IJBSM January 2025, 16(1): 01-06
Article AR5787
Research Article
Natural Resource Management
DOI: HTTPS://DOI.ORG/10.23910/1.2025.5787

Evaluation of Aeroponic Minitubers of Newly Released Potato Varieties under Various Spacing Combinations

Murlidhar J. Sadawarti[1], Tanuja Buckseth[2], S. P. Singh[3], Ashwani Kumar Sharma[4], Vinod Kumar[2], R. K. Singh[5], Subhash Katare[1], Brajesh Singh[2], R. K. Samadhiya[1], Y. P. Singh[1] and S. K. Sharma[1]

[1]ICAR-Central Potato Research Institute, Regional Station, Gwalior, Madhya Pradesh (474 020), India
[2]ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh (171 001), India
[3]ICAR-Central Potato Research Institute, Regional Station, Patna, Bihar (801 506), India
[4]ICAR-Central Potato Research Institute, Regional Station, Kufri Fagu Himachal Pradesh (171 012), India
[5]ICAR-Central Potato Research Institute, Regional Station, Modipuram Uttar Pradesh (250 110), India

Open Access

Corresponding murlidharsada@gmail.com

0000-0003-2469-2075

ABSTRACT

This study was conducted during 2020–21 to 2023–24 at ICAR-Central Potato Research Institute, Regional Station, Gwalior, Madhya Pradesh, India to compare the production potential of newly released potato varieties grown as aeroponic minitubers under different spacing combinations under net house conditions. The planting was done in 2nd week of November each year two spacing combinations 30×10 cm^2 (333333 plants ha^{-1}) 30×15 cm^2 (222222 plants ha^{-1}) and four varieties *viz* Kufri Ganga-Medium maturing, Kufri Lima-Medium maturing heat tolerant and Kufri Mohan -early bulking medium maturing and Kufri Sangam-medium maturing processing with plot size of 1.80m^2. The trial was planted in factorial RBD with three replications with spacing combinations as main plot and varieties as sub plots. The objective was to determine the optimal spacing for maximizing yield, tuber size, and overall performance of these varieties. No significant difference in growth parameters among spacing combinations, but varietal differences were observed. 30×10 cm^2 spacing recorded significantly higher total tuber number (1571 thousand ha^{-1}) compared to 30×15 cm^2 spacing (1301 thousand ha^{-1}). Varieties Kufri Ganga, Kufri Mohan, and Kufri Sangam recorded significantly higher total tuber numbers over Kufri Lima. Study suggests that newly released potato varieties grown as aeroponic minitubers should be multiplied at 30×10 cm^2 spacing to achieve a higher number of tubers. Kufri Ganga and Kufri Mohan performed better in terms of total tuber weight, while Kufri Lima and Kufri Mohan had a higher percent of medium-sized tubers by number.

KEYWORDS: Aeroponic minitubers, hi-tech system, new varieties, potato, spacing

***Citation* (VANCOUVER):** Sadawarti et al., Evaluation of Aeroponic Minitubers of Newly Released Potato Varieties under Various Spacing Combinations. *International Journal of Bio-resource and Stress Management,* 2025; 16(1), 01-06. HTTPS://DOI.ORG/10.23910/1.2025.5787.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 16th September 2024 RECEIVED in revised form on 20th December 2024 ACCEPTED in final form on 05th January 2025 PUBLISHED on 24th January 2025

