Potato J (2023) 50 (2): 185-188

# EVALUATION OF AEROPONIC MINITUBER'S POTENTIAL FOR BASIC SEED PRODUCTION

**Murlidhar J Sadawarti*[1], SP Singh[2], Tanuja Buckseth[3], RK Singh[4], RK Samadhiya[1], Subhash Katare[1], Vinod Kumar[3], YP Singh[1], Ashwani K Sharma[5] and Brajesh Singh[3]**

**ABSTRACT: The study conducted at ICAR-Central Potato Research Institute, Regional Station Gwalior over a six-year period from 2017-18 to 2022-23 aimed to evaluate the performance of 17 popular potato varieties. These varieties were divided into early maturing and medium maturing categories. The study focused on various yield attributes and health parameters of these potato varieties, with a particular emphasis on breeder seed production. The emergence percentage ranged from 85% to 99%, indicating that different varieties had varying rates of successful sprouting and growth. Health status of the varieties was found sound. Variability was observed among varieties for yield attributing parameters and Kufri Neelkanth emerged as the top-performing variety in the study. It displayed the highest seed yield per square meter (3.31 kg), the highest number of tubers per square meter (231), and the largest mean seed weight (25.1 grams). Additionally, it had a significant seed multiplication ratio (SMR) by both number (6.9) and weight (25.1).**

**KEYWORDS:** Healthy planting material, aeroponics, minitubers, varieties, virus incidence

Aeroponic systems for potato pre-basic seed production were established following increased demand for more efficient, high quality seed production (Ritter *et al*. 2001, Nichols 2005) and has taken its feet at the turn of the century, as an efficient, high-quality potato minituber production technology. It is an alternative technique of soilless culture in growth-controlled environments (Singh *et al*, 2020) and can produce higher yields (up to 10-times higher), more quickly, and at lesser cost than conventional growing methods (Devi *et al*, 2019). Aeroponics system has maximum application in potato seed production (Ritter *et al*., 2001; Factor *et al*., 2007. Owing to higher rates of multiplication as well as improved health standards and size regulation with sequential harvesting of mini-tubers favoring potato seed growers (Farran and Mingo-Castel 2006). As of now aeroponic system has become an integral part of potato seed production across the world, including India (Buckseth *et al*., 2016). Mini-tubers are principally used for the production of pre-basic or basic seed by direct field planting (Ritter, 2001). Efficient management and utilization of these small sized minitubers to produce successive disease free generations is the next most critical issue after the successful advent of the aeroponic technology. Being a nascent technology, there is a severe dearth knowledge related to the management and planting of the aeroponic minitubers (Devi *et al*, 2019). Cultivars differ widely in their capacity to produce minitubers, some have high and some have low yielding potentials (Caligari and Powell, 1989). Sometimes the potentiality of newly developed varieties is not known in terms of all categories of tubers. However, seed minituber is the first generation seed; it is important to produce sufficient qualities of minituber. The variability

[1]ICAR-Central Potato Research Institute, Regional Station, Gwalior-474020, Madhya Pradesh, India
[2]ICAR-Central Potato Research Institute, Regional Station, Patna -801506, Bihar, India
[3]ICAR-Central Potato Research Institute, Shimla - 171001, Himachal Pradesh, India
[4]ICAR- Indian Institute of Vegetable Research, Varanasi, UP -221305 India
[5]ICAR-Central Potato Research Institute, Shimla - 171001, Himachal Pradesh, India
*Corresponding author; email: murlidharsada@gmail.com

of multiplication rates of different varieties should be determined before going to plan any seed production scheme (Mallick *et al*, 2017). In India, at the time of standardization of Seed Plot Technique in late sixties, the virus profile comprised of only six viruses (PVS, PVX, PVA, PVM, PVY, PLRV). New strains of PVY ($PVY^n$, $PVY^{o+c}$) have either been introduced or developed through mutations (Kreuze *et al*, 2020; Singh and Sharma, 2018). Today, virus profile is much wider and complex than what it was in seventies when seed plot technique was developed (Singh and Sharma, 2018). ELISA testing consists of detecting the antigen-antibody interactions by enzyme induced color reaction which is reasonably sensitive and highly amenable to high throughput automation hence suitable for large scale screening of samples. With this background, first field performance of the precious delicate aeroponic minitubers of different early and medium maturing varieties were evaluated for its production potential and health standards thereof.

