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**Integrated pest management
of the coffee berry borer**

Executive summary 1998 – 2002

Background

1. The attached executive summary has been submitted by the Project Executing Agency, CABI Bioscience. The project commenced in April 1998, and will be completed on 31 May 2002. Colombia, Ecuador, India, Mexico, Guatemala, Honduras and Jamaica participated in this project.
2. The final review meeting for the project is scheduled for 22 May 2002, and information about this meeting has been circulated in document ED-1830/02.

Action

The Council is requested to note this executive summary.

INTEGRATED PEST MANAGEMENT OF COFFEE BERRY BORER

CFC/ICO/02

Executive Summary
1998-2002

Prepared & submitted by:

CABI Commodities
Bakeham Lane
Egham
Surrey TW20 9TY
United Kingdom

EXECUTIVE SUMMARY

I. Project Summary:

- I.1.** Title: Integrated Management of Coffee Berry Borer (CBB)
- I.2.** Number: CFC/ICO/02
- I.3.** Project Executing Agency: CABI *Commodities*, CABI *Bioscience*, U.K.
(formerly IIBC, the International Institute of Biological Control)
- I.4.** Participating countries / Location: Colombia, Ecuador, India, Promecafé (Mexico, Guatemala, Honduras and Jamaica), USA (USDA Starkville, Mississippi)
- I.5.** Starting date: 1st January 1997 (official)
3rd April 1998 (actual)
- I.6.** Completion date: 31st December 1999 (original)
31st May 2002 (actual)
- I.7.** Financing:
Total Project Cost:
USD 4,837,000
- Of which:
- | | | |
|---|---------------------------------|---------------|
| * | CFC Financing: | USD 2,968,000 |
| * | Co-financing:
220,000 (USDA) | USD |
| * | Counterpart contributions: | USD 1,649,000 |

II. Overview:

The project was to comprise the following four components: (a) the improvement and testing of mass rearing and delivery systems for natural enemies (pathogens and parasitoids) of the CBB, (b) the provision of natural enemies to participating countries, (c) the integration of biological control technologies and other methods for cultural and chemical control to develop IPM systems; and (d) dissemination of IPM technology/information and associated training to participating and other countries.

In this Project we worked towards a more rational, economic and environmentally friendly way of controlling the major pest of coffee, the coffee berry borer, which we believe are conformable with the wishes of consumers and much of the industry. We also attempted to change the prevailing mind-set of institutions in the way they interact with farmers towards a more participatory approach.

Essentially the project was concerned with two categories of work:

- *Biocontrol*: we introduced a new natural enemy of the coffee berry borer, studied its establishment and effect, and looked at ways in which it might be used.
- *IPM and how to get farmers to adopt*: we have tried to change the way that IPM and other technology is researched, developed and transferred to farmers.

III. Project Implementation and Results Achieved:

III.1. Biocontrol

Parasitoid training: A successful training course in Colombia in August 1998 where countries sent one to two representatives. Further training was provided in three separate courses run by Cenicafé in Colombia for scientists from India, Central America, Mexico and Ecuador in 1999. Two Jamaicans were trained in 2000. A special course was also arranged for Pascal Wegbe of Togo in April 2002, whom we believe to be one of the very few African scientists currently studying CBB. As Togo provided some of the first wasp shipments to Colombia in the 1980s this was a fitting end to the present project's activities.

Follow-up visits were made by Mr. Orozco (of Cenicafé) to Ecuador, Central America and India to give first hand advice on the developing wasp cultures in these countries.

Parasitoid shipments: Numerous shipments were sent from Cenicafé's facility to Ecuador, Guatemala (and thence to Honduras) and India. Honduras supplied Jamaica with wasps and Guatemala supplied stocks to non-Project countries El Salvador and Costa Rica. Wasp and CBB material were also sent to USDA-ARS at Mississippi.

Parasitoid culturing: At its peak, the Colombian facility was regularly producing nearly three million wasps per month - a decade earlier some of us had thought that rearing it successfully in the laboratory might be too difficult. That the difficulties have been so comprehensively overcome, and the techniques so readily transferable to other countries, is a tribute to Mr. Orozco and his staff. Other laboratories in Ecuador, Central America and Jamaica had much smaller facilities but, over the course of the

project, those of Ecuador, Honduras and Guatemala had each managed to produce approximately a million wasps.

Ecuador has subsequently received a US\$98,000 grant from CORPEI (Corporación de Promoción de Exportaciones e Inversión) to continue producing wasps after the CFC project ends. Rearing of *P. coffea* continues at CARDI (Jamaica) and one rural rearing facility has now managed to produce 30,000 wasps.