1. INTRODUCTION

Aeroponic systems have become a cornerstone for pre-basic potato seed production in both public and private sectors in India, revolutionizing the industry with high multiplication rates and healthy seed production (Anonymous, 2018). It is a cost-effective and more efficient method of pre-basic quality seed production (Ritter et al., 2001) and its optimization is important for sustainable production of potato (*Solanum tuberosum* L.) Rykaczewska, 2016. Minitubers can be produced using this technology by using healthy *in vitro* plants. This technique makes it easier to apply phytosanitary requirements and to produce minitubers over the entire year (Buckseth et al., 2016; Tiwari et al., 2022). Shortening the span of potato stock breeder seed production by just about a pair of years and production of fresh material are the most important advantages of aeroponic system (Sadwarti et al., 2024). Aeroponic potato production provides better profit compared to G0 conventional as the productivity higher, the tuber was better and healthier, sterile and free from pests and diseases (Sembiring et al., 2021). This method is well integrated at the Central Potato Research Institute (CPRI) and its regional stations for basic/nucleus seed potato production (Anonymous, 2022). Aeroponic minitubers, typically 3–5 g, are further multiplied in net houses under various spacing combinations to optimize yield and facilitate the production of breeder seeds (Sadawarti et al., 2020). While the standard 30×10 cm spacing has been commonly used, it often results in a high percentage of very small minitubers (<3 g) (Sadawarti et al., 2020), which are not ideal for further field multiplication. Therefore, optimizing planting geometry is crucial for producing larger tubers and increasing growers' revenue (Kaur et al., 2019). Higher production potential of aeroponically produced minitubers under nethouse, ridge and furrow method of planting along with sprinkler irrigation (Sadawarti et al., 2024).

The ICAR-Central Potato Research Institute (CPRI) continuously develops new potato varieties to meet the demands of farmers and consumers. These varieties are tailored for specific purposes, such as table and processing uses, nutrient enrichment, and heat tolerance for early planting or hot regions (Anonymous, 2021). Among these, Kufri Ganga, Kufri Lima, Kufri Mohan, and Kufri Sangam are prominent varieties each suited for different conditions and purposes. Evaluating the production performance of these varieties under different spacing combinations in net house conditions is crucial for optimizing yield and tuber quality, essential for successful seed production programs. Kufri Ganga is a medium maturing, main season, high yielding table purpose potato variety suitable for cultivation in north Indian plains (Lutra et al., 2019). Kufri Lima is a heat tolerant table potato variety suitable for early planting in North Indian plains (Lutra et al., 2020). Kufri Mohan is a medium maturing, main season, high yielding table purpose potato variety suitable for cultivation in Indo-Gangetic plains (Lutra et al., 2017). Kufri Sangam is a medium maturing, main season high yielding dual purpose potato variety suitable for cultivation in northern plains (for table use) and central plains (for processing and table use) Gupta et al., 2021. At ICAR-CPRI, these cultivars are further integrated into the seed production chain via an aeroponic and conventional system. Profiling diverse tuber sizes is critical for seed generation and multiplication (Kaur et al., 2019). As a result, there is a need to assess the production performance of these newly released varieties under various spacing combinations and net house circumstances.

2. MATERIALS AND METHODS

An experiment was conducted under the net house of ICAR-Central Potato Research Institute, Regional Station, Gwalior (26° N and 78° E, altitude 207 m msl) with four recently released cultivars *viz* Kufri Ganga-Medium maturing (planted in 2020–21 and 2021–22), Kufri Lima -Medium maturing heat tolerant and Kufri Mohan -early bulking medium maturing (planted in 2021–22 and 2022–23) and Kufri Sangam-medium maturing processing (planted in 2022–23 and 2023–24). Aeroponic minitubers were allowed to sprout under diffused light and planted in the 2nd week of November. Seed bed was prepared with layer of well decomposed farm yard manure and sand in the ratio of 1:1 on the top of the bed under insect-proof net house Well sprouted aeroponic minitubers (4–5 g) were planted two spacing combinations 30×10 cm^2 (333333 plants ha^{-1}) 30×15 cm^2 (222222 plants ha^{-1}) with plot size of 1.80m^2. The trial was planted in factorial RBD with three replications with spacing combinations as main plot and varieties as sub plots. Trial was conducted as per standard seed plot techniques in which N:P:K was given in the ratio of 150:60:100. Full doses of P through single super phosphate, K through muriate of potash and half dose of N through ammonium sulphate were applied at the time of planting. Remaining half dose of N was applied through urea after 25–30 days of planting. Standard seed production practices were followed for the management of the crop. The emergence was recorded at 30 days after planting (DAP). The crop was terminated at 90 days by uprooting haulms and harvested after allowing skin curing for 15 days. Yield, total number of tubers, tuber grades, *viz*. Undersize <3 g, 3–10 g, 11–20 g, 21–40 g, 41–80 g and >80 g were recorded after harvesting. Data was pooled and analyzed statistically and means were separated according to the least significant differences (LSD) at 0.05 level of probability.

