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Economic viability of large-scale production of the biocontrol agent *Trichoderma harzianum* Rifai

M S Madan, K V Ramana, K A Manoj, M Anandaraj, R Suseela Bhai & I S Meera

Indian Institute of Spices Research
Calicut – 673012, Kerala, India.
E-mail: msmadan@iisr.org

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Abstract

The economic viability of large scale production of the biocontrol agent *Trichoderma harzianum* effective against the soil-borne disease *Phytophthora* foot rot (caused by *P. capsici*) of black pepper (*Piper nigrum*) was studied. The enterprise was highly profitable for the entrepreneur with a benefit:cost ratio of 1.84. The investment returned a net present worth of Rs. 2,42,618 @ 11% interest rate for 10 years period with an internal rate of return of 121%.

Keywords: black pepper, biocontrol agent, economic viability, *Phytophthora* foot rot, *Piper nigrum*, *Trichoderma harzianum*.

Crop loss due to pests and diseases is one of the major reasons for the low productivity of black pepper (*Piper nigrum* L.) in India. *Phytophthora* foot rot caused by *P. capsici* Mchau et Coffey inflicts large-scale death of black pepper vines in Kerala causing severe crop losses of around 2,000 t valued at Rs. 320 million (Sarma & Anandaraj 1998). Though chemical control measures are effective, they are not economically viable and environmentally safe. Pesticide residues often pose a major threat for export of black pepper and hence eco-friendly disease management schedules is a major option. *Trichoderma harzianum* Rifai, a biocontrol agent, is effective against this soil-borne disease (Anandaraj & Sarma 1994; Sarma *et al.* 1996). The technology for mass multiplication of this biocontrol agent has been standardized and commercialized by Indian Institute of Spices Research, Calicut. In this study, the profitability and financial viability of mass multiplication technology of *T. harzianum* was evaluated during 2003–04. The employment potential created by the technology, aspects of marketing and constraints were also studied.

The target area for the study was confined to the predominantly black pepper growing districts of Kerala. Nine small-scale industrial units producing biocontrol agents were selected for the survey. The entrepreneurs included four from Kottayam District and one each from Thiruvananthapuram, Kollam, Idukki, Thrissur and Malappuram districts. The survey was conducted with the help of well-structured questionnaire prepared for the purpose.

The cost-wise approach was followed for working out the year-wise cost of mass multiplication of *T. harzianum* in an industrial unit. After identifying costs and benefits, the economic worthiness was evaluated following the criteria suggested by Gittinger (1976). Generally, the investment made on an industrial unit generates cash flow for number of years in future. Hence, for long-term evaluation of benefits and costs, the discount factor concept is necessary to have meaningful comparison. The most commonly used discounted measures to evaluate the project worth are net present worth (NPW), internal rate of return (IRR) and benefit:cost ratio (BCR).

$$NPW = \Sigma[(B_t-C_t)/(1+r)^t];\ IRR = \Sigma[(B_t-C_t)/(1+IRR)^t] = 0;\ BCR = \Sigma[(B_t/(1+r)^t]/\Sigma[(C_t)/(1+r)^t]$$

where, B_t denotes the benefits in the year t, C_t is the cost in year t, t is the time period, and r is the discount rate (rate of interest). A stream of benefits or costs for any length of time in the future can be reduced to its present value by using the present value of constant annuity (PVCA). To obtain the amortized value for initial investment for a 10-year project the following formula was used:

$$PVCA = \sum_{n=1}^{x} \frac{1}{(1+r)^n}$$

where, n denotes the number of years and r is the rate of interest.

The PVCA was calculated at an interest rate of 11%, ie, the lending rate of government banks for long-term loans at discounting rate. The annuity value thus obtained was added to the annual operational cost to arrive at the total cost per unit. In this case the initial investment being Rs. 2,81,946, the annuity value for 10 years at the rate of 11% was Rs. 47,931; the amortized land and building value was Rs. 56,263. For analysis of data, a 'Spreadsheet Model' in MS Excel 2000 was developed. The survey data were fed into the spreadsheet model and the final results were obtained in the template.