Parasitoid releases: In recipient countries a total of more than two million wasps were released into the field during the course of the project.

Parasitoid field studies: The establishment of *P. coffea* seems certain for Colombia, Ecuador, Guatemala, Honduras and Mexico. Jamaica has started releasing (6,900 in 4 farms) but it is too early to confirm establishment there. Levels of parasitism have varied widely, from 3% to 50 %. This is to be expected given the wide range of habitats, climatic conditions and coffee growing systems, and especially since over the course of much of the project conditions were not ideal for CBB (such as prolonged rains due to *La Niña*). More prolonged studies will be needed to ascertain long-term levels.

Mass rearing on artificial diet: The original plan was to do much of this at Cenicafé and experiments were carried out there for the first two years, but yielded no measurable improvement so they were suspended. All subsequent work was done by Dr. Portilla at the USDA-ARS laboratories in Mississippi. By the end of the project a sustainable and healthy rearing system for CBB was established. Dr. Portilla continues in this work until 2004 thanks to USDA support. She has prepared a manual of mass rearing techniques as a separate output of the project.

Parasitoid economic feasibility: A cost model was constructed by consultant Dr. Adrian Leach. Costs for regular releases of up to 100,000 wasps / ha were calculated to be comparable to those of other control methods. An unpublished report of this assignment is available separately from CABI *Commodities*.

III.2. IPM and participation

Economic studies of IPM: Audits of each project country's IPM activities were carried out by Hernando Duque (Cenicafé) for Ecuador, Guatemala, Honduras, Mexico and India. The one for Colombia was undertaken by Gerard Stapleton of LMC International. These separate studies have been compiled into book form as a separate output of the project (Duque & Baker, 2002).

Training in participatory research: Training and in-country assessments of participatory research was carried out by Dr. Jeffery Bentley, a consultant anthropologist. The result of these various assignments have been compiled into a farmer participatory manual as a separate output of the project.

In a relatively short time the project produced a substantial list of R&D contributions as a result of farmer participatory research (see Bentley & Baker, 2002, for more details):

- Adaptive research:
 1. Forage groundnut as a cover crop (Guatemala)
 2. Coffee pulp as fertilizer (Guatemala)
 3. Use of *caturra* variety (Ecuador)
 4. Observations on problems with *beneficio ecológico* (Ecuador)
 5. *Re-Re* (economic validation, Colombia)
- New technology, developed by scientist-farmer collaboration:
 1. Manure slurry to control coffee diseases (Ecuador)
 2. Picking mats (India)
 3. Strip applications near stumped groves (Honduras)
 4. Picking dry berries in March, then spraying (Honduras)
 5. Greased bin covers (Colombia)
 6. Greased harvesting barrel (Colombia)
 7. Trap trees in stumped groves (Colombia)
 8. Identification of 'hot-spots' (foci of CBB infestation) by farmers
- Validations by scientists of farmer technologies:
 1. Traditional planting styles (Ecuador)
 2. Traditional harvesting (Honduras)
- Strategic, on-farm research:
 1. Alcohol-bait traps (Ecuador, Colombia, India)
 2. With wasps (all countries)
- Rejection by farmers of unworkable technologies:
 1. *Beauveria bassiana*
 2. Standard numerical sampling

In summary, some countries took better to participatory work than others. Most of the topics above are unlikely to be followed up after the project ends and as such the project was too short to show more concrete advances and institutes too cash-strapped to allow them to continue after it ended. One group in **Colombia** however has been sufficiently empowered by the activities to try to commercialise their own coffee.

Guatemala also undertook some on-farm IPM experiments on a large farm which Anacafé scientists undertook themselves, with little or no farmer input. Both Drs Baker (PEA) and Duque (Cenicafé) examined the results and found the experimental design flawed. The Guatemalan scientists, under the guidance of Bentley (Independent consultant), developed and undertook some participatory work with farmers of the Chocolá community, mostly on organic compost and cover crops, which showed some promising advances.

In **Mexico** the results of a detailed study between two extension methods ('traditional' vs. 'participatory') showed significantly lower levels of CBB infestation in the seven plots studied with the participatory focus (analysis of variance, $P=0.027$) than the 'institutional' focus.

Questionnaires revealed a higher level of knowledge amongst the participatory farmers, and they manifested fewer problems with CBB or coffee diseases. Attendance at meetings was also higher when using the participatory system.

Operational costs of this method were considerably higher, especially in the first year when the regular presence of a facilitator was essential. But costs fell over time as farmers became more empowered and proactive, whereas the institutional groups' service costs would level off.

