Economics of producing plantlets in Temporary Immersion Bioreactors

Poor quality planting material remains a challenge undermining efforts to improve productivity of roots and tubers (Ezeta 2001, Gildermacher et al., 2009, Mignouna et al., 2012, Maroya et al., 2014). The use of certified seed in roots and tubers is estimated to be less than 5 percent as most farmers do not use (Hidalgo et al., 2009, Mignouna et al., 2014, Maroya et al., 2014). Production of certified seed yams involves overcoming a complex combination of technical, ecological, institutional and economic constraints. Main economic problem is their cost to end-users: Seed yam (based on ware yam) could take up to 50% of the total production costs (Correa et al., 2009; Mignouna et al., 2014). To relax these constraints, new technologies developed and employed in YIIFSWA projects include Temporary Immersion Bioreactors (TIBs)

Temporary Immersion Bioreactor (TIB) technology (Adelberg and Simpson 2002) is a propagation system that grows plants rapidly by immersing them intermittently in liquid nutrients in sterile laboratory containers (bioreactors). The system is propelled by air flow under pressure. In temporary immersion, the cultures are immersed in the medium for a pre-set duration at specified intervals. The TIB system is new generation tissue culture technology, and the timed immersion of plant tissues in liquid medium allows for the aeration of cultures. Each unit is a bioreactor – an enclosed sterile laboratory environment – provided with inlets and outlets for air flow under pressure. This circumvents the limitations associated with conventional tissue culture.

Attempts were being made to estimate the cost of producing plantlets in the TIBs. Fixed and variable costs elements were established with the manager and other experts working on the TIBs. Supplementary data was collected from IITA-Oracle database. Qualitative data were also collected on ease of technology, requirement for equipment and inputs, qualified personnel, etc

The adopted analytical techniques included production costs and several other profitability indicators as described by Espinos et al., (1996). Total production costs (TPC, US $ per season) included fixed costs and variable costs. Fixed costs included investment in infrastructure as well as materials and equipment. The fixed costs were estimated for a variable lifetime following Miragem et al., (1982) and amortized during each agricultural season. Variable costs were the costs on inputs, maintenance, storage, and personnel expenses. The cost of the plantlet (C,US $ per unit) was calculated using the formula C=TPC/Q, where Q is the quantity of plantlet produced. For an estimation of gross income (GI, US $), an estimate of sale value is expected to be used. This would be varied for sensitivity analysis. The net profit (NP, US $) would be calculated following Maldonado et al., (2007), NP =GI-TPC and the Profitability would be obtained applying the formula, P =NP/TPC*100. With the figure of TPC, and the estimates of GI and NP, the cash flows are established considering a productive activity of 3 years. The projected cash flow of the productive activity would then used to define financial viability: Net present value (NPV, US $), internal rate of return (IRR, %) and benefit-cost ratio. However, the estimation was based on the following assumptions: (i) Expectation of good yield that will attract higher price. The bioreactor system is expected to last for 3 years. This is because by the end of the third year, most capital equipment will reach their useful life span and will have to be replaced. Land rent was not considered because it was done once and for all other components provided by nature. The monetary unit used is US$ at an exchange rate of N160 to one US$. Production cost vary in a given proportion in a certain period. Costs and revenue are discounted by 3.4% based on latest available lending rate of 12% for loans of 3 to 3 years minus inflation rate of 8.6%.

Some preliminary results show that TIBs technology provides great opportunity for ameliorating challenges of producing disease-free and high ratio propagated seed yam. Many planting materials could also be generated from the plantlets produced in the TIBs. However, at present, the cost of producing in the TIBs is prohibitively high. Cost of labour and materials dominated the cost items. Attempts should be made to source for materials for TIBs locally or local materials should be adapted to its development and operations. Attention therefore should be focused on reducing the costs of production in the TIBs as a way of reducing the costs to the end-users. Engagement of private entrepreneurs with pure business motives compare to public institution could be more cost-effective