

Performance of Aeroponically Produced Potato Minitubers under Insect Proof Net House Conditions

MURLIDHAR J SADAWARTI^{*1}, KK PANDEY³, RK SAMADHIYA¹,
RK SINGH², SP SINGH¹ AND SATYAJIT ROY¹

¹ICAR-Central Potato Research Station, Gwalior (MP) 474 006

²ICAR-Central Potato Research Station, Institute (HP) 171 001

³ICAR-Indian Institute of Vegetable Research (UP) 221 305

*murlidharsada@gmail.com

The production of clean seed is very crucial to sustain the production and productivity of potato in the country. Currently the common method for propagation of commercially important cultivars is through tubers (conventional method). However this propagation method has encouraged accumulation of tuber-borne viruses, fungi and bacteria in subsequent seasons leading to significant losses in yield and tuber quality over seasons [1]. Rapid multiplication techniques especially tissue culture and aeroponic used to increase the amounts of nuclear seed stocks for further seed multiplication as it is better multiplication method than conventional method [2] and provides higher multiplication rate (1:40 to 1:several thousand per year), lower rate of contamination, particularly from soil and tuber borne pathogen [3].

Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate media where root system of the plants is confined to a dark environment without substrate, and is continually saturated with a mist spray of a water and nutrient solution. This is an alternative method of soil-less culture in growth-controlled environments [4, 5]. Nutrient solution is continuously recirculated through the system. The top portion of the plant is exposed to the open air and a light source (either artificial light or natural sunlight). Only one per cent of conventional water usage is required which is basically recycled water.

It is the ideal technology for cost-effective production of quality seed in the present era. Plant density and harvesting intervals influence the minituber production in aeroponic system. The field performance of aeroponically produced minitubers was comparable to the minitubers produced from other techniques [5]. Aeroponics for potato mini-tuber production is practiced throughout the world, including in Asia, Europe and Latin America for research purposes and commercial seed production [6].

In aeroponic system, after one week of transplanting the plantlets starts developing roots inside the growth chamber stolon and tuber formation initiated at different intervals depending upon cultivars. Sequential picking was done at regular interval. Tubers were harvested when they attained the desired size of 3-4g. Harvesting continues until plants are about six months old. Harvested minitubers are left to cure and hardening for 2 weeks before cold storage. This is because the minitubers have imbibed a lot of water during development and they can rot if they are taken to cold store immediately. Subsequent harvests are done every 10 to 14 days [7]. Harvesting in aeroponics is convenient, clean, and allows a greater size control by sequential harvesting [8]. Sequential harvesting of mini-tubers allows selection of desired size for the mini-tubers [9]. There is very scanty information of the field

performance of aeroponic minitubers under field condition. Hence in this study we compare the subsequent *ex-vitro* performance under net house conditions of two grades of minitubers sequentially harvested at 8-10 days interval.

An experiment was conducted at ICAR-CPRS, Gwalior during 2013-14. Aeroponic minitubers of cultivar Kufri Lauvkar were produced in ICAR-CPRI, Shimla where sequential harvesting of minitubers was done at regular interval of 8-10 days. After cold storage, minitubers were sent to ICAR CPRS, Gwalior for further multiplication under G-0. Well sprouted minitubers of nine harvesting dates starting from 22nd January (1st harvest), 2013 to 24th April, 2013 (9th harvest) with two grades of <3g and 3-10g were planted under net house conditions at ICAR CPRS, Gwalior. Experiment was planted in factorial RBD with three replications. 20 aeroponic mini tubers of <3g in spacing of 30x10cm and 13 mini tubers of 3-10g in spacing of 30x15 cm in 2 m row (0.6M²) were planted in 2nd week of November under aphid free net house conditions. A light irrigation was given with the help of shower just after planting and subsequent irrigations were given as per requirement. Other package of practices was followed as per recommendation for seed potato.

Data on germination was recorded 30 DAP. Plant height, number of stem and compound leaves/plant were recorded after 50 and 75 DAP. Yield attributing parameters *viz.*; number and weight of mini tubers/plant, grade wise number and weight of tuber/plot, per cent <3 g tubers both by number and weight were recorded after harvesting. Data were pooled and analyzed statistically and means were separated according to the least significant differences (LSD) at 0.05 level of probability.