Some final points were made by the leader of the project in Mexico, Ramón Jarquín:

"Both methods can be effective if well executed, especially if the technology used can show a positive impact on the problem in question."

"The participatory model enthused the participants much quicker than the institutional model, but makes greater demands on facilitators."

III.3. Dissemination

Mass extension, and training of trainers, was performed mainly by Ecuador and India. The other countries concentrated more on developing participatory studies with smaller groups of farmers as reported above, and in the manual prepared for this project (Bentley & Baker, 2002).

Guatemala concentrated on one small community of farmers (Chocolá). The Promecafé 2000 project progress report stated that between 18 and 28 farmers would attend the meetings. High levels of adoption of technology of this group were reported, but no attempt seems to have been made to disseminate to farmers outside this group.

In **Ecuador**, Anecafé calculates that more than 9,000 farmers were exposed to training and dissemination as a result of this project, which means that the CFC funds were spent at an average of US\$ 61 per farmer. Since coffee prices halved during the project it is difficult to see whether this expenditure was recouped, but judging by reductions in CBB levels recorded, this is quite possible.

Some 500 farmers also received a total of 400,000 coffee plants, and training on renovation. Anecafé felt that replanting is an important element of CBB control to ensure the plots are yielding sufficiently to make it worth the extra trouble of the farmer to control the pest. Additionally, 330 school children in village schools in the Cotopaxi province, together with 70 farming families, have produced a further 320,000 plants of which 280,000 have now established in the field. The PEA visited two schools in January 2001 and was impressed by the collaborative spirit of teachers, children and parents that attended meetings.

Anecafé points to evidence (gathered during the project) of very low capabilities of both extensionists and farmers who are resistant to change. Effectively, the challenge has been to upgrade skills of extensionists sufficiently to be able to convince farmers to change. Although there have been encouraging signs, the coffee crisis has been a major brake on this process. Evaluations carried out during the project on extensionists (based on CATIE protocols provided by Dr. Guharay) give the following global picture and the improvement during the project (Table 1).

Table 1 - Knowledge uptake in Ecuador

% Possessing relevant knowledge on...	Jul 1998	Aug 1999	Mar 2001
Relation between farmer and extensionist	40%	60%	72%
Training methods	28%	46%	68%
Experimentation methods	21%	42%	50%
Recording of data	32%	56%	75%
Knowledge of bio-ecology	26%	41%	65%
Planning and participatory evaluation	28%	45%	60%
Options for managing the plantation	29%	47%	73%
Economic analysis	26%	40%	50%
Gender knowledge	25%	45%	55%

In **India** the Coffee Board (CBI) considers that the most significant training programme was that of the Training in Farmers' Participatory Methods (FPM) conducted by the Board during January 2000. Dr. Falguni Guharay (Consultant, CATIE, Nicaragua), visited India and conducted master training of 126 research and extension personnel of the Coffee Board. These master trainees later on conducted FPM programmes in their respective zones in the techniques of:

- Field assessment of pest incidence through participatory methods for effective participatory assessment, and
- Dissemination of IPM techniques (tested at on-farm IPM plots) to the smallholder farmers.

The FPM technique was adopted with the following objectives:

- To bring the farmer, researcher and extensionist together on 'one platform'
- To find out the adoption level of the recommended package of practices
- To improve the growers' decision making ability
- To identify the constraints in adopting technologies
- To identify innovative, locally adopted technologies
- To improve the productivity and quality of coffee
- To improve the overall socio-economic status of the farmer

Dr Guharay conducted two workshops of four days each at two different locations, and also exposed a couple of groups of farmers and enlightened planters to the participatory techniques. These workshops were held from 17th January 2000 to 22nd January 2000 in Kodagu zone, and 24th January 2000 to 27th January 2000 in Kerala zone.

From April 2000 the Training of Trainers (ToT) workshops conducted by Dr. Guharay led to the implementation of a pilot project for FPM as part of the CBI's regular transfer of technology programme. Accordingly, 40 farmers' groups (consisting of 20-30 farmers each), were selected in all the Senior Liaison Officer/Junior Liaison Officer zones:

- *Kodagu zone*: Madikeri, Napoklu, Shanivarasanthe, Suntikoppa, Siddapur, Virajpet, Srimangala & Ammathi.

