Transferring biopesticide technology to the private sector – lessons learnt from LUBILOSA

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1 LUBILOSA PROJECT – Overview

Project conception and rationale

LUBILOSA is an acronym for Biological control of locusts and grasshoppers (LUtte BIoloque contre les LOcustes et SAuteriaux). The project was conceived following the locust plagues of 1986 – 1989. These were the first major desert locust outbreaks in over 30 years. During this 30 year lull, the control organisations had fallen into lethargy, and the most effective control agent, dieldrin, banned in most countries without an effective replacement being developed. Treatments in the 1986 – 89 plague mostly used organophosphate chemicals, with serious side-effects on birds and other non-target organisms. Donor concern about ineffectiveness of the control operations and environmental contamination led to a search for an environmentally friendly, effective alternative.

Not only was there a need for ‘green’ alternative, there was also a need to develop an integrated pest management (IPM) scheme. This was developed by FAO in the form of the EMPRES programme (Emergency Prevention Scheme for Trans-Boundary Pests and Diseases).

CAB International and IITA proposed a project to investigate biological control options for locust control, highlighting the possibility of oil formulations of fungal spores. Work by Chris Prior of CABI (International Institute of Biological Control) had indicated that suspending insect pathogenic fungal spores in oil might allow them to function and infect insects under conditions of low humidity (Prior and Greathead, 1989).

Phase 1 1989 – 1992 Laboratory testing, strain selection

The project began late in 1989; work at CABI in Ascot focussed on the development of bioassay system and selection of isolates (Bateman et al., 1996), and confirmed the enhanced infectivity of the proposed oil formulations (Bateman et al., 1993). Isolates were collected by a network of collaborators based at DFPV, Niamey, Niger. An isolate of the fungus *Metarhizium* from Niger was selected. Isolates of this fungus were tested in laboratory, cage and on-station trials. Field observations in the framework of a systems analysis examined the role of natural enemies in regulating grasshoppers and locust populations (Shah et al., 1994).

Phase 2 1993 – 1995 Field testing, network development

Phase 2 of LUBILOSA was highly focussed on obtaining scientifically valid evidence for the field efficacy of *Metarhizium* (Lomer et al., 1997). Donors provided no funds for socio-economic and environmental impact modules of the phase 2 proposal. Field testing was carried out in participation with a network of collaborators from CILSS countries. Training, in the form of joint participation in field trials, was a key element. Production of fungus spores was scaled up to permit field testing on up to 50 ha plots. The key constraint was the mobility of the pest populations.

Phase 3 1996 – 1998 Implementation

For the first time in phase 3, a full-time socio-economist was employed to design a programme of studies. Similarly, an eco-toxicologist designed laboratory and field testing of *Metarhizium*. Mass production was scaled up at IITA Cotonou, enabling large scale field testing (Cherry et al., 1999). A 'two-technology' approach was adopted; the vast majority of project results were published and available in the public domain, while some elements of a high-technology specification product were kept confidential. Major advances in spore production and storage technology were made, and these have applicability beyond LUBILOSA (Hong et al., 1999). A product specification was designed, and this forms the basis for the agreement transferring the technology to the private sector. Ecotoxicological trials demonstrated the high degree of specificity of the *Metarhizium* product in field use (Peveling et al., 1999). Registration requirements were fulfilled, and the product is registered in South Africa and accepted by the FAO pesticide referee group (Neethling and Dent, 1998).

Phase 4 1999 – 2000 Follow up

A proposal for a follow-up phase has been submitted to donors. Two donors have accepted the proposal and some work has already begun. The objective is to stimulate demand and ensure supply of the *Metarhizium* product, and to design and advocate use strategies

Spin-off projects

The technology developed by LUBILOSA has been used to develop projects on the microbial control of stem-borers, banana weevil and termites.

2 Farmers viewpoints and ex ante impact assessment

In the first contacts with farmers, it rapidly became apparent that there was a gulf between farmers' concerns and donor concerns, which can be equated with the concerns of poor farmers in developing countries compared with the concerns of rich tax payers in developed countries. The former are concerned with feeding their family at any cost; the latter are concerned about environmental and other issues.

Locusts need to be tackled far from farmers' fields; an individual farmer can do little to protect him or herself against a swarm of locusts. These migratory pests are therefore best dealt with as public rather than private pests.

The project had originally hoped to develop something cheaper than chemical pesticides, produced locally to stimulate economy, but nothing as effective as the *Metarhizium* was found.

Realistically, main impact is on reduced environmental contamination. Components of environmental contamination are food-stuffs, medical costs from application, livestock poisoning, disposal costs (Houndekoun et al., 1999).

3 The technology developed

Oil formulation of spores of the fungus *Metarhizium (flavoviride) anisopliae var. acridum*

IMI 330189. The fungal spores are lipophilic, they suspend will in oil. Not only does this enhance their infectivity at low humidities, but such formulations fit current pesticide application practices.

Fungus production is on cereal or waste substrates – but village level production was rejected following technical and economic analysis. The production process is prone to contamination and involves a lot of time and work. Specialist producers are needed.

4 Farmer's and NGO response to the technology; designing an implementation pathway

First participatory trials disappointing because of technical difficulties, there was little point in involving farmers in solving the technical aspects of formulation. The farmers' response was favourable once the product was adequate; they appreciated being able to see the fungus spores appear on the dead insects, and the slow speed of kill was not a concern so long as the grasshoppers were not already in the crop (De Groote et al., 1999).