Among two grades, germination percentage was significantly higher in 3-10g of aeroponic minituber (95.73) over <3g of minitubers (83.15). Field emergence of 100% has been reported in the harvested aeroponic mini tubers [5]. Small mother tubers often showed a low percentage of emergence, which was delayed and low in vigor [10]. This confirms the present study. Among harvest dates, all the dates expect 1st harvest date recorded significantly higher germination over 2nd harvest

date (76.60%) and highest (93.72%) was recorded in 6th harvest (21st march). Single stem/plant were reported in both the grade and harvest dates. Minitubers had a tendency to produce one or even two stems [5]. Compound leaves/plant and plant height was significantly higher in 3-10g of minituber) over <3g of minitubers (Table 1). Among harvest dates, compound leaves/plant were significantly higher (12 and 13) in 6th harvest (21st march) when recorded after 50 and 75 days of planting over 1st harvest date- 22nd January (10 and 11). Ground cover of minituber-derived plants was not complete, and this could explain the lower yield potential per unit when 20-28mm minitubers were tested under greenhouse conditions [5]. For plant height at 50 days there was non-significant differences among date of harvest. But 75DAP significantly higher plant height was recorded in 6th (34cm) and 9th harvest (35cm) over 1st harvest.

For yield/plant, 3-10g size of aeroponic mini tuber recorded significantly higher number (9) and weight (49g) of mini tuber over <3g (6 and 33g). Similar trend for harvest date was observed wherein 6th harvest (21st March) recorded significantly highest tuber number (9) and weight (47g) over 4th harvest-2nd March (6 and 34g). In greenhouse beds, the cultivar Agria was the most productive variety with 3.1 followed by Zorba and Monalisa, with 2.4 tuber number/plant [11]. When 20-28mm minitubers were tested under greenhouse conditions resulted in 4-5 minituber and 95g of weight/plant [5]. Similar trend was recorded for yield/plot wherein only 6th harvest (21st March) recorded significantly highest tuber number (112) and weight (2066 g) over 4th harvest-2nd March (79 and 786g). When 20-28mm minitubers were tested under greenhouse conditions resulted in total tuber yields about 6.3 t/ha and in number 30 tubers/m² [5]. This confirms the larger size tubers have higher vigor than small size tubers leading to more number and weight of tubers.

Aeroponic minituber size of 3-10g was recorded in significantly higher numbers (49) and weight (95g) of <3g minitubers/plot over <3g (30 and 53g). Among harvest dates, no significant differences was recorded for <3g minitubers number/plot, but highest was recorded in over 4th harvest-2nd March (45), but for weight significantly higher <3g minitubers/plot was recorded in 4th harvest-2nd

Table 1. Effect of tuber size and harvest interval on growth and yield parameters

Parameters	Growth attributing parameters										Yield parameters					
	Tuber size (TS)/Harvest Intervals (HI)	Germi- nation (%)	Compound Leaves/plant		Plant height (cm)		Number	Yield/ plant (g)	Weight (g)	< 3g by No.	Yield/ M ² (g)	Total No.	Total wt	< 3g by No.	Percent Tuber	
			50 DAP	75 DAP	50 DAP	75 DAP										< 3g by wt
< 3g	83.15	9.0	10.0	22.0	26.0	6.0	33.0	33.0	30.0	53.0	81.0	886.0	35.44	6.87		
3-10g	95.73	13.0	13.0	32.0	35.0	9.0	49.0	49.0	49.0	95.0	123.0	1477.0	39.14	6.96		
CD@5%	6.11	0.8	0.7	4.0	3.2	0.9	4.9	4.9	10.5	20.4	24.7	357.2	5.21	1.83		
1 st -22 nd Jan	85.77	10.0	11.0	22.0	27.0	7.0	35.0	35.0	41.0	80.0	86.0	867.0	47.24	9.47		
2 nd -29 th Jan	76.60	10.0	11.0	27.0	30.0	8.0	43.0	43.0	43.0	98.0	101.0	1325.0	35.26	7.07		
3 rd -19 th Feb	91.22	11.0	11.0	28.0	33.0	8.0	37.0	37.0	45.0	121.0	109.0	1299.0	41.14	11.39		
4 th -2 nd March	91.16	11.0	12.0	23.0	28.0	6.0	34.0	34.0	32.0	48.0	79.0	783.0	41.21	6.62		
5 th -12 th Mar	93.33	11.0	11.0	28.0	31.0	9.0	43.0	43.0	43.0	62.0	121.0	1141.0	32.73	5.27		
6 th -21 st Mar	93.72	12.0	13.0	29.0	34.0	9.0	47.0	47.0	37.0	80.0	112.0	2066.0	35.11	5.11		
7 th -2 nd April	89.49	11.0	13.0	24.0	29.0	7.0	41.0	41.0	42.0	59.0	107.0	927.0	39.38	6.76		
8 th -10 th April	90.77	10.0	12.0	29.0	32.0	8.0	42.0	42.0	29.0	52.0	94.0	1104.0	26.62	4.40		
9 th -24 th April	92.89	13.0	13.0	30.0	35.0	8.0	45.0	45.0	44.0	65.0	112.0	1121.0	36.91	6.16		
CV (%)	12.36	12.5	11.2	27.0	19.1	22.5	21.9	21.9	48.1	50.0	43.6	54.7	25.29	47.75		
CD (p=0.05)	12.97	1.6	1.6	8.5	6.8	2.0	10.5	10.5	22.2	43.3	52.3	757.7	11.06	3.87		
CD (p=0.05) (TSXHI)	18.34	2.3	2.2	12.1	9.7	2.8	14.8	14.8	31.4	61.2	74.0	1071.6	15.64	5.48		