3. RESULTS AND DISCUSSION

3.1. Emergence and growth parameters

No significant difference was reported for emergence percentage across spacing combinations and among the varieties. No significant differences in plant height, number of stems per plant, and number of compound leaves per plant (Table 1). This aligns with findings from previous studies by Sadawarti et al. (2020), Devi et al. (2023), and Kaur et al. (2019). Among varieties significantly higher plant height was recorded in K. Lima (42.3 cm) and K. Sangam (49.3 cm) over K. Mohan (37.7 cm). Number of stems plant^{-1} was significantly higher only in K. Mohan (2.0) over all other tested varieties. Compound leaves/plant was significantly higher in K. Ganga (17.7), K. Lima (15.3) and K. Mohan (24.8) over K. Sangam (12.2). Variability among varieties was reported for growth parameters (Devi et al., 2023; Kaur et al., 2019).

Table 1: Growth parameters and grade wise tuber yield by number as influenced by spacing combinations and varieties

Spacing combinations /varieties	Growth parameters				Tuber yield by number (000 ha^{-1})						
	Emergence %	Plant height plant^{-1} (cm)	Stem No. plant^{-1}	Compound leaves plant^{-1}	<3 g	4–10 g	11–20 g	21–40 g	41–80 g	>80 g	Total
30×10 cm^2	97.71	41.7	1.2	17.2	629	402	259	209	69	4	1571
30×15 cm^2	97.66	41.9	1.4	17.8	502	315	215	188	74	7	1301
CD (p=0.05)	NS	NS	NS	NS	82.5	69.0	26.2	NS	NS	NS	80.0
K. Ganga	97.50	38.0	1.2	17.7	884	438	253	240	35	5	1856
K. Lima	97.90	42.3	1.0	15.3	316	205	195	158	73	8	954
K. Mohan	98.46	37.7	2.0	24.8	581	484	255	227	126	7	1680
K.Sangam	96.88	49.2	1.2	12.7	481	307	247	169	51	1	1256
CD (p=0.05)	NS	4.29	0.48	2.83	116.7	97.6	37.1	32.2	49.3	4.4	113.2
Interaction	3.38	6.07	0.68	4.00	165.1	138.0	52.5	45.5	69.7	6.2	160.1

3.2. Grade wise and total tuber yield

3.2.1. Number of tubers (000 ha^{-1})

Closer spacing (30×10 cm^2) favors the production of more small-sized tubers, while wider spacing (30×15 cm^2) favors larger-sized tubers. Very small (<3 g), small size tubers (3–10 g and 11–20 g) were significantly higher in 30×10 cm^2 spacing (629 thousand ha^{-1} for 3 g, 402 thousand ha^{-1} for 3–10 g and 259 thousand ha^{-1} for 11–20 g) over 30×15 cm^2 spacing (502 thousand ha^{-1} for 3 g, 315 thousand ha^{-1} for 3–10 g and 215 thousand ha^{-1} for 11–20 g). For 21–40 g tuber also, 30×10 cm^2 spacing (209 thousand ha^{-1}) recorded non significantly higher tubers over 30×15 cm^2 spacing (188 thousand ha^{-1}). But for medium seed size^{-1} (41–80 g) and over size (>80 g) higher in wider 30×15 cm^2 spacing (74 thousand ha^{-1} and 7 thousand ha^{-1} respectively) over higher spacing 30×10 cm^2 (69 thousand ha^{-1} and 4 thousand ha^{-1} respectively) table 1. Reduced intraspecific competition among potato plants, leading to a shift from producing many small minitubers at closer spacings to fewer larger minitubers at wider spacings (Santos and Rodriguez, 2008). At 0.20 m between plants, potato plants produced many small minitubers, whereas at a distance of 0.40 m between plants, there were fewer and larger minitubers (Santos and Rodriguez, 2008). Present finding is also supported by Sadawarti et al., 2020. 30×10 cm^2 (1571 thousand ha^{-1}) recorded significantly higher total tuber number over 30×15 cm^2 spacing (1301 thousand ha^{-1}) table 1. Closer spacing (30×10 cm^2) significantly increases the total number of tubers per hectare compared to wider spacing (30×15 cm^2). Similar reports were found by Sadawarti et al., 2020. Increased in number of tubers per unit area might be due to more number of plants or stems per unit area in 30×10 cm^2 plant geometry which is directly related to stem number (Kaur et al., 2019; Sharma and Kumar, 2014; Mohamed et al., 2018).