- *Chikmagalur / Hassan zone*: Giris, Balehonnur, Kalasa, Aldur, Koppa, Mudigere, Sagar, Mallandur, Gonibeedu, Yeslur, Hanbal, Rayarkopal, Belur & Sakleshpur
- *Wayanad zone*: Kalpetta, Chundale, Meenangadi, Manantoddy, Panamaram, Pulpally, Sultan Battery, Vandiperiyar, Kattapana, Adimali, Palakkad
- *Tamilnadu zone*: Bodinayakanur, Batlagundu, Yercaud, Coonoor, Adalur, Pannaikadu, Perumalmalai

The FPM process is a three-way interactive mode between Research-Extension-Farmers and consists of regional technical workshops between research and extensionists and farmers' participatory workshops involving farmers' groups and extensionists. Both types of workshops are held on bi-monthly basis in the regional research stations and in the villages of the farmers' group.

In summary, FPM Groups consisting of 20-30 growers each were formed in all the liaison zones in the three states of Karnataka, Kerala and Tamil Nadu during the years 2000 and 2001. The details of number of FPM groups formed and meetings held are presented in Table 2.

Table 2 - Details of Indian FPM groups and meetings conducted

States	No. of FPM groups			Total no. of growers			No. of meetings held		
	2000-01	2001-02	Total	2000-01	2001-02	Total	2000-01	2001-02	Total
Karnataka	22	48	70	469	980	1449	132	122	254
Kerala	11	23	34	215	461	676	66	58	124
T. Nadu	7	15	22	145	309	454	42	38	80
Total	40	86	126	829	1750	2579	240	218	458

The training programme enthused the master trainers to an extent that the majority of them expressed the desire to adopt the participatory methods in their function as extensionists. Apart from the training workshop for master trainers, a planters' meet was organized in Kodagu zone wherein the team of entomologists of the Board and an elite group of planters with great experience in CBB Management came together in a face-to-face interactive discussion.

Dr. Falguni and the project staff also visited 3 small holders estates in Kodagu zone and had detailed interactive discussions with farmers regarding CBB Management and other integrated crop technology practices.

The **Indian Women Empowerment Programme (WEP)** came about as a result of a visit by Dr. S T. Murphy in April 2001, when it was decided to initiate special activities on the empowerment of women in CBB management and other coffee cultivation aspects. This was as a direct result of the fact that most women could not attend FPM activities due to other chores. Two workshops were held at Kalpetta and Somawarpet to gauge the response of the women and the degree of their involvement in managing coffee plots. Encouraged by the positive response from these meetings, similar programmes were organized in all CBI liaison zones. A total

of 26 meetings were held in different areas between April and October 2001 (Table 3).

Table 3 - Details of women empowerment meetings held in India

States	No. of meetings conducted	No. of women participated
Karnataka	13	45
Kerala	8	218
Tamilnadu	5	198
Total	26	870

The assessment reports received from field units revealed that the knowledge of women/spouses of estate owners, on coffee cultivation varied from 60% to 80%, but with regard to technical aspects it varied between 20% and 30%. Their involvement in decision-making on the management of estates varied from 10% to 20%, and they had expressed that men generally take decisions.

The WEP meetings gave women an opportunity to get motivated and understand that they have a greater role to play in the management of estates. They were also interested to train on coffee cultivation, preferably at local level and in the local language.

In addition to the above dissemination activities the CBI conducted a **Mass Media Programme**, organized by the Board's extension department. This included a number of mass media campaigns e.g. press releases, publicity material, guidelines, warnings on CBB management in all regional and national newspapers, talks on CBB management on All India Radio, production of video film on CBB management and broadcasts on national TV (Doordarshan).

The details of various extension activities conducted by the Coffee Board of India to combat Coffee Berry Borer between 1998 and 2001 are summarized below in Table 4.

Table 4 - Summary of Extension activities

ACTIVITIES	1998-1999	1999-2000	2000-2001	2001-2002	Total (to 31-08-01)
Contact visits	9811	3442	11671	3546	28470
Technical workshops (research & extension)	3	6	18	8	35
Farmers' group workshops (extension)	0	0	240	153	393
Regional review workshops (district level)	0	1	8	2	11
Apex level workshops (state level)	0	0	1	1	2
Seminars on CBB	3	1	12	4	20
IPM plots	50	52	52	52	52
Group gatherings at IPM plots	0	1	17	1	19
Study tours	0	0	43	0	43
Issue of advisory letters on CBB	1925	331	1729	466	4451
Contact / assessment camps	13	3	11	1	28
Media campaigns					
a) Newspaper	15	5	13	5	38
b) Radio announcements	19	1	4	4	28
c) Radio talks	4	3	5	1	13