Cost and return

Analysis of cost and returns for the industrial units indicated that the annual operational cost of Rs. 6,34,435 was much higher than the establishment cost of Rs. 2,81,946. The share of the operational cost in the total production cost was 85.9% and the rest was accounted by the amortized value of initial investment on land and building. Expenditure towards raw material procurement was 53% of the total operational cost. The second major components in the total production cost were wages and salary for the work force (Table 1). The cost of production was reduced through innovative use of cheaper inputs. Most units (80%) have introduced their own innovative ideas into *T. harzianum* production through in-house research activities. Further, scaling up of operations also helped them to reduce the cost per unit by these small scale industrial units.

Rate of return

In order to analyze the rate of return involved in production of *T. harzianum*, the involved costs and returns were subjected to standard cash flow analysis @11% interest rate. The IRR from the investment was 99%, which is more than 10 times the opportunity cost of capital. The NPW was Rs. 2,42,533 at the end of 10 years with a BCR of 1.84 at discounted cash flow. Further, the entrepreneur was able to get back the initial investment in the second year itself (pay back period), while the factory can be operated for more than 10 years. Since *T. harzianum* was one among the many biocontrol/fertilizer products produced by the unit, the common facility created in the factory was shared in production of all these products.

Employment potential

The production units provided employment opportunities to both educated and uneducated youth in production and marketing of the biocontrol agent. Each industrial unit had 2–6 staff in the production field and 5–8 staff in the marketing side. Around 50–60 staff work in the laboratories of these industries related to the production of the biocontrol agents and all of them are either post graduates or graduates in Microbiology.

Marketing

T. harzianum culture produced and marketed

Table 1. Cost and returns for production of *Trichoderma harzianum*

Component	Cost (Rs.)	Share in total cost (%)
Establishment cost		
Machinery	2,17,268	77.1
Vehicle	54,678	19.4
Technical know-how	10,000	3.6
Total establishment cost	2,8,1946	100.0
Operational cost		
Salary for production staff	31,204	4.2
Salary for marketing staff	31,375	4.3
Labour	25,280	3.4
Materials	3,91,553	53.0
Fuel for vehicle	38,194	5.2
Electricity charges	24,857	3.4
Telephone charges	12,976	1.8
Water charges	1,333	0.2
Fire wood/LPG	3,460	0.5
Building repair/maintenance per annum	3,944	0.5
Tax	1,222	0.2
Insurance	2,417	0.3
Packaging cost	18,875	2.6
Travel expenses	8,333	1.1
Marketing cost	3,000	0.4
Miscellaneous	30,833	4.2
Interest on working capital @11% per annum	5,577	0.8
Total operational cost	6,34,435	85.9
Amortized initial investment cost @11%	47,931	6.5
Amortized land and building value @11%	56,263	7.6
Total cost of production	7,38,629	100.0
Cost of production (t^{-1})	38,291	
Cost of production (kg^{-1})	38.30	
Returns		
Total *T. harzianum* production (t)	19.29	
Gross returns @ Rs. 90 kg^{-1}	17,36,100	
Net returns	9,97,471	

by the surveyed units during 2001–02 and 2002–03 was 150 t and 174 t, respectively. However, as per the market reports the total production of *T. harzianum* was 300 t $annum^{-1}$. The produce was being sold at a market price of Rs. 90 kg^{-1}. Out of the total quantity sold, 90% of the product was sold in Kerala and remaining 10% in Karnataka.

The market price of *T. harzianum* was Rs. 90 kg^{-1}. The prices are fixed taking into account various factors like cost of production, dead stock, expected margin, etc. Prior to bulk production of *T. harzianum* for the season, orders for the produce from different markets, governmental and non-governmental agencies, farmers and other consumers, etc. are taken into consideration, because of the short shelf life of the produce. Entrepreneurs prefer to sell their produce to state departments, as they can move bulk quantities with negligible risk. The major markets for biocontrol agents are the high range districts of Kerala and other districts wherever black pepper cultivation is higher. Government organizations and farmer's societies procure in bulk for distribution among farmers. Most entrepreneurs provide detailed information about the product and its usage procedure through brochures and bulletins. Village level seminars are arranged with the help of experts from research institutes and state agricultural universities to educate the farmers. Direct marketing, discount sales, lucky draws, participation in seminars and exhibitions are some of the techniques used by the entrepreneurs to increase the sale volume. The entrepreneurs incorporate their own innovations and improvements not only in production but also in application of *T. harzianum* to various other crops to expand the market for the product.

Black pepper being an export oriented commodity, stringent sanitary and phyto-sanitary requirements in the importing countries and increasing demand for organic spices can accelerate the demand for biocontrol agents leading to better future for this eco-friendly industrial venture.

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