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Effect of MS Medium Gel on Potato Micro Plants Performance Under *In Vivo* Conditions of Central India

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Abstract A field experiment was conducted to evaluate the production potential of gel rooted microplants and non-gel rooted microplants of three varieties viz. Kufri surya, Kufri lauvkar and Kufri sindhuri under aphid proof net house condition in G-0. All the growth and yield attributing parameters viz. establishment percent, number and weight of tuber per plant, mean tuber weight, number and weight of tuber per plot and percentage of <3g tubers both by number and weight were significantly higher in gel rooted microplants over non-gel rooted microplants. The very good establishment (84.4%) was recorded in gel-rooted planting of microplant which resulted higher yield than non-gel transplanting. Among the varieties, establishment percent was significantly higher in Kufri lauvkar and Kufri surya. All other yield attributing parameters viz. number and weight of tuber per plant, mean tuber weight, number and weight of tuber per plot were significantly higher in Kufri surya and Kufri sindhuri. Percentage of <3g tubers both by number and weight were significantly higher in Kufri sindhuri (54.64 and 14.46). Health wise gel rooted microplants and non-gel rooted micro plants in all the three varieties were found to be free from five major potato viruses (X, S, M, Y and A). It is clear that mini-tuber production of potato through gel rooted microplants is better under water deficit soil ecosystem of Gwalior regions.

Keywords Potato, Mini-tuber, Microplants, MS medium. Gel.

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Introduction

Potato seed production in India is being done through conventional and high-tech system. Under the conventional seed production program, released varieties were undertaken for the nucleus seed production

through clonal selection and tuber indexing while in hi-tech seed production system, nucleus planting material was produced in the laboratory under controlled condition. Potatoes are normally propagated by planting the buds, or "eyes" present on the tubers. This method of propagation allows viruses to be transmitted to the new crop each year, resulting in diseases which in turn reduce yields [1, 2]. Tissue culture techniques are most effective to get virus free microplants. The virus free plants will be used as mother plant for micropropagation [3]. The microplants/microtubers were planted in net-house conditions for production of mini-tubers (G-0). Normally in tissue culture, agar is most frequently used as solidifying agent. It is commercially extracted from red algae genera *Gelidium gracillaria* [4, 5]. The main reasons for its wide use are stability, high clarity, non-toxicity and metabolic inactiveness [5]. Agar is generally the gelling agent used during shoot multiplication and in *vitro* tuberization of potato [6]. Gelling agent such as agar which is usually added to increase media viscosity contributes 70% of the media costs [7]. However, production of low cost high value plantlets is an ultimate objective which could be achieved by appropriate choice of media components [8].

The main advantage of producing mini-tubers from *in vitro* plantlets is that it allows a faster multiplication rate in seed programs and reduces the number of field generations needed [2] and also produces high quality and uniform plantlets [8]. Moreover, transferring of virus-free plantlets from *in vitro* to *in vovo* and pot conditions are a cultical period [9]. Mini-tuber production through planting of micro-propagated plantlets in soil can be regarded as a quick and effective appreach for potato seed tuber production [10] which is termed as G-0 under aphid proof net houses and further multiplied as Gen-1 and Gen-2 in fields and then supplied as breeder seed. In the last four years experience (2007–2010) of multiplication of non gel-rooted microplants which was normal trend of multiplication under aphid proof net house condition, it had observed that establishment rate was very low ranging from 6% in Kufri chipsona-3 to 47.5% in Kufri lauvkar and yield ranging from 0.60 g/m^2 in Kufri chandramukhi to 2.11 kg/m^2 in Kufri sindhuri under Gwalior conditions [11]. The soil conditions and water constraints are also a reason for poor establishment of microplants in Gwalior region. Therefore, present experiment was conducted to evaluate established production potential of gel-rooted microplants and non-gel rooted microplants under aphid proof net house condition in G-0.