The results highlight significant differences in tuber size distribution and total tuber number among the different potato varieties. Significantly higher counts for very small and small size tubers in all varieties (K. Ganga, K. Mohan, and K. Sangam) over K. Lima. 21–40 g tubers were significantly higher in K. Ganga (240 thousand ha^{-1}) and K. Mohan (227 thousand ha^{-1}) over K. Lima (158 thousand ha^{-1}) and K. Sangam (169 thousand ha^{-1}). Medium size (41–80 g) tubers were significantly higher in K. Mohan (126 thousand ha^{-1}) over other three varieties and least was found in K. Ganga. All the other three varieties found significantly higher over size (>80 g) tubers over Kufri Sangam (1 thousand ha^{-1}). K. Ganga (1856 thousand ha^{-1}), K. Mohan

(1680 thousand ha^{-1}) and K. Sangam (1256 thousand ha^{-1}) recorded significantly higher total tuber number over K. Lima (954 thousand ha^{-1}) table 1. The genotype (cultivar) and the type of planting material significantly impact the total number of minitubers, minituber mass, and overall potato production (Buckseth et al., 2023). Similar trends were observed in minituber multiplication studies by Sadawarti et al. (2023).

3.2.2. Tuber weight (t ha^{-1})

The findings indicate how spacing impacts the weight of tubers of different sizes. Very small (<3 g), small size tubers (3–10 g) tuber weight were non significantly higher in 30×10 cm^2 spacing over 30×15 cm^2 spacing. 11–20 g (3.42 t ha^{-1}) and 21–40 g (6.35 t ha^{-1}) tubers were significantly higher 30×10 cm^2 spacing over 30×15 cm^2 spacing. But for medium seedsize^{-1} (41–80 g) and over size (>80 g) non significantly higher in wider 30×15 cm^2 spacing (3.47 t ha^{-1} and 0.97 ha^{-1} respectively) over higher spacing 30×10 cm^2 (3.05 t ha^{-1} and 0.66 t ha^{-1} respectively). Total weight (t ha^{-1}) was at par among both the spacing combinations (table 2). Plant spacing of 30×15 cm^2 is optimal for potato plantlets transplantation in greenhouse benches for maximum minituber yield (Gul et al., 2020). Increasing in-row distances between 0.20 and 0.40 m resulted in a significant decline (−44%) in minituber weight per unit area (Santos and Rodriguez, 2008). These results suggest that while closer spacing (30×10 cm^2) can increase the weight of small and intermediate-sized tubers, wider spacing (30×15 cm^2) is slightly more favorable for larger tubers. However, the total tuber weight remains unaffected by the spacing, indicating that the choice of spacing should be guided by the desired tuber size distribution rather than total yield.

K. Ganga and K. Mohan significantly outperformed K. Lima and K. Sangam for these smaller tuber categories. Among varieties, very small (<3 g), small size tubers (3–10 g, 11–20 g and 21–40 g) were significantly higher in K. Ganga (1.20, 2.20, 3.96 and 10.43 t ha^{-1} for <3 g, 3–10 g, 11–20 g and 21–40 g respectively) and K. Mohan (0.96, 2.85, 3.61 and 5.52 t ha^{-1} for <3 g, 3–10 g, 11–20 g and 21–40 g respectively) over K. Lima and K. Sangam. Medium size 41–80 g tubers were higher in all the other three varieties over K. Ganga. But Large (>80 g) tubers were significantly higher in K. Ganga, K. Lima and K. Mohan over K. Sangam (0.18 t ha^{-1}). Total tuber weight was significantly higher in K. Ganga (20.31 t ha^{-1}) and K. Mohan (19.75 t ha^{-1}) over K. Lima (12.19 t ha^{-1}) and K. Sangam (11.11 t ha^{-1}) table 2. Variability in tuber weight plant^{-1} was observed among three potato varieties in aeroponic (Bag et al., 2015). Five potato cultivars *viz* Agria, Cleopatra, Désirée, Kennebec, and Sinora recorded variation in yield due to their plant origin (Brocic et al., 2022).