The roles of the plant protection services and NGOs in the Sahelian countries is evolving. PPS are retiring from direct interventions in crop protection, except in the case of migratory pests, where continued donor/central government involvement is necessary and desirable.

The operating characteristics of the *Metarhizium* biopesticide are (i) slow speed of kill compared with chemical pesticides, (ii) Prolonged persistence – only one application is needed to provide season-long control.

LUBILOSA adopted a two technology approach to ensure most research stays in public domain, and the decision was taken to define and register a product. There followed a process of selection of companies to produce *Metarhizium.* Large agrichemical companies are not interested in biopesticides, so we decided to work with small specialist production companies.

5 IPR Issues associated with implementing the transfer to the private sector

World-wide the market in biological pesticides is developing slowly so there was a need to give comparative advantage to the selected production companies. This was achieved through exclusive marketing and licensing agreements. To do this, there was a to develop confidentiality agreements. This posed a problem of conflicting interests; scientists advance careers by publishing, not by withholding information. This was resolved by confining confidential information to one or two project scientists, and defining an absolute minimum of information as confidential – 'bargaining chips'.

We designed a LUBILOSA trust fund as a model for receipt of royalty payments and licence fees. Any payments will be collected in the fund and disbursed on the recommendation of a disbursement committee. Project participants, including NARES, and donor representatives will sit on the committee. In reality, as meeting costs would be met from the trust fund, actual meetings are unlikely, and interactions by mail or electronic conferencing are more plausible.

The definition of ownership of intellectual property was a complex issues, which was resolved by a multi-party transfer agreement from donors to the executing agencies.

The Convention on Biological Diversity provides a clear and binding articulation of many of the issues facing LUBILOSA, and greatly strengthened our hand in dealing with the companies and donors. In particular, the convention emphasises the importance of developing countries participating in technology development rather than merely receiving royalty payments

6 Basis of the LUBILOSA – private sector agreement

The licensing agreements between LUBILOSA and the companies provides for, on the company side; assignment of 'jurisdiction' over geographical area, pest or crop system, transfer of liability, advance payment, royalty payments on sales, acceptable accounting procedures, non-assignable agreement, regular interactions. LUBILOSA' side of the agreement involves; provision of unpublished toxicological and ecotoxicological data, provision of published efficacy and other data, and transfer of know-how and expertise in production, registration, labelling and marketing.

7 IPM Context – a basket of technologies

LUBILOSA has developed an effective biological pesticide which now needs to be placed in an IPM context in several different settings. The basic 'basket of technologies' consists of

Metarhizium
Judicious use of chemical insecticides having different properties (pyrethroids, fipronil, IGRs)
Neem and other botanicals
Nosema – protozoans with chronic effects
Cultural controls – egg pod destruction

Different configurations and selections will be necessary according to the ecological and socio-economic factors at four pilot implementation sites

Desert locust, Red Sea basin with EMPRES
South Africa, Brown locust with PPRI
Sahel, Senegalese grasshopper with Niger PV, Various grasshoppers with NGOs
Variegated grasshopper as commercial product (not currently funded)

7 Lessons learned

Many lessons were learned during the LUBILOSA project, some of which might have application in other areas of IITA's work. One is that LUBILOSA became a world leader in the field; reviews and input from ARIs was no longer useful in the particular area of expertise of the project. By contrast, it became increasingly important to identify particular areas of deficiency and be able to employ consultants to fill these gaps. Moreover, these gaps were essentially unpredictable at the planning stage of each project phase.

Because of the novelty of the technology, a high level of support was needed; normally, IITA is involved in transferring technologies developed elsewhere – in this case, we were developing novel technologies.

The project became highly complex and multidisciplinary, with many participants and activities in many countries. The use of formal project planning tools was essential in monitoring and reporting on the project.

Regular meetings with donors at Project Management Committee (PMC) meetings was very important, as the project moved fast and there were changes in emphasis that had to be justified and explained. It is also worth noting that the PMC had an executive, decision-making function which again enabled the project to respond flexibly to changing circumstances.

Sustained donor support – 10 years, at total cost of about $14M was very important to the project. We were able to sustain a critical mass of dedicated full-time scientists for long enough to achieve real progress. Although the project cost sounds high, this is a low cost to develop a commercial product. The cost was kept low because of the commitment and participation of NARES

There was a need for professional advice on IPR issues, particularly drafting Material Transfer Agreements and Confidentiality Agreements. As this was not available through CGIAR, CABI contracted individual consultants in UK.

Exclusive agreements give private sector partners a comparative advantage and a strong motivation to succeed in taking IITA technologies to clients. This lesson in particular might be of interest to other IITA projects, such as disseminating high-yielding seeds or cassava varieties. The private sector in Africa is extremely dynamic and motivated, and is also in favour with donors.

Table 1

LUBILOSA project phases – milestones and achievements

Phase	1 1989 - 1992	2 1993 - 1995	3 1996 – 1998	4 1999 – 2000
Objective	Investigate feasibility of oil formulation of fungal spore technology System characterisation	Demonstrate field efficacy	Implement technology in 3 pilot sites	Sustainable implementation Product stewardship, information, advocacy, use strategy development
Achievements	Metarhizium IMI 330189 selected Laboratory feasibility demonstrated Ecological data collected	Field efficacy demonstrated in Sahel, South Africa and Benin Network of NARES collaborators trained	Socio-economic studies ⇨ development of implementation pathway Ecotoxicological studies ⇨ registration Transfer to private sector	

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