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Report Of The External Advisory Committee

GLO/91/013 ECOLOGICALLY SUSTAINABLE CASSAVA PLANT PROTECTION IN SOUTH AMERICA AND AFRICA (PROFISMA)

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Acknowledgement

The members of the EAC wish to thank the members of PROFISMA and EMBRAPA for their warm hospitality during the course of the mission. In particular the EAC is grateful for the open and friendly manner in which PROFISMA staff discussed their work with the EAC. While sometimes loud, the interactions were always positive, and contributed greatly to a successful review.

List of Abbreviations

This report contains the following abbreviations:

CGM, Cassava Green Mite
CIAT, Centro Internacional de Agricultura Tropica, Columbia
CNPMF, Centro Nacional de Pecquisa de Mandioca e Fruticultura, Crus das Almas, Brazil
CVMV, Cassava Vein Mosaic Virus
EAC, External Advisory Committee
EMBRAPA, Empresa Brasileira de Pesquisa Agropecuária, Brazil
ESCAPP, Environmentally Sensitive Cassava Plant Protection, Africa
IICA, Inter-American Institute for Tropical Agriculture, Costa Rica
IITA, International Institute for Tropical Agriculture, Africa
IPM, Integrated Pest Management
PROFISMA, Protecao Fitossanitaria Sustentavel da Mandioca (Sustainable Cassava Plant Protection)

I. INTRODUCTION

There is a great need for environmentally sound crop protection for cassava, a staple food for millions of people, particularly the poor, in South America and Africa. Accordingly, UNDP approved in January 1993 a project to be executed by CIAT and IITA "to develop, test and implement sustainable cassava protection technology for the most damaging insect (sic) pests found in northeast Brazil and in the African countries". (p.3. of UNDP Recommendation to the Administrator appended to the PROJECT DOCUMENT for GLO/91/013). (This project is not restricted to insect pests, but also includes plant pathogens and weeds). The project, with a budget of just over $10 mill. (U.S.), aims to achieve by the end of its four year duration (p.20 of PROJECT DOCUMENT):

1) enhanced national research capability,
2) farmer knowledge through training,
3) technology adoption, and
4) improved yield and quality of cassava.

These aims are to be attained through three "interrelated and partially concurrent phases" dealing with (p.18 of PROJECT DOCUMENT):

1) refining the existing knowledge base through diagnostic surveys,
2) farmer participation in research and development of relevant crop protection methods, with concomitant training of farmers, extension workers and researchers, and
3) evaluation of progress in achieving training and technology implementation.

The South American part of the project (PROFISMA) is administered partly by CIAT and partly by the Brazilian federal government's agricultural research station (EMBRAPA) at whose research station (CNPMF) the project's principal activities are based. IICA is also involved insofar as the PROFISMA staff in Brazil are officially IICA staff. The African component of the project (ESCaPP) is administered separately by IITA and four participating governments.

Although the project was approved retroactive to 1 January, 1993, the South American component was not initiated until the last quarter of 1993. Thus this review occurred approximately one year after the project's inception.

The terms of reference of the EAC included:

1) reviewing the quality, focus and progress of the project, with particular reference to research, training and collaboration,
2) evaluating the management and administration of the project,
3) providing suggestions to improve the probability that the project will have an important impact on cassava production, and
4) providing other relevant comments and suggestions.

Because the EAC concurred strongly with the farmer-centered nature of the project document, it adopted as its principal criterion for examining project activities the implicit question "what does this do for the small farmer?" Although the project document does not use the term "integrated pest management" (IPM), the objectives are consistent with the principles of IPM. Hence during two days of field visits and three subsequent days of discussions with project personnel, the EAC conducted its review with these principles in mind.

In the following review the EAC's impressions of the key aspects of various components of the project are described. Specific suggestions are formulated in bold face as 21 recommendations, although other suggestions may be embodied in the text. The report may contain some factual or interpretive errors. In large part any inaccuracy probably was caused by the excessive amount of time required for Portuguese/English translations (and *vice versa*) of all discussions, allowing the EAC little opportunity to verify all of the contents of this report.