The aeroponic minitubers of potato varieties were produced in aeroponic facility at ICAR-CPRI, Shimla which were further planted during crop season of 2017-18 to 2022-23 (for 6 years) under aphid proof net house conditions at ICAR Central Potato Research Institute, Regional Station Gwalior. Aeroponic minitubers of 17 varieties viz., K. Chandramukhi (KCM), K. Lauvkar, K. Surya, K. Pukhraj, K. Khyati, K. Lima (early maturing ) and K.Jyoti, K.Chipsona-1, K.Chipsona-3,K. Himalini, K. Mohan, K. Karan, K. Ganga, K. Thar.-2, K. Sangam, Kufri Neelkanth and K. Garima(medium maturing ) under seed production system for pre-basic seed production were planted/ multiplied and taken under study. Details of planting years, variety wise average area and number of aeroponic minitubers planted is given in table 1. Aeroponic minitubers weighing ~4-5g were planted on well prepared beds during last week of October to second week of November in different years. Seed bed was prepared after addition of one-inch-thick layer of well decomposed farm yard manure and sand in the ratio of 1:1 on the top of the bed. Well sprouted aeroponic minitubers were planted at inter and intra row spacing of 30×10 cm in 2 m wide stripas per availability in different years. A light irrigation was given with the help of rose cane just after planting and subsequent irrigation was given as per the requirement and other packages of practices were followed as per seed plot technique. After 85-90 days after planting, haulms were pulled manually and after 10-12 days of de-haulming the crop was harvested manually. The data recorded during the study are plant emergence %(25-30 DAP), mean tuber weight (g), seed multiplication rate both by number and weight (formulae) , tuber yield both by number and weight per $m^2$at the time of harvesting and mean was calculated. Health standard for major viruses *viz* PVX, PVS, PVY, PVM, PVA, PLRV, $PVY^n$ and $PVY^{o+c}$ was evaluated with Enzyme-linked Immuno Sorbent Assay (ELISA) test.

Seed multiplication rate both by number and weight = No. and weight of tuber produced per $M^2$/ No. and weight of tuber planted per $M^2$

Emergence % varied among the varieties and it ranged from 85-99 %. Highest emergence was reported in K. Lima (99.50%) and lowest in K. Chandramukhi (85%) table 1. Variability in terms of emergence was also reported among varieties in microplant, microtuber and recycled minituber study (Sadawarti *et al*, 2018) and aeroponic minituber multiplication study (Sadawarti *et al*, 2021). The percent survival/establishment was significantly influenced by potato cultivar and type of planting material and their interaction under *in vivo* conditions (Venkatasalam *et al*., 2011). This confirms the present study.

