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Short Communication

THE ECONOMICS OF PLANT TISSUE CULTURE: AN INDIAN PERSPECTIVE

MANU PANT*, RENU MEHTA

Department of Biotechnology, Graphic Era University, Dehradun - 248 002, Uttarakhand, India. Email: himaniab@gmail.com

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Plant tissue culture (PTC), in India, is a clichéd topic to discuss. For an agriculturally reliant nation, the concept of large scale production of disease-free plants of choice, starting from a strikingly small plant tissue in a limited space, and in a seasonally independent manner has proven to be tremendously appealing. After initial success, the technology spread its roots to most of the research institutes/universities across the world. The technology continues to charm with the benefits of mass propagation of desired plant variety, germplasm conservation, virus free plant production, somaclonal variations, propagation of RET plants, and an endless list thereof. Consequently, PTC features as a basic requirement for numerous projects/state-of-art laboratories sponsored by national and international funding agencies.

However, what is being attended here is a not-so-well attended question of actual technology adaptation at field level; the answer to which is not very satisfying. Dwelling into the situation highlights two major reasons: Problems in hardening/acclimatization of tissue culture raised plantlets and a reasonably high production cost. The challenges have long been identified, and concerted efforts have been made in this direction by dedicated research institutes and commercial laboratories. Both these enterprises (research-based and commercialized) have been working on developing systems for complete plantlet development aided with methods for maximal field survival with highly successful outputs. The fundamental difference in work culture of both set ups is that while most of the research labs focus on the development of micropropagation protocols for a chosen plant species (utilizing sophisticated/expensive materials and instruments/methods fascinating to the research community); a commercial lab ensures minimal investments chiefly focusing on ultimate financial gains. In both the cases, the final produce is available with a considerably handsome market price. The high cost of tissue raised plants (thanks to all the input costs) continues to challenge their wider acceptance by the farmers/growers. In developing countries, the field plantations of such plants remain largely restricted to cases where material supply is taken care of by government agencies-mostly through some funded projects or by commercial set-ups in alliance with well-off farmers who can pay a good price of the produce.

A further insight reveals PTC nutrient media, agar and sucrose to be the major contributors to overall production cost. The problem being identified, several research works have already been focused on minimizing this production cost. These studies are still at large to be practically incorporated primarily due to the existing gap between research and production parameters. Needless to say, replacing tissue culture media components with alternatives such as hydroponics/Hoagland's solution remains unsuccessful in the most cases. Contrastingly, shifting the focus to replace the commonly used solidifying agent/carbon source with cheaper alternatives is a feasible choice.

In PTC experiments, most commonly used and least expensive solidifying agent is agar (others being agarose or phytagel) that only serves to provide a semisolid substratum for plant tissues to be cultured on *in vitro*. It is generally used at a concentration ranging from 7.0 to 7.5 g/l of culture media. Considering an example of India, the cost of agar ranges with different suppliers (Hi Media: INR 4,024.00/500 g; CDH: 2495.00/500 g to name a few). On an average, about 150 ml culture media in an Erlenmeyer flask can easily house approximately 100 rootable size shoots and the cost of agar in this 150 ml media amounts to about INR 5.00-9.00 (depending on the chemical grading of commercially available agar). In this context, replacing agar with a commonly available psyllium husk (aka isabgol in India, average market price INR 320.00/500 g) in Indian market can be looked up to as a good option.

Psyllium husk is the upper coating of *Plantago ovata* and widely used as an ayurvedic treatment for stomach ailments. The husk forms a semisolid mass on coming in contact with water (a function attributed to agar in media preparations). As per the statistics, India leads the global production of psyllium husk providing approximately 80% of psyllium in the world market. Psyllium husk industry in the country is mostly flourishing in Gujarat/Rajasthan (Sarvoday Sat Isabgol Ind., Shiv Psyllium Ind., Atlas Ind., Urvesh Ind. to name a few). These industries are also leading exporters to other countries, viz., US/UK/Germany/Indonesia/Malaysia/China, etc. The international buyers range from Procter and Gamble (under brand name Metamucil), Reckitt Benckiser Healthcare (as Fybogel Ispaghula Husks), and many more. While US shares 60% of the world demand, other countries share 25% while the domestic market shares only 15% of the gross psyllium husk production. If psyllium husk is tried as an alternative solidifying agent in majority of PTC labs in the country, what can be eyed next is coming up of larger number of small scale industries on psyllium husk production to cater to the increased demands with successive augmentation in job opportunities, not to mention the overall reduction in production cost of tissue culture plantlets.

Furthermore, the use of glass beads also holds promise. For plant tissues growing well in liquid medium, glass beads provide suitable substratum with an additional benefit of reuse, hence bringing down the input cost by eliminating the usage of a solidifying agent in every cycle.

Similarly, the idea of replacing purified sucrose with market sugar/jaggery holds analogous promise. Comparative cost assessment reveals sucrose price varies from 220.00 to 450.00/500 g (grade dependent) while the cost of market sugar ranging from INR 20.00 to 30.00/500 g.

Besides the idea of using LEDs in place of fluorescent tubes in culture room (growth chamber for cultured plant tissues) can also be put to work.

What is being suggested here is a simple concept of each research lab in the country designing at least one experiment with low cost alternatives. The result would be marked reduction in total production cost (over 6-10 times), wider acceptance of the plant produce by the target growers, increased demand of the husk/sugar in the indigenous market, and an improved scope for upcoming cottage industries.

True it is that the concept calls for concerted efforts and experimentation on standardizing husk/sugar concentration for optimal plant growth *in vitro.* Nevertheless, the efforts shall pay once we witness the elevated transfer of tissue culture raised plantlets to the growers, increased farm employment and industrial expansion. The modus operandi has previously been tried in certain cases and has proved its worthiness. The need is to highlight this model and accept it for a change from the conventional conduit irrespective of availability or paucity of funds. This shall strengthen the very objective of PTC: Products (a huge number of agriculturally/horticulturally/floriculturally important healthy plants) from LAB-to-LAND-at a markedly reduced cost and at elevated benefits to a wider population.