March (121g) followed by 3rd harvest -19th Feb (98g). No significant difference was recorded in per cent <3g minituber both by number and weight among the two grades planted. Among harvest dates, significantly higher <3g minitubers by number were recorded in 1st, 3rd, 4th and 7th harvest over 8th harvest (26.62%). By weight, significantly higher <3g minituber weight was recorded in 3rd (11.39%) and 1st harvest (9.47%).

Performance of 3-10 gram aeroponic tubers of 21st March (6th harvest) was better in seed potato production system of Generation-0 and 1st-22nd January harvest produced higher amount of <3g minitubers under net house conditions in central India.

REFERENCES

1. TOSKA O, P DEMO, AB NAYDE AND K NAGAMAU (2012). Potato seed tuber production from in vitro and apical stem cutting under aeroponic system. *African Journal of Biotechnology*, **11**: 12612-12618.
2. ENDALE G, W GEBREMEDHIN AND M LEMAGA (2008). Potato seed management. In root and tuber crops: The untapped resources, Gebremedhin GEW and B Lemaga (Eds). Ethiopia Institute of Agriculture Research, Addis Ababa, Ethiopia. pp: 53-78.
3. FAO (2008). International year of potato. Retrieved from http://www.fao.org/agriculture/crops/thematic_site_map/theme/hort-indust-crops/international-year-of-potato/en/
4. CHRISTIE, CB AND MA NICHOLS (2004). Aeroponics: A Production system and research tool. *Acta Horticulturae*, **64**(8): 289-91.
5. FARRAN I AND AM MINGO-CASTEL (2006). Potato Minituber Production Using Aeroponics: Effect of Plant Density and Harvesting Intervals. *American Journal of Potato Research*, **83**: 47-53.
6. MATEUS-RODRIGUEZ J, S DE HAAN, ANDRADE-PIEDRAJ, L MALDONADO, G HAREAU, I BARKER, C CHUQUILLANQUI, V OTAZÚ, FRISANCHORANDBASTOSC (2013). Technical and economic analysis of aeroponics and other system for potato mini-tuber production in latin America. *American Journal of Potato Research*, **90**: 357-368.
7. SINGH S, V SINGH AND SK PANDEY (2010). Aeroponic for potato seed production. *ICAR News: A Science and Technology Newsletter*, New Delhi, **16**(2): 1-2.
8. RITTER E, ANGULOB, RIGAP, HERR-INC, RELLOSOJ AND M SAN JOS (2001). Comparison of hydroponic and aeroponic cultivation systems for the production of potato minitubers. *Potato Research*, **44**: 127-35.
9. BAG TK, AK SRIVASTAVA, SK YADAV, MS GURJAR, LC DIENGDOH, R RAI AND S SINGH (2015). Potato (*Solanum tuberosum*) aeroponics for quality seed production in north eastern Himalayan region of India. *Indian Journal of Agricultural Sciences*, **85**(10): 1360-1364.
10. RANALLI PM, L BIZARRI AND M MARI (1994). Genotypic influence on in vitro induction, dormancy length, advancing age and agronomical performance of potato microtubers (*Solanum tuberosum* L.). *Annals Applied Biology*, **125**: 161-167.
11. TIERNO R, A CARRASCO, E RITTER AND JIR DE GALARRETA (2014). Differential growth response and minituber production of three potato cultivars under aeroponics and greenhouse bed culture. *American Journal of Potato Research*, **91**: 346-353.