**Table 1: Emergence and yield parameters of different varieties under field multiplication of aeroponic minitubers**

| Variety | No. of year planted | Average | | | | | | Seed multip lication Rate | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number Planted | Area planted ($m^2$) | Emergence % | Yield (Kg/$m^2$) | Yield (No/$m^2$) | Tuber weight (g) | By number | By weight |
| KCM | 1 | 2910 | 87.3 | 85.00 | 1.15 | 110 | 10.4 | 3.3 | 8.7 |
| K. Lauvkar | 2 | 8128 | 243.8 | 89.50 | 1.72 | 146 | 11.8 | 4.4 | 13.0 |
| K. Jyoti | 2 | 1377 | 41.3 | 97.00 | 1.69 | 135 | 12.5 | 4.1 | 12.8 |
| K.Chipsona-1 | 5 | 2117 | 63.5 | 95.00 | 1.20 | 156 | 7.7 | 4.7 | 9.1 |
| K.Chipsona-3 | 2 | 357 | 10.7 | 99.00 | 1.17 | 136 | 8.6 | 4.1 | 8.8 |
| K. Surya | 2 | 1265 | 38.0 | 97.50 | 1.15 | 126 | 9.1 | 3.8 | 8.7 |
| K. Pukhraj | 4 | 1456 | 43.7 | 95.25 | 1.27 | 183 | 7.0 | 5.5 | 9.6 |
| K. Khyati | 4 | 2448 | 73.4 | 92.50 | 1.06 | 118 | 8.9 | 3.5 | 8.0 |
| K. Lima | 2 | 1908 | 57.2 | 99.50 | 1.53 | 98 | 15.6 | 2.9 | 11.6 |
| K. Himalini | 2 | 2577 | 77.3 | 97.00 | 1.82 | 108 | 16.9 | 3.2 | 13.8 |
| K. Mohan | 4 | 3338 | 100.1 | 96.13 | 1.58 | 141 | 11.2 | 4.2 | 12.0 |
| K. Karan | 2 | 700 | 21.0 | 96.00 | 2.40 | 120 | 20.0 | 3.6 | 18.2 |
| K. Ganga | 2 | 2273 | 68.2 | 98.00 | 2.68 | 214 | 12.5 | 6.4 | 20.3 |
| K. Thar.- 2 | 1 | 777 | 23.3 | 95.00 | 0.86 | 101 | 8.5 | 3.0 | 6.5 |
| K. Sangam | 1 | 1137 | 34.1 | 98.00 | 1.47 | 133 | 11.0 | 4.0 | 11.1 |
| K. Neelkanth | 1 | 2013 | 60.4 | 97.00 | 3.31 | 231 | 14.4 | 6.9 | 25.1 |
| K. Garima | 1 | 3200 | 96.0 | 94.00 | 0.49 | 145 | 3.4 | 4.4 | 3.7 |

Variability was reported in terms of yield parameters among varieties. Tuber yield/$m^2$ was ranged from 0.49-3.31 kg and highest was reported in K. Neelkanth (3.31Kg/$m^2$) and lowest in K. Garima (0.49 Kg/$m^2$). Highest tuber number/ $m^2$were recorded in K. Neelkanth (231) followed by K. Ganga (214) and lowest in K. Lima (98). Highest mean tuber weight was reported K. Karan (20.0g) and lowest in K . Garima (3.4g). Seed multiplication rate by number was highest in K. Neelkanth (6.9) followed by K. Ganga (6.4) and lowest in K Lima (2.9). Similar trend was recorded with regard to SMR by weight wherein highest SMR by weight was recorded in K. Neelkanth (25.1) followed by K. Ganga (20.3), but lowest was recorded in K. Garima (3.7) (Table 1). Non significant variation was reported in tuber number but significantly higher tuber weight was recorded in Kufri Lauvkar (30.49 t/ha) over K. Mohan (26.59 t/ha) and K. Chipsona-1 (25.06 t/ha) under soil solarization study (Sadawarti *et al*, 2021). Similar variation for growth and yield parameters were reported among 6 varieties studied under successive double cropping of potato minitubers under insect proof net house conditions of N-W India (Kaur *et al*, 2021). Variability in terms of mean tubers weight and seed multiplication rate was reported in microplant, microtuber and recycled minituber of varieties in (Sadawarti *et al*, 2018) and microtuber multiplication study (Somani and Venkatasalam, 2012) confirming variation due to genetic makeup of the cultivar. In the present study, under 5 % samples with ELISA test health status were evaluated and were found sound.

The study demonstrated that there is significant variability among potato varieties in terms of emergence, yield attributes and Kufri Neelkanth emerged as the top-performing variety in the study, particularly in terms of yield and yield parameters.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

## ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors.

## LITERATURE CITED

Buckseth T, Sharma AK, Pandey KK, Singh BP and Muthuraj R (2016) Methods of pre-basic seed potato production with special reference to Aeroponics- A review. *Scientia Hortic.* **204**: 79-87

Caligari PDS and Powell W (1989) Variability in response of potato cultivars to micro-propagation I. In vitro Performance. *Ann. Appl. Biol.* **115**: 115-21.