Materials and Methods

The experiment was conducted at Central Potato Research Station, Gwalior during 2010-11 crop seasons, Microplants of three varieties viz. Kufri surya, Kufri lauvkar and Kufri sindhuri were produced in the tissue culture laboratory at CPRI, Shimla. After virus testing of plants with ELISA, EM and PCR, free plants selected for meristem tip culture. Using nodal/sprout cuttings, the *in vitro* stocks of selected plants are developed and further sub-cultured in Ribavarin (20 ppm) modified MS media for chemotherapy. This culture is then given thermotherapy at 37°C and 16 h photo period (120–200 µmol/m2/s-1) in the culture room for nearly 20 days. Using stereomicroscope, the apical/axillary meristem (0.2 to 0.3 mm) is excised from *in vitro* plants aseptically with the help of streile scalpel, needle and blade. The excised meristem is grown in the test tubes containing MS medium (0.8% agar) with growth regulators and incubated in the culture tubes at 25°C and 16 h photo period (120-200 µmol/m2/s-1) in the culture room until the meristem germinates. The meri-clones are then sub-cultured through nodel cutting after it attains a height of 4-5 cm and the pedigree is maintained. The fully grown mericlones tested against potato viruses like PVX, PVS, PVA, PVY, PVM, PLRV, PALCV and PSTVd through ELISA, EM and PCR. The virus-free cultures are again subcultured once in every 3-4 week so as to get more number of virus-free microplants [12]. The microplants supplied along with agar in test tube for further multiplication under G-0 in net house. Before transplanting microplants were hardned in nethouse at Gwalior for one week for acclimatization.

Two types of microplants viz. microplants along with MS media gel with roots (M_1) and microplants without MS media gel-M_2 transplanted under aphid free net house on well prepared beds during last week of October. Seed bed was prepared by making one inch thick layer of well decomposed farm yard ma-

Table 1. Growth and yield attributes of micro plants in different cultivars. M_1 - Gel rooted microplants, M_2 - Non-gel rooted microplants.

	Growth attributes		Yield attributes					<3 g mini-tuber (%)	
				Per plant		Per plot (0.6 m^2)			
Parameters	Establish-ment (%)	No. of compound leaves	No. of mini-tuber	Weight of mini-tuber (g)	Mean mini-tuber weight (g)	No. of mini-tuber	Weight of mini-tuber (g)	By number	By weight
M_1 *	84.44	15.3	14.8	237	15.8	182	1976	53.62	12.11
M_2 *	42.22	15.9	10.7	154	14.7	65	913	48.31	8.88
SE(m) 0.70	3.52	0.4	0.4	1.7	1.0	0.16	3.0	2.3	0.53
CD (0.05)	7.17	NS	3.5	2.0	0.32	6.2	4.8	1.08	1.42
Kufri lauvkar	67.50	13.5	12.7	154	13.5	67	676	51.14	9.95
Kufri surya	65.83	15.0	13.3	248	16.6	121	1928	47.11	7.08
Kufri sindhuri	56.67	18.3	12.2	185	15.7	183	1731	54.64	14.46
SE(m)	0.69	2.2	0.4	0.8	0.31	2.1	2.1	0.55	1.14
CD	1.40	4.4	0.7	1.6	0.62	4.4	4.3	1.08	2.32
SE(m) Interaction	0.21	1.8	0.3	0.4	0.55	1.6	1.1	0.81	0.25
CD (Interaction)	0.43	3.6	0.60	0.7	1.13	3.2	2.3	1.64	0.51

nure and sand in the ratio of 1:1 on the top of the bed. Microplants from whole test tube along with gel (M_1) and two seedlings of micro plant without gel (M_2), 20 each of cultivar Kufri lauvkar, Kufri surya and Kufri sindhuri were planted at 30 × 10 cm spacing in 2 m rows (0.6 M^2 plot size). For non gel microplants, agar gel media sticking to roots was properly washed off and excessive long roots were removed before transplanting. The trial was planted in randomized block design (RBD) and replicated 3 times. A light irrigation was given with the help of shower just after planting and subsequent irrigation was given as per the need of the crop. Other package of practices was followed as per recommendation for seed potato crop.