Other dissemination material

1. Final project report: '*Natural Enemies, Natural Allies*' by Baker, Jackson & Murphy, 2002.
2. A field manual: '*Collaborative Research with Smallholder Coffee Farmers - what we learned from the CFC IPM coffee project (CFCICO/02)*' by Bentley & Baker, 2002. Versions in English and Spanish.
3. A laboratory manual: '*Mass Rearing Techniques for the Coffee Berry Borer*' by Maribel Portilla (in preparation)
4. Technical reports:
 - Vol. 1: Colombia and PROMECAFE
 - Vol. 2: India
 - Vol. 3 Ecuador
5. An economic study: '*The Economics of Coffee Berry Borer IPM*', by Duque & Baker (in preparation)

6. A CD-ROM: with all the above documents plus additional information (in preparation)
7. A video by PROMECAFE - to be shown at the final project meeting, May 22nd 2002
8. A website by CENICAFE of the farming communities with which they worked - soon to be available through www.cabi-commodities.org
9. Ecuador carried out a series of radio spots, posters and bulletins with information about the pest.

IV. Summary

- The project made significant advances in mass rearing the coffee berry borer, as well as introducing and verifying the establishment of an exotic wasp *Phymastichus coffea*.
- The project attempted to introduce new participatory methods to help improve IPM uptake with smallholder farmers. These methods were taken up more effectively in some participating countries than in others
- The Project Executing Agency recommends as a priority that countries develop quality incentives for all coffee farmers to encourage them to adopt IPM.
- The Project Executing Agency notes the severe problems now being faced by many coffee research and extension services and recommends a comprehensive review of skills and training needs in order that these institutes may fulfil the increasingly exacting requirements of the industry.

Finally, we present a synopsis of project activities in Table 5.

Table 5 - Synoptic table of Project Implementation activities by Activity as itemised in the original CFC appraisal report

Planned activities	Targets set	Final status	Remarks
1. Activity 1.1			
Develop diet and rearing systems	Develop mass rearing for CBB and <i>C. stephanoderis</i>	Mass rearing of <i>Cephalonomia</i> abandoned in favour of <i>Phymastichus</i> Artificial diet and CBB breeding work stopped at Cenicafé due to lack of progress. All diet work at USDA Starkville with new co-financing	Clear evidence that <i>Cephalonomia</i> is not economic. All resources should be channeled to <i>Phymastichus</i> . Significant progress by USDA on continuous CBB rearing on diet (20+ generations) with good quality. Initial “ball-park” feasibility of the method undertaken with positive results
2. Activity 1.3			
Training course on <i>Phymastichus</i>	1 st year training course	Took place in August 1998 in Colombia	Successful course All country participants subsequently reared <i>P. coffea</i>

Planned activities	Targets set	Final status	Remarks
3. Activity 1.4			
Training course on farmer participatory research	2 nd year training course	Took place in May 1999 in Colombia	Moderately successful course, from later interactions it became clear that many participants did not fully understand the concepts
4. Activity 1.5			
Training course on IPM of CBB	3 rd year training	Took place in May 2000 in Mississippi	Successful course Participants exposed to the concepts of true mass rearing.
Central American training course on participatory research		Took place in August 2000	Central American course by Bentley more successful
Training for 3-member Indian team		Took place in October 2001	Indian training undertaken in Nicaragua
5. Activity 2			
Transfer of parasitoids to recipient countries	Shipments of parasitoids by end of Year 1	All designated countries have received shipments of <i>Phymastichus</i> Jamaica has received <i>Cephalonomia</i> , <i>Prorops</i> and <i>Phymastichus</i> Jamaica has also received training in <i>Phymastichus</i> rearing	<i>Phymastichus</i> released into the field in Honduras, Guatemala, Mexico, Ecuador India now has a strong culture.

Planned activities	Targets set	Final status	Remarks
6. Activity 3			
On farm plots	Initiation of IPM plots and participatory work with farmers by month 9 of Year 1	Preliminary surveys carried out in all countries and areas for plots identified On farm activities in all countries, a wide range of activities.	Valuable baseline data on farmers collected Evidence of a significant impact of the project in India and Ecuador as extension exercises. Some true progress on participatory work in Colombia and Mexico. Less in other countries.
7. Activity 3.3			
Audit by PEA of IPM activities	Audit of countries IPM activities in relation to farmers needs	Fieldwork carried out in all countries.	Reports available for Ecuador, Mexico, Honduras, India
8. Activity 4			
Training	Informal training only in Year 1 Training courses for extensionists	Training undertaken in all countries Courses in Ecuador, India carried out	Indian training in January 2000, Central America (Honduras) in August 2000
Information and dissemination	Project meeting	April 1998, Mexico May 1999, Colombia May 2000, Mississippi, October 2001 in Costa Rica, December 2001 in India Farmer participatory manual produced	Ecuador & India have produced many posters, flyers and folders on IPM, aimed at farmers