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RESEARCH BRIEF

Apical Rooted Cuttings for Cheaper Potato Seeds

Advances in ARC technology can save farmers money and lower capital start-up costs for producing better seeds.

Background

The potato sector in India continues to face serious problems accessing good-quality planting materials at affordable prices for small and marginal farmers in many potato-growing states. Because seed accounts for 40-50% of the total cost of production, this is a huge burden for small farmers. In the coming season, seed costs will be even higher—more than one lakh rupees¹ per hectare. The high cost of seed has led some small farmers to use discarded small-sized potato as seed in the potato-growing belts.

Even if farmers want to purchase good-quality seed at such a high price, there is still no guarantee they will be able to obtain high-quality of seed in a timely manner because of the long distances (up to 2,000 km) seed often has to be transported, affecting both their quality and delivery.

Objectives

So, how do we solve the potato seed problem? Two things need to happen. First, a low-cost seed multiplication technology should be made available instead of aeroponic technology, which requires high capital and a long



Figure 1. Apical Rooted Cutting ready for planting. (© CIP/R. Reddy)

gestation period. Second, this low-cost technology needs to be promoted in the production belts so that progressive farmers, farmer producer organizations (FPOs), and other small entrepreneurs in potato-growing states can adopt seed potato production.

¹ At the time of publication, 1 US dollar (USD) is equivalent to 73.7 Indian rupees (INR). To derive USD equivalents in this brief, divide the number of INR by 73.7. One lakh rupees is 100,000 and equal to USD 1,356.

Accordingly, this research pursued four objectives:

- To pilot apical rooted cutting (ARC) technology in different parts of India;
- To assess its performance and economic viability;
- To scale up ARC technology in different potato growing states; and
- To attract youth and women to take up ARC potato seed production

Approach

Apical rooted cutting (ARC) is a low-cost potato seed production technology introduced in different parts of India last season to examine its performance and economic viability. Last season (in partnership with the University of Horticultural Sciences, Bagalkot), we produced apical rooted cuttings in our Bangaluru/Hassan facility to produce tissue culture plantlets of popular varieties, rooted cuttings from mother plants, and seed tubers from cuttings for further multiplication (Figure 1). We also piloted apical rooted cuttings in Assam and Odisha in partnership with the Central Potato Research Institute, Shimla (CPRI).

Outcome and discussion

Table 1 presents the cost and returns to produce cuttings from tissue culture plantlets. The investment in infrastructure is approximately INR 35 lakhs with INR 15 lakhs required for the tissue culture laboratory and INR 20 lakhs for two polyhouses. Assuming a 10-year life span for the tissue culture laboratory and polyhouses, the annual amortized amount is estimated to be INR 3.5 lakhs. The cost to produce 20 lakhs of ARCs from tissue culture plantlets is estimated to be INR 14.1 lakhs. At a price per cutting of INR 1, the potential profit is INR 5.9 lakhs.

Table 1: Cost and Returns of Establishing Tissue Culture Laboratory and Polyhouses to Multiply Tissue Culture Plantlets and Apical rooted cuttings

Facility	One-time investment for 10 years (INR)	Annual amortization cost (INR)
Tissue culture laboratory	1,500,000	
Two polyhouses of 500m ² size	2,000,000	
Upfront investment	3,500,000	350,000

Item	Number	Unit cost (INR)	Cost/revenue/profit (INR)
Tissue culture plantlet production	20,000	3	Cost 60,000
Production of cuttings (including labor, coir pith, and tray)	2,000,000	0.50	Cost 1,000,000
Total cost			1,410,000
Gross revenue from selling cuttings	2,000,000	1.00	2,000,000
Net profit (revenue minus cost)			590,000

With an upfront investment of INR 35 lakhs and operating budget of INR 14 lakhs, the scenario in Table 1 could be expensive for small farming entrepreneurs. In that case, farmers can purchase tissue culture plantlets from a tissue culture laboratory and operate on a smaller scale. As shown in Table 2, the upfront cost of setting up one polyhouse would be INR 10 lakhs and the operating budget to produce 10 lakhs (one million) cuttings would be approximately INR 5.3 lakhs. Selling at INR 1 per cutting, the operation will generate a net profit of INR 3.7 lakhs within a period of 4-6 months.

Table 2: Cost and Returns of Establishing Polyhouses to Produce Apical Rooted Cuttings from Tissue Culture Plantlets

Item	One-time investment for 10 years (INR)	Annual amortization cost (INR)
One polyhouse of 500m ²	1,000,000	
Upfront investment	1,000,000	100,000

Cost	Number	Unit cost (INR)	Cost/revenue/profit (INR)
Tissue culture plantlet production	10,000	3	Cost 30,000
Production of cuttings (including labor, coir pith, and tray)	1,000,000	0.50	Cost 500,000
Total cost			630,000
Gross revenue by selling cuttings	1,000,000	1.00	1,000,000
Net profit (revenue minus cost)			370,000

The cuttings are planted in an open field or temporary net house for producing first-generation seed and in an open field for second-and third-generation seed. The cuttings grown in open fields can be sold to farmers after the second generation, whereas cuttings planted in the net house can be multiplied one more round before selling to farmers to make them economically viable (Figure 2).

Table 3 shows the cost and returns of producing first- and second-generation seeds from ARC in an open field. One acre will require 40,000 cuttings to produce approximately 400,000 seed tubers with an average of 10 tubers per cutting. These were results determined by cuttings planted in Hassan (Karnataka), Bhubaneswar (Odisha), Morigaon (Assam), and Shamgarh (Haryana) (Figure 3).



Figure 2. Various steps in ARC seed production. (© CIP/Karnataka)

Table 3. Cost and returns of producing first- & second-generation seed potato from apical rooted cuttings.

	Item	Unit cost (INR)	Cost (INR)
Apical rooted cuttings	40,000 (per acre)	1	40,000
Cost of production	1 Acre	60,000	60,000
Cold storage cost of first generation tubers	400,000	5,000 per 100,000 tubers	20,000
Multiplication from first to second generation seeds			
Cost of production	10 acres	60,000	600,000
Cold storage cost of second generation tubers	80 tons	2,000	160,000
Total cost			880,000
Gross revenue	80 tons	20,000	1,600,000
Net profit			740,000



Figure 3. Potato seed tubers from apical rooted cuttings in Morigaon, Assam. (© CIP/S. Mohanty)

In the next season, 400,000 first generation tubers can be planted on 10 acres to produce 80 tons of second-generation seeds. These second-generation seeds can be sold to farmers in the following season at INR 20 per kilogram to generate a net profit of INR 7.4 lakhs.

Scaling up ARC technology in potato-growing states

So far, seven nurseries in Hassan and a few large potato farmers in Haryana have begun producing ARCs from tissue culture plantlets. The numbers in Karnataka and Haryana are expected to rise significantly in the coming season. Recently, we provided training to two nurseries with tissue culture facilities in Odisha to start producing ARCs in the coming season. They are expected to produce 500,000 to one million cuttings next season for further

multiplication on their farms and to begin selling to other farmers or organizations interested in producing first and second generation potato seeds. We are partnering with the Central Potato Research Institute (CPRI) and horticulture departments in Bihar and Meghalaya to pilot and demonstrate the ARC technology to larger groups of farmers.

The decentralization of potato seed production using this low-cost technology has the potential to reduce the seed costs by 25-50%. The availability of quality seed at cheaper price will encourage farmers to purchase seed rather than use discarded small-sized potato not suitable for human consumption. This will have significant positive effect on potato yield, ultimately leading to higher profits for small and marginal farmers in potato growing states.

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