planting (Subarta, 1997).

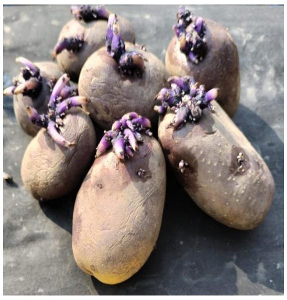
Method of Planting

The tubers were planted on the ridges. These ridges were made after land preparation with the help of tractor driven ridge-maker or with the help of Spade manually. For conducting the experiment Bed cutting (3mx60cmx 5 lines) was done as per layout of the experiment. The planting of potato tubers was done with the help of *khurpi* at the depth of 7-8 cm followed by covering of the tubers with surrounding soil. Light irrigation was given just after planting of the experiment for better germination of the experimental material.

Inter Culture Operations

Inter culture operation plays important role in the expression of yield and yield attributing traits. Weeds are major problems in the potato crop. The important weeds are Moth grass, Gajar ghaas, Palak grass, *Trifolium spp.etc.* After planting of the crop, weedicide Oxflurofen 23.5% SC (500 ml/ha) was sprayed at pre-emergence stage. In order to control prolific growth of weeds in the field during germination of the crop. All inter culture operations like weeding, earthing up etc. were done manually as per requirement of the crop. After hoeing remaining half dose of Nitrogen in the form of Urea was applied in side of the furrows and then earthing up was done in order to get better nutrition to support tuberization in the crop. In potato crop 4-5 irrigations at an interval of 10-15 days were given to meet the moisture requirement of the crop. Irrigation interval may vary as per requirement and level of moisture present in the field. Late blight of potato is very harmful disease in this crop as it affects leaves, stems, tubers etc (Singh *et.al.*, 2014). This disease spreads very fast under congenial environment and if not controlled timely then it may destroy whole crop. This disease was controlled by one prophylactic spray of Mancozeb 75WP followed by 2 sprays of Cymoxanil 8% + Mancozeb 64% WP at an interval of 15 days. For control of as aphids and pest such as potato leaf cutters, cutworms etc. Imidacloprid 17.8% SL was sprayed in 45 days crop.


PS/16-02


PS/16-34


PS/17-12

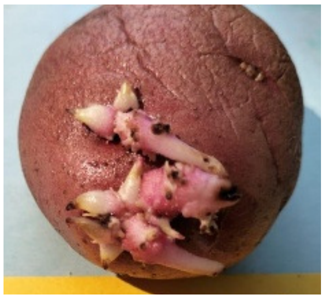

PS/17-09

Plate 2: Sprouted tubers of advance clones

Data collection and recording

The important observations were recorded for range of plant emergence (%), Total Tuber Yield (t/ha), Marketable tuber yield (t/ha) and dry matter (%). The other important observations like Plant Emergence (%), total tuber yield (t/ha), marketable tuber yield (t/ha), dry matter (%) and Dry matter (%) were recorded at different physiological stages of the crop. Plant emergence was recorded at 30 days after planting by counting and calculation of percentage with germinated tubers over total planted tubers per plot, Total Marketable yield was calculated by weighing of the whole produce harvested from a plot & designated as total marketable yield per plot. The marketable tuber yield (kg/plot) was recorded by substraction of the very small grade tubers from the total marketable yield of the plot as marketable yield per plot. Dry matter was calculated by keeping 200g fresh tubers during the harvesting from each replication. These tubers were cut into small pieces followed by 72 hours drying in hot air oven. After drying of the cut potatoes these were weight on the electronic balance. The measured cut tuber weight of the dry matter (%) of the respective advance clones and varieties.

Formula

$$\text{Tuber yield (t/ha)} = \frac{\text{weight of the tubers per plot}}{\text{Area of the plot}} \times 10000$$

$$\text{Dry matter (\%)} = \frac{\text{Weight of the cut oven, dried potato}}{\text{Fresh weight of the potato}} \times 100$$

Result and Discussion

Data interpretation and analysis

Plant Emergence:

Data were recorded for plant emergence, 25 days after planting (Table-1). The plant emergence ranged from 86.39% (K. Lohit) to 97.78% (PS/17-19) in 75 days crop. In the experiment planted for evaluation in 90 days crop the range was 90.00% (K. Manik) to 98.89% (PS/17-19).