II. FIELD VISITS

The EAC welcomed the program of field visits as proposed by PROFISMA. These visits allowed first-hand observation of the efficacy of the project's farmer-centered approach and the agro-ecological context in which PROFISMA operates.

On Monday, 29 August the EAC visited farms in the vicinity of Piritiba, 300 km west of Cruz das Almas in the "Agreste" agro-ecological zone, intermediate between the humid coastal zone and the semi-arid "Sertão" of the interior. The EAC observed several on-farm trials and witnessed the explanation of these trials by PROFISMA staff to farmers on whose fields they were conducted. Four pertinent points arose from this experience.

1) The growers were attentive and interacted in a free and frank manner with the PROFISMA team. They did not appear to be overawed by any of their visitors.
2) The PROFISMA professionals used plain, straight-forward Portuguese or even the growers' own idiom, and refrained completely from baffling "techno-talk".
3) The growers evidently appreciated the chance to observe the experiments in progress and the invitation to be present when the experiments are evaluated after three years. A clever enticement was provided by the PROFISMA team in that the growers will be welcome to obtain planting material at will from the plants after the experiments are completed.
4) The local "prefeito" (approximately equivalent to Mayor) attended the field visit. Despite an impending election, he confined his well-informed public remarks to agricultural topics, rather than electioneering, apparently reflecting his respect for agricultural science and the PROFISMA project.

On Tuesday, 30 August, the EAC visited the "Colonia de Roberto Santos", a small-farmer settlement located in the coastal zone about 200 km northeast of Cruz das Almas. The growers in this community are part of the participating extension, training and survey components of the PROFISMA program. In the field the EAC noted an interesting contrast in the attitudes of growers towards the extension staff. On being asked why they accepted the recommendation of the extensionists, some growers conveyed the impression that it would be unthinkable to do otherwise. This attitude possibly survives from previous authoritarian top-down relationships. On the other hand, one young grower was bold enough to state "we believe the 'tecnicos' because they have done their experiments here with us". This is the sort of reaction that the project is expected to generate!

The EAC also observed two "cottage-industry", cassava-processing factories, where cassava roots are peeled, pulverized, pressed, dried/toasted, sized and bagged for sale as "farinha" (cassava flour). These factories are a mix of private enterprise capitalism and family-communal labor. The unit is owned by its constructor, who supervises the operations by each grower's family and friends, mainly women and children, in manual peeling and subsequent semi-mechanized steps. The owner receives

payment as 20% of the product, which is currently worth ca. 20 Centavos of a Real per kg. There is great potential for improving the welfare of communities with such factories by improving the yield and quality of the raw product.

Recommendation 1. To recognize their achievement, growers who complete a training program and participate with PROFISMA and extension staff in research and diagnostics should be presented with a physical symbol of recognition, perceptible to other members of their community, such as a T-shirt or cap bearing the PROFISMA logo. Growers who have become adept in training programs at diagnosing pest incidence and damage should be given a personal hand-lens as a working diagnostic tool that can be used in caring for their crop.

Recommendation 2. When scheduling permits, field visits for the EAC team should be planned before and after formal discussions. The latter visit will allow the EAC to reconfirm or amend its early perceptions prior to finalizing its report. Such visits need not be to the same areas.

III. REVIEW OF RESEARCH

A. Participating Training Methods and Diagnostic Surveys

In the first of the formal discussion sessions on Wednesday, 31 August the EAC found the proposed training program for research and extension workers, who will work with growers in diagnostics and participatory research, to be well underway. To date it involves 50 trainees from six states and 45 communities. Fifteen of the trainees are women. Three are PROFISMA staff.

Farmers have not yet been formally trained, and participatory IPM research has not been attempted. Rather, initial work has been to survey and rank the growers' perceptions of the causes and consequences of their horticultural and pest problems. This will result in a group of growers familiar with PROFISMA staff and collaborating extension workers. Moreover, the scientifically-based socioeconomic study will provide background data as a basis for comparison when participatory research on the implementation of IPM is evaluated.

Recommendation 3. Because of the importance of the initial diagnostic work with growers, a concerted effort should be made to accelerate the scientific validation of the grower diagnoses and to complete the statistical analysis of the results of the diagnostic study.