Devi S, Singh S, Kaur RP, Shah M A and Singh R K (2019) Sprouting behavior of aeroponic minitubers of different varieties. *Potato J* .**46** (1): 67-72

Factor TL, Araujo JAC de, Kawakami FPC, Lunck V (2007) Potato basic minitubers production in three hydroponic systems. *Hort Brasileira.* **25**(1): 82-87.

Farran I and Mingo-Castel AM (2006). Potato mini-tuber production using aeroponics: Effect of plant density and harvesting intervals. *American Journal of Potato Research* **83**: 47–53.

Jeevalatha A (2013) Detection of potato viruses through molecular techniques. http://14.139.61.83/E-Book-Summer School/lecture-notes/Detection-Jeevalatha.pdf

Kaur R P, Devi S, Singh S, Minhas J S, Singh A K, Rana R K, Rawal S and Singh R K (2021). Successivedouble cropping of potato minitubers under insect proof net house for increased seed productivity. *Indian Journal of Agricultural Sciences* 91 (2): 202–7

Kreuze JF, Souza-Dias JAC, Jeevalatha A, Figueira, AR, Valkonen JPT, Jones RAC(2020). Viral Diseases in Potato. In: Campos, H., Ortiz, O. (eds) The Potato Crop. Springer, Cham. https://doi.org/10.1007/978-3-030-28683-5_11

Mallick R, Hossain MA, Rahman MM, Sarker R and Jui SA (2017) Minituber Yield Potentials of Potato Varieties of Bangladesh. *International Journal of Agricultural* **2** (2):22–30

National Academy of Agricultural Sciences (NAAS) (2021) Innovations in potato seed production. strategy paper No.14 (New Delhi: National Academy of Agricultural Sciences).

Nichols MA(2005) Aeroponics and potatoes. ISHS *Acta Horticulturae*. 670: 201–206.

Ritter E, Angulo B, Riga P, Herran J, Relloso J and San Jose M (2001) Comparison of hydroponic and aeroponic cultivation systems for the production of potato mini-tubers. *Potato Research* **44**: 127–35.

Sadawarti M J, Samadhiya RK, Singh RK, Sharma AK, Singh SP, Sharma SK, Buckseth T, Katare S, Singh YP, Rawal S, Singh V, Roy S and Chakrabarti SK (2021) Influence of soil solarization on the multiplication of aeroponic seed potato under net house (Gen-0) and open field conditions (Gen-1) of north central India. *Indian Journal of Agricultural Sciences* **91** (2): 213–7,

Sadawarti M J, Samadhiya RK, Kumar V, Singh SP, Roy S, Venkatasalam EP, Buckseth T, Singh RK, Pandey KK and Chakrabarti SK (2018) Hi-tech planting materials performance under *in vivo* conditions for potato breeder seed production. *International Journal of Chemical Studies* **6**(3): 817-822

Sharma S (2013) Pest and Disease Scenario Impacting Seed Production in the Tropics. Souniour Workshop on Problems and Prospects of Seed Potato Production Systems in India September 20, 2013 pp 59-63.

Singh P, Singh SK, Anmol and Sharma KK (2020) Evaluation of Performance of Popular Cultivars of Potato under Aeroponic Conditions. *Annals of Biology* **36** (3):412-417.

Singh BP, Sharma S (2018) Potato seed production systems: then and now. *Potato. J.* **45** (1):1–16.

Somani AK and Venkatasalam EP (2012). Microtuber propagation for breeder's seed production of potato. *Potato J* **39** (1): 98-100

Venkatasalam EP, Latawa J, Sharma S, Sharma S, Sharma AK, Sharma PR (2011) In vitro and in vivo performance of potato cultivars for different seed production systems. *Potato J* **38**:149-154

MS Received : December 13, 2023; Accepted : March 14, 2024