Results and Discussion

Growth parameters

It is evident that establishment was significantly higher in gel rooted microplants (84.44%) over non-gel rooted microplants (42.22%). MS medium avoids the dehydration during microprogration of meristems in test tubes. The more root system in gel rooted microplants with MS media agar provides carbon source and less dehydration of microplants which helped for better establishment under net house conditions. The high number of roots per explants allowed easier absorption of nutrients from the medium, which led to better plantlet growth, also potato plantlets require an initial source of carbon and hence energy from the medium until they are capable of using CO_2 as their main carbon source for efficient metabolism [4]. There was no root damage hence no transplanting shock and predonged water retention in gel resulted more easily establishment of microplants. Among varieties, Kufri lauvkar (67.50%) and Kufri surya (65.83%) recorded significantly higher establishment in comparison to Kufri sindhuri (56.67%). Average establishment for four years multiplication in Kufri lauvkar (47.5%), for three years multiplication of Kufri sindhuri (46.7%) and Kufri surya (42.0%) was recorded with non-gel rooted microplants under Gwallor region during 2007–2010 [11].

No significant difference was recorded between gel and non-gel rooted microplants in terms of compound leaves per plant. Kufri sindhri recorded comparatively higher compound leaves per plant (18.33) over Kufri lauvkar and K. surya. Single stem per plant was recorded in gel and non-gel rooted microplants in all the three varieties (Table 1).

Yield attributes

The number of mini tuber was significantly higher (14.8) in gel rooted plant as compared to non-gel plant-

ing (10.7). Significantly higher weight per plant and also mean tuber weight was recorded in gel-rooted microplants (237 g and 15.8 g) over non-gel rooted microplants (154 g and 14.7 g). Among the varieties, significantly higher tuber number per plant, recorded in Kufri surya and Kufri sindhuri over Kufri lauvkar. Average mean tuber weight for three years multiplication in Kufri surya (30.5 g), Kufri lauvkar (16.4 g) and Kufri sindhuri (12.2 g) was recorded of microplants under Gwalior region during 2007–2010 [11].

Significantly higher mini-tuber yield per plant (0.6 m^2) both by number (182) and weight (1976 g) was recorded in gel-rooted microplants over non-gel rooted microplants (65 and 913 g). The tuber number in gel rooted microplants is about three times and tuber yield is more than three times than non gel rooted microplants (Table 1). This is due to higher establishment and significant growth parameters in the gel rooted microplants in Gwalior conditions. Among varieties, Kufri surya (121 and 1928 g) and Kufri sindhuri (183 and 1731 g) produced higher number and yield of tubers over Kufri lauvkar (67 and 676 g) is referred maximum on the unit area. However, tuber number and yield/m^2 during three years multiplication of microplants of Kufri sindhuri was reported (173 and 2.11 g/m^2) at Gwalior [11]. Mini-tuber yield per plant and per unit area was recorded highest in cultivar Kufri bahar followed by Kufri badshah and Kufri chipsina-1 at Modipuram [13].

Percentage of <3g mini-tuber both by number and weight was significantly higher in gel planted microplants (53.62 and 12.11) over non-gel planted microplants (48.31 and 8.88). It is clear that gel root planting is not good for reduction of <3 gram mini-tuber production. Among varieties, Kufri lauvkar (51.14 and 9.95) and Kufri sindhuri (54.64 and 14.46) were recorded significantly higher percent <3g tubers over Kufri surya (47.11 and 7.08) both by number and weight in non-gel. Similar results were obtained during three years multiplication of non-gel rooted microplants of Kufri sindhuri, Kufri lauvkar and Kufri surya during 2007–2010 at Gwalior MP where <3 g mini-tubers varied from 42.5 to 38% by number and 10.2 to 13.9% by weight in gel based planting [11].

Gel rooted microplants and non-gel rooted microplants in all the three varieties were free from five major potato viruses (X, S, M, Y and A) in ELISA testing which are mainly responsible for degenerating of the seed quality. This indicates the high quality of seed material in Generation-0 and thus can lead to production of disease free breeder seed in Generation-1 and Generation-2.

Conclusion

There is a perpetual problem of ground water for irrigation, cloddy textured soil with negligible organic carbon, high temperature and harsh climate in Gwalior region. It is very difficult to implement high-tech seed production system through microplants. On the basis of present findings it was observed that gel rooted microplants performed significantly better in all growth as well as yield attributing parameters over non-gel rooted microplants. Very good establishment about 84% was achieved by gel based planting which can be further improved with manipulation of soil ecology and planting time. Among varieties, Kufri surya and Kufri sindhuri performed better in growth as well as yield attributing parameters over Kufri lauvkar. It is recommended on that mini-tuber production of potato should be taken through gel rooted microplants under Gwalior region.

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