Table 2: Grade wise tuber yield by weight as influenced by spacing combinations and varieties

Spacing combinations /varieties	Tuber yield by weight (t ha^{-1})						
	<3 g	4–10 g	11–20 g	21–40 g	41–80 g	>80 g	Total
30×10 cm^2	0.79	2.15	3.42	6.35	3.05	0.66	16.41
30×15 cm^2	0.72	1.73	2.94	5.45	3.47	0.97	15.27
CD (*p*=0.05)	NS	NS	0.37	0.87	NS	NS	NS
K. Ganga	1.20	2.20	3.96	10.43	1.05	1.48	20.31
K. Lima	0.43	1.23	2.67	3.58	3.65	0.63	12.19
K. Mohan	0.96	2.85	3.61	5.52	5.84	0.97	19.75
K.Sangam	0.42	1.48	2.47	4.07	2.50	0.18	11.11
CD (*p*=0.05)	0.13	0.71	0.52	1.24	2.15	0.52	2.34
Interaction	0.19	1.00	0.73	1.75	3.04	0.74	3.31

3.3. Percent <3 g and 41–80 g tuber

Percent <3 g (very small) both by number and weight were at par in both the spacing combinations. But in case of *percent* 41–80 g (medium size) tuber, 30×15 cm^2 recorded non significantly higher % tuber spacing number (5.80%) and weight (23.61%) tuber % over 30×10 cm^2 spacing (Figure 1). Higher proportions of large-sized minitubers are obtained at lower plant densities, while higher plant densities lead to smaller tubers due to increased competition for space and nutrients (Sadawarti et al., 2020; Sharma et al., 2014). Among varieties, K. Ganga (47.5%) by number and K. Ganga (5.93%) and K. Mohan (4.91%) by weight recorded significantly higher % <3 g (very small) tuber over other varieties. For percent 41–80 g (medium size) tuber by number, K. Lima (7.73) and K. Mohan (7.62) recorded over other two varieties and by weight all other three varieties recorded significantly higher % tuber over K. Ganga (5.15) Figure 2. 36.6% and 3.6% in K. Lauvkar and 37.7% and

1.1% in K. Surya <3 g and 41–80 mini tuber respectively was reported in aeroponic minituber multiplication study (Sadawarti et al., 2023) confirming the varietal differences resulted in the present study.

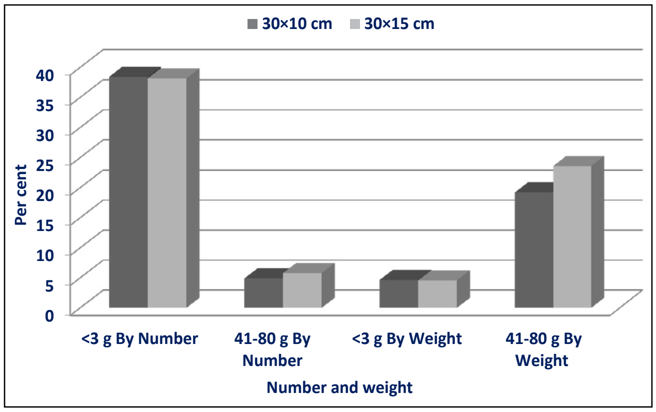

Figure 1: Per cent <3 g and 41–80 g tubers by number and weight as per spacing combinations