The EAC again noted that in the second phase of the project "farmers will participate in the development and testing of a range of crop protection technology components" (p.18 of PROJECT DOCUMENT). However, the entire project is projected to last only four years and there is relatively little time to initiate and develop the participatory research program. Moreover, although many of the researchers who appeared before the EAC were working actively with growers, none had any training in participatory research and none had yet been involved in such research as part of this project.

Recommendation 4. In order to ensure that the participatory research effort is successful, a small group of researchers, growers and extension workers should be brought together immediately to begin participatory research in a pilot project involving an IPM component that is clearly ready for practical application.

A. Cassava Green Mite (CGM)

CGM is a subject of critical importance to the PROFISMA effort, because its control is needed in the IPM program, and the chances of its regulation by classical biological control are excellent. The two principal aspects of ongoing biological control work are:

1) selection and release of predaceous, phytoseiid mites adapted to dry and humid cassava-growing regions, and
2) characterization, conservation, and perhaps importation into Africa, of *Neozygites* sp., a fungus which occurs naturally at epizootic levels in some cassava-growing regions of Brazil.

Emphasis at present is on three species of phytoseiid mites currently in rearing at CNPMF, but releases of small numbers of these mites in fields heavily infested with CGM have apparently not resulted in their successful establishment.

Recommendation 5. Since there may be effective and easily reared predatory mites as yet undiscovered, survey for other species and biotypes should be continued throughout the natural range of CGM, particularly in dry areas where *Neozygites* is not very effective.

The rearing of large numbers of predaceous phytoseiid mites for release in classical biological control is a critical component of this project. Because this effort is limited at present by the inability to rear large numbers of cassava green mites in Brazil, the EAC met separately with a small group of scientists concerned with this problem. The scientists' opinion that rearing of these mites should take place at EMBRAPA in Cruz das Almas was supported by the EAC. In touring the station, the EAC confirmed that adequate facilities for rearing of predators were available, that the principal scientists involved were highly competent, and that limited production of the cassava green mite was indeed a major impediment.

The impediment would be relieved if a a dedicated screen-house for rearing CGM were constructed. The enlarged prey and predator rearing program would require a full time Research Assistant (not a degree-holding professional). A good phase-contract compound microscope is required for confirmation of the identity of predaceous phytoseiids in rearing, and for identifying new specimens from field collections. Such a microscope has been budgeted for, but is not yet purchased. Finally there will be a need for ongoing materials and supplies.

The approximate costs ($US) for these items are as follows:

Capital Expenditures	
Screen-house	$20,000
Phase contrast microscope	10,000
Total	$30,000
Annual Operating Expenditures	
Research Assistant, salary and benefits	$10,000
Materials and supplies	6,000
Total	$16,000

Recommendation 6. Purchase of the budgeted phase-contrast microscope should proceed immediately, the 1994 budget should be revised to provide funds for rapid construction of a dedicated screen-house, and future budgets should include provision for a Research Assistant in mite rearing, and for associated materials and supplies.

Recommendation 7. Provision should be made for the key researcher involved in phytoseiid production to visit the IITA mite-rearing facility in Africa, and if possible to visit European facilities while in transit, to assist her in optimizing her own mass-production schemes.

The EAC noted that nucleic acid or antibody-based identification of predator mites is possible. However, it felt that development of such techniques is not immediately necessary if adequate microscopic capability is provided.

Neozygites sp. is apparently already important in controlling CGM populations in humid to semi-humid regions of Brazil. This is a very interesting and important (hot) area of study. It may be of central importance in the overall UNDP project in that Brazilian strains may succeed in protecting cassava from CGM in Africa following widespread, classical biological control introductions. Considerably more information is needed on the biology and taxonomy of the fungus. Also practical studies need to be carried out on schemes to mass produce and release this fungus into the field in an effective manner. These studies would include speed of spore germination as well as spore numbers and rate of spore production. The EAC noted that some of the research reported was directed toward sophisticated *in vitro* culture techniques that were beyond the province of the current PROFISMA project.

Recommendation 8. Research on *Neozygites* sp. in PROFISMA should be limited only to those propagation and release techniques that have immediate practical potential. The PROFISMA project may be used