Total tuber yield:

The total tuber yield was recorded maximum in PS/17-09 (30.64 t/ha) followed by PS/17-12 (30.42 t/ha) in 75 days crop experiment. In the 90 days crop experiment the total tuber yield was highest in PS/17-09 (36.88 t/ha) performed better than the controls followed by PS/17-20 (32.75 t/ha) and PS/16-02 (32.14), PS/17-12 (31.82), PS/17-11 (30.61) performed significantly at par with the controls. (Table-2).

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/17-09 (29.56 t/ha) significantly superior over planted control varieties. In the 90 days crop highest marketable tuber yield was recorded in PS/17-09 (34.96 t/ha) followed by PS/17-20 (30.21 t/ha), PS/16-02 (30.16 t/ha) significantly at par with the most of the control varieties (Table-3).

Table & Fig. 1: Plant Emergence of advance clones (Pooled data 2020-21, 2021-22 & 2022-23)

Advance clones /Varieties	Emergence (%)	
	At 75 days	At 90 days
PS/16-02	94.26	95.83
PS/16-17	96.85	91.67
PS/16-19	93.61	93.89
PS/16-20	93.52	92.22
PS/16-22	96.48	93.62
PS/16-34	96.48	92.50
PS/17-09	95.00	97.23
PS/17-11	95.00	97.23
PS/17-12	94.52	97.50
PS/17-15	95.93	95.28
PS/17-19	97.78	98.89
PS/17-20	96.67	96.95
PS/17-22	97.04	97.78
K. Keshar	96.11	97.23
K. Lalit	88.70	92.50
K. Lohit	86.39	92.78
K. Manik	89.78	90.00
K. Neelkanth	96.85	96.67
CD (0.05)	3.92	4.28
CV (%)	2.47	2.66

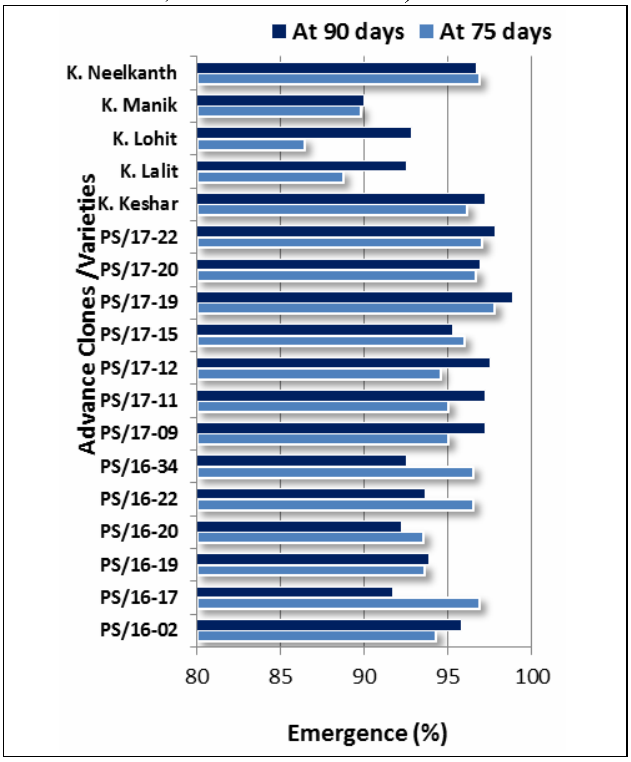


Table & Fig. 2: Total tuber Yield (t/ha) of advance clones (Pooled data 2020-21, 2021-22 & 2022-23)

Advance clones /Varieties	Total tuber Yield (t/ha)	
	At 75 days	At 90 days
PS/16-02	26.44	32.14
PS/16-17	24.70	27.10
PS/16-19	21.45	28.88
PS/16-20	22.15	19.63
PS/16-22	20.30	23.53
PS/16-34	24.20	27.67
PS/17-09	30.64	36.88
PS/17-11	27.23	30.61
PS/17-12	30.42	31.82
PS/17-15	26.13	26.44
PS/17-19	27.83	26.65
PS/17-20	26.68	32.75
PS/17-22	28.19	30.85
K. Keshar	27.35	27.72
K. Lalit	23.76	28.15
K. Lohit	26.23	35.14
K. Manik	22.68	16.87
K. Neelkanth	24.94	29.03
CD (0.05)	3.28	5.68
CV (%)	8.26	12.59

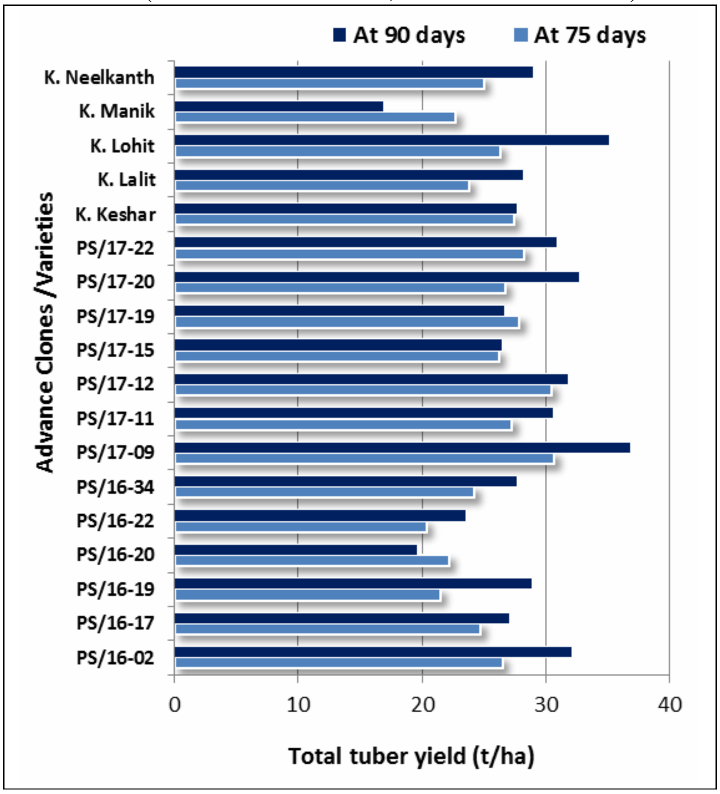
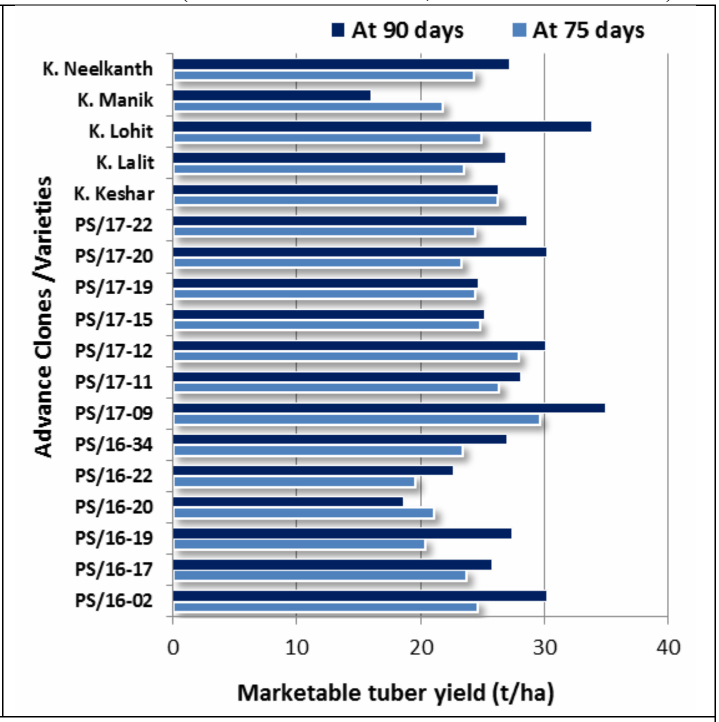


Table & Fig. 3: Marketable tuber Yield (t/ha) of advance clones (Pooled data 2020-21, 2021-22 & 2022-23)

Advance clones /Varieties	Mkt. tuber Yield (t/ha)	
	At 75 days	At 90 days
PS/16-02	24.53	30.16
PS/16-17	23.65	25.81
PS/16-19	20.30	27.41
PS/16-20	21.03	18.62
PS/16-22	19.54	22.61
PS/16-34	23.31	26.97
PS/17-09	29.56	34.96
PS/17-11	26.32	28.05
PS/17-12	27.85	30.07
PS/17-15	24.74	25.13
PS/17-19	24.41	24.70
PS/17-20	23.28	30.21
PS/17-22	24.32	28.59
K. Keshar	26.21	26.28
K. Lalit	23.41	26.86
K. Lohit	24.88	33.78
K. Manik	21.72	16.04
K. Neelkanth	24.26	27.17
CD (0.05)	3.13	5.29
CV (%)	8.29	12.31



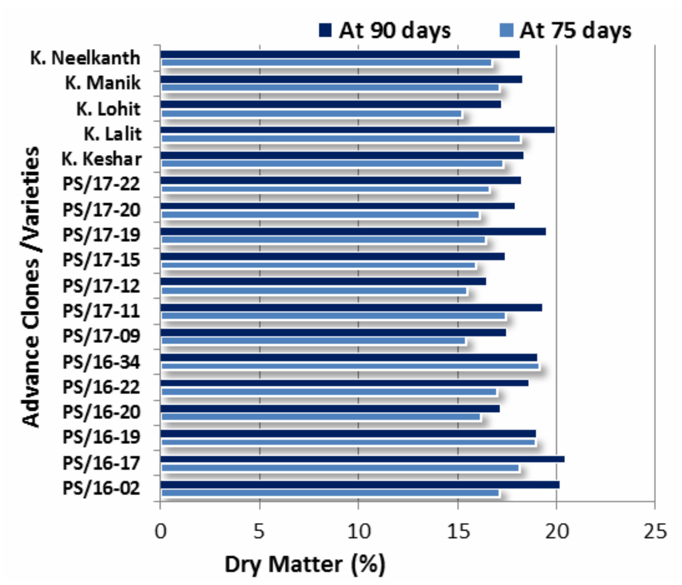
Dry Matter:

The dry matter content plays very important role in selection of clones. The range varies from 19.14% (PS/16-34) to 15.42% (PS/17-09). The advance clones PS/16-17 & PS/16-19 performed better than the controls during 75 days crop. In 90 days crop it varies from 20.42 (PS/16-17) to 17.17% (PS/16-20). The advance clones PS/16-02, PS/16-19, PS/17-11, PS/17-19 & PS/16-34 were significantly at par the controls. 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.

Plate 3: Tubers of advance clones

Table & Fig. 4: Dry Matter (%) of advance clones (Pooled data 2020-21, 2021-22 & 2022-23)

Advance clones /Varieties	Mkt. tuber Yield (t/ha)	
	At 75 days	At 90 days
PS/16-02	17.12	20.17
PS/16-17	18.09	20.42
PS/16-19	18.92	19.00
PS/16-20	16.20	17.17
PS/16-22	17.00	18.59
PS/16-34	19.14	19.08
PS/17-09	15.42	17.50
PS/17-11	17.42	19.34
PS/17-12	15.50	16.50
PS/17-15	15.92	17.41
PS/17-19	16.42	19.50
PS/17-20	16.09	17.92
PS/17-22	16.59	18.25
K. Keshar	17.33	18.34
K. Lalit	18.21	19.92
K. Lohit	15.25	17.25
K. Manik	17.11	18.33
K. Neelkanth	16.71	18.17
CD (0.05)	0.63	1.01
CV (%)	2.16	3.22



Discussion

The medium maturing red skin and purple skinned advanced clones viz., PS/16–02, PS/17-09 and P S/17–12 were suitable for table potatoes. The total tuber yield was maximum in PS/17-09 (36.88 t/ha) followed by PS/17-20 (32.75 t/ha) and PS/16-02 (32.14 t/ha) The PS/16-02 bears attractive purple coloured potato with purple flesh and good in taste. The colour of PS/17-09 and PS/17-12 is deep red skin colour with round tubers, shallow eyed and yellow fresh colour. The dry matter content plays important role in processing varieties as it is positively correlated with the quality of products like chips, French fries etc. As per organoleptic test these advance clones bear Mealy texture with pleasant flavour. The tubers of these advance clones cook easily (15-18 minutes) and cooked and boiled tubes were free from any discolouration after cooking. These clones do not have any internal or external defect during harvesting and after storage of the tubers.

Conclusion

The yield and yield attributing traits like plant emergence (%), total tuber yield (t/ha), marketable tuber yield (t/ha) and dry matter (%) of advance clones were significantly superior or at par with control varieties. and do not have any internal or external defect during harvesting and after storage of the tubers. On the basis of consistent performance over the three consecutive years, the advance clones PS/16-02, PS/17-1-09 and PS/17-12 are promising for multilocation testing and competent variety release proposal.

References

Amador, V., Bou J,. Martine-Garcia J. Monte E. Rodriguez Falcon M. Russo E. and Prat S. (2001). Regulation of potato tuberization by daylength and gibberellins. *The Inter. J. of Development Biology*. **45**(SI) S37-S38.

Bartova V, Barta J, Brabcova A, Zdrahal Z, Horackova V.(2015). Amino acid composition and nutritional value of four cultivated South American potato species. *J Food Compos Anal*.; **40**:78-85.

Beals KA. (2019). Potatoes, nutrition and health. *Am J Potato Res.*; **96**:102-10.

Bhagowati R.R. Saikia M. and Sut D. (2002) *Variability heritability, genetic advance and character association in True Potato Seed (TPS) population.*

Bonierbale M. (2020). Procedures for standard evaluation trials of advanced potato clones. *An international cooperator's guide.* International Potato Center, Lima, Peru.

Burgos G, Zum Felde T, Andre C, Kubow S. (2007) *The potato and its contribution to the human diet and health*. In: Campos H, Ortiz O, editors. The potato crop. Cham, Switzerland: Springer. 2020; 37-74.

Chidda Singh (2010). *Modern Techniques of Raising Field Crops.*, 449-463.

CIP (2009). *Catalog of potato varieties*. International Potato Center, Lima, Peru.

CIP (2007). *Procedures for standard evaluation trials of advanced potato clones*. International Potato Center Apartado 1558, Lima 12, Peru.

Cutter EG. (2018) Structure and development of the potato plant. In: Haris, P. M. *The potato crop. Springer, Science + Busines media, B.V, UK.*;70-152.

Dalamu, S.K., Luthra, J.K., Tiwari, J., Sharma (2019). Mineral content of red skinned potatoes of eastern India. *J.Horti. Sci.*;**14**(1):79-82

Das, S., Mitra, B., Saha, A., Mandal, S., Paul, P.K., El-Sharnouby, M., Hassan, M.M., Maitra, S., Hossain, A. (2021). Evaluation of quality parameters of seven processing type potato (*Solanum tuberosum* L.) cultivars in the Eastern Sub-Himalayan Plains. *Foods*.; **10**:1138.

FAOSTAT, *Food and Agriculture Organization of the United Nations*, Rome, Italy; 2019, 2020, 2021, 2022.

Firman, D. and Daniels, S. (2011). Factors affecting tuber numbers per stem leading to improved seed rate recommendations. *Potato council report*; 22-28.

Gopal, J. (2015). Challenges and Way-forward in Selection of Superior Parents, Crosses and Clones in Potato Breeding. *Potato Research.*, **58**: 165-88.

Hardigan, M.A., Laimbeer, F.P.E., Newton, L., Crisovan, E., Hamilton, J.P., Vaillancourt B. and Buell, C.R. (2017). Genome diversity of tuber-bearing Solanum uncovers complex evolutionary history and targets of domenstication in the cultivated potato. *Proceedings of the national academy sciences,* **114**(46). E9999-E10008.

Hassanpanah, D., Hassanabadi, H. (2014). Evaluating quantitative and qualitative traits of promising potato clones and commercial cultivars using the GGE BI- plot and AMMI models. (article in Persian with an abstract in English). *Iranian Journal of Agricultural Science*, **30**:149-164.

Haverkort, A., Struik, P., Visser, R.G.F., Jacobsen, E. (2009). Applied biotechnology to combat late blight in potato caused by Phytophthora infestans. *Potato Research,* **52**, 249-64.

Hawkes, J.G., Francisco-Ortega, J. (1993). The early history of the potato in Europe. *Euphytica*., **70**: 1-7.

Hirdesh, K.B., Rashmi, M.J., Sushma, T., Singh, S.P., Samad, D.R.K. (2003) Evaluation of potato (so tube, L *Selenium tuberosum* capital L.) hybrid and varieties for medium maturity and quality component for North Central India. *Biological forum–An international journal*., **15**(2); 1244–1250.

Horton, D.E. (1987). *Potatoes: Production, marketing and programs for developing countries*. International Potato Center.

Jansky, S. (2009). *Breeding, genetics and cultivar development. Advances in potato chemistry and technology*. Academic Press, Burlington, VT.;27-62.

Jozani, S., Abd-Mishani, G.H.R.S., Hosenzadeh, A.H., Seied Tabatabaei, B.E. (2003). Genetic diversity analysis of commercial potato cultivars (*Solanum tuberosum*) in Iran using RAPD-PCR technique. (article in Persian with an abstract in English*) Iranian Journal of Agricultural Science,* **34**: 1021-1029.

Kabira, J.N., Lemaga, B. (2003). *Quality Evaluation procedures for research and food industries applicable in East and Central Africa Kenya Agricultural Research Institute* Publication.

Kibar, H. (2012). Design and management of postharvest potato (Solanum tuberosum L) storage structures. Ordu Univ. *J Sci Tech*.;2-23-48.

Kowalczewski, P.Ł., Olejnik, A., Białas, W., Rybicka, I., Zielinska-Dawidziak, M., Siger, A., Kubiak, P., Lewandowicz, G. (2019). The nutritional value and biological activity of concentrated protein fraction of potato juice. *Nutrients*; **11**: 1523.

Lutaladio, N., Castaldi, L. (2009). Potato: The hidden treasure. *Journal of Food Composition and Analysis,* **22**(6):491-493.

Luthra, S.K. (2001). Heritability, genetic advance and character association in potato. *Journal of the Indian Potato Association,* **28**(1)1-3.

Meltzer, H.V. (1992). The effect of growth regulators on the relationship between numbers of stems and tubers in potato. *Potato Research*, **35**: 297-303.

Muhinyuza, J.B., Shimelis, H., Melis, R., Sibiya, J., Nzaramba, M.N. (2012). Participatory assessment of potato production constraints and trait preferences in potato cultivar development in Rwanda. *Int J Dev Sci*., **1**: 358-80.

Mulatu, E., Ibrahim, O., Bekele, E. (2005). Improving Potato Seed Tuber Quality and Producers Livelihoods in Hararghe, Eastern Ethiopia. *Journal of New Seeds*, **7**(3), 31–56.

Mulema, J., Adipala, E., Olanya, O., Wagoire, W. (2008). *Yield stability and resistant potato selections*. *Exp Agric*; **44**, 145-55.

Muthoni, J., Shimelis, H., Melis, R. (2014). *Genetics and reproductive biology of cultivated potato* (*Solanum tuberosum* L.), *implications in breeding. Reproductive Biology of Plants.* CRC press, Taylor & Francis group.;164-194

Khurana, S.M.P., Minhas, J.S., Pandey, S.K. (2003). *The Potato: Production and Utilization in Sub-Tropics* Mehta, New Delhi. 2003;15-24.

Patel, R., Patel, N., Pandey, S., Patel, J., Kanbi, V. (2008). Adaptability of Potato in north Gujarat, *Potato J.*, **35**:19-22.

Roy, A.K. and Singh, P.K. (2006) Genetic Variability, heritability and genetic advance for yield in potato (*Solanum tuberosum* L.) *International Journal of Plant Sciences,* **1**(2), 282-285.

Rukundo, P., Ndacyayisenga, T., Ntizo, S., Kirimi, S., Nshimiyima (2020). Components of CIP advanced potato clones *J Appl Biosci*., **136**: 13909-20.

Rukundo, P. (2019). *Overview of potato sector in Rwanda*.

Saxena, R. and Mathur. P. (2013). Analysis of Potato Production Performance and Yield Variability in India. *Potato J.*, **40**(1):38-44

Singh, B.P. and Rana, P.K. (2014). History of Potato and its emerging problems in India. *In Souvenir-National seminar on emerging problems in potato. Shimla India: India Potato Association.* (7-21)

Subarta, M., Upadhya, M. (1997). *Potato production in west Bengal,* **15**, 646-9.

USAID (2016). Early generation seed systems study. *Country report study.* USAID Bureau of Food Security.

www.hau.gov.in (OPSTAT, 2023)