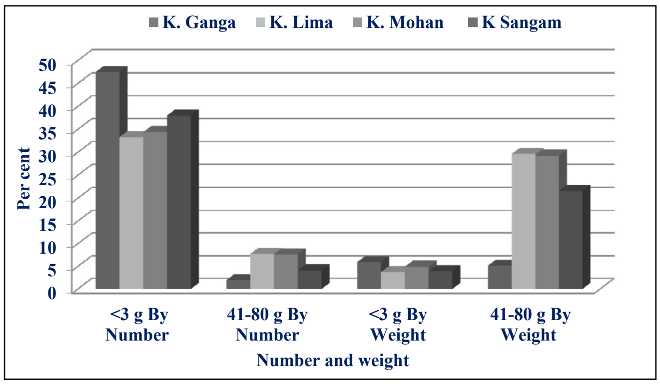

Figure 2: Per cent <3 g and 41–80 g tubers by number and weight in different varieties

4. CONCLUSION

The spacing of 30×10 cm^2 with plant population of 333333 plants ha^{-1} could be adopted for optimizing aeroponic seed multiplication of newly released potato varieties. This spacing resulted in a significantly higher total number of tubers per hectare that helped in maximizing production.

5. REFERENCES

Anonymous 2021. Indian Potato Varieties (1949–2020) Tiwari, J.K., Luthra, S.K., Dalamu, Bhardwaj, V., Singh, R.K., Buckseth, T., Kumar, R., Gupta., V.K., Kumar, V., Kumar, S., Sood, S., Kumar, M., ICAR Central Potato Research Institute eTechnical Bulletin No. 7 (Ref.: No.F.PME/3-3/2021 dated 4.7.2021). Available at https://cpri.icar.gov.in/ and 15.09.2024

Anonymous, 2022. CPRI annual report. Pp 1–165. Available at: https://cpri.icar.gov.in/. Assessed on: 15.09.2024.

Anonymous, 2018. Hi-tech seed production system. In: Singh,T. Buckseth, R.K. (Eds.), Training on seed potato production, ICAR-Central Potato Research Institute, Shimla and CPRS, Jalandhar, April 04–13, pp. 8–13.

Bag, T.K., Srivastava, A.K., Yadav, S.K., Gurjar, M.S., Diengdoh, L.C., Rai, R., Singh, S., 2015. Potato (*Solanum tuberosum*) aeroponics for quality seed production in north eastern Himalayan region of India. Indian Journal of Agriculture Science 85(10), 1360–1364.

Buckseth, T., Sharma, S., Tiwari, J.K., Kumar, V., Sharma, A.K., Challam, C., Sadawarti, M., Singh, R.K., 2023. Plant sources identify variations in potato production potential under aeroponics. Potato Research 67, 931–941. https://doi.org/10.1007/s11540-023-09670-4

Devi, S., Bharti, K., Kaur, R.P., Nare, B., Singh, S., 2023. Evaluation of potato *in vitro* plants with different inter and intra-row spacing in soilless system under insect proof net house. Potato Journal 50(2), 158–164.

Gul, Z., Qureshi, F., Jamal, Z., 2020. Growth and minituber yield response of potato plantlets in micropropagation to different plant spacing under greenhouse conditions. International Jornal of Agriculture Environment and Food Science 4(3), 271–277. DOI: https://doi.org/10.31015/jaefs.2020.3.5.

Gupta, V.K., Bhardwaj, V., Luthra, S.K., Singh, S.V., Mehta, A., Bandana, Rawal, S., Kumar, V., Singh, B.P., Kumar, M., 2021. Kufri sangam: a high yielding dual purpose potato variety for table and processing. Potato Journal 48(1), 15–26.

Kaur, R.P., Minhas, J.S., Singh, S., Singh, A.K., Singh, R.K., 2019. High density planting of potato (*Solanum tuberosum* L.) minitubers for increased seed productivity. Indian Journal of Agriculture Science 89(6), 989–993.

Luthra, S.K., Pandey, S.K., Singh, S.V., Kumar, V., Gopal, J., Singh, B.P., Naik, P.S., Gupta, V.K., Rawal, S., Malik, K., Bandana, Bhardwaj, V., Chakrabarti, S.K., Bonierbale, M., Kadian, M.S., Sharma, N., Arya, S., 2020. Kufri lima: a new heat tolerant potato variety. Potato Journal 47(2), 107–115.

Luthra, S.K., Gupta, V.K., Rawal, S., Lal, M., Malik, K., Kumar, V., Chakrabarti, S.K., 2019. Kufri Ganga: a new high yielding table potato variety for north Indian plains. Potato Journal 46(2), 138–148.

Luthra, S.K., Gupta, V.K., Lal, M., Rawal, S., Kumar, V., Singh, B.P., 2017. Kufri mohan-a new high yielding table potato variety. Potato Journal 44(1), 65–73.

Mohamed, F.H., Genesia, F.O., Khalid, E., Hamed, A.E., Basma, A., El-Safty, 2018. Influence of plant density and genotype on potato minituber production from microshoots and microtubers. Catrina 17(1), 77–78.

Ritter, E., Angulo, B., Riga, P., Herran, C., Relloso, J., San Jose, M., 2001. Comparison of hydroponics and aeroponics cultivation systems for the production of potato mini-tubers. Potato Research 44, 127–135.

Rykaczewska, K., 2016. Field performance of potato minitubers produced in aeroponic culture. Plant Soil Environment 62(11), 522–526.

Sadawarti, M.J., Singh, S.P., Buckseth, T., Katare, S., Singh, R.K., Kumar, V., Singh, B., Samadhiya, R.K., Singh, Y.P., 2023. Production potential of aeroponic potato as influenced by different planting and irrigation methods in North-Central India. Potato Journal 50(2), 165–167.

Sadawarti, M.J., Samadhiya, R.K., Singh, R.K., Singh, S.P., Buckseth, T., Rawal, S., Singh, V., Katare, S., Roy, S., Chakrabarti, S.K., 2020. Standardization of agro-techniques for aeroponic potato (*Solanum tuberosum*) minitubers under generation-0. Indian Journal of Agriculture Science 90(3), 616–620.

Sadawarti, M.J., Singh, S.P., Buckseth, T., Singh, R.K., Samadhiya, R.K., Katare, S., Kumar, V., Singh, Y.P., Sharma, A.K., Singh, B., 2023. Evaluation of aeroponic minituber's potential for basic seed production. Potato Journal 50(2), 185–188.

Sadawarti, M., Singh, S.P., Singh, R.K., Katare, S.,Tanuja, B., 2024. Technological innovations of seedpotato systems in india. In: Kiran, P.B., Kashyap, P.,Narwade, A.V., Roy, S.S., Meena, A.L. (Eds.), Astress-free horticulture: empowering crop resilienceagainst abiotic challenges. Thirugnanavel Today &Tomorrow's Printers and Publishers-New Delhi (India), 143–194.

Sadawarti, M.J., Singh, S.P., Buckseth, T., Katare, S., Singh, R.K., Kumar, V., Singh, B., Samadhiya, R.K., Singh, Y.P., 2024. Production potential of aeroponic potato as influenced by different planting and irrigation methods in north-central India. Potato Journal 50(2), 165–167.

Santos, B.M., Rodriguez, P.R., 2008. Optimum in-row distances for potato minituber production. Horticulture technology 18(3), 403–406.

Sembiring, A., Murtiningsih, R., Sahat, J.P., Hartanto, S., 2021. G0 potato aeroponic seed production in Indonesia, producers' perception toward the benefits and challenges. IOP Conf. Series: Earth and Environmental Science 948 (2021) 012086. doi:10.1088/1755-1315/948/1/012086.

Sharma, A.K., Kumar, V., Venkatasalam, E.P., 2014. Effect of method of planting and plantlet density on potato minituber production. Potato Journal 41(1), 52–57.

Tiwari, J.K., Buckseth, T., Singh, R.K., Zinta, R., Thakur, K., Bhardwaj, V., Dua, V.K., Kumar, M., 2022. Aeroponic evaluation identifes variation in Indian potato varieties for root morphology, nitrogen use efciency parameters and yield traits. Journal of Plant Nutrition 45(2), 1–14. https://doi.org/10.1080/01904167. 2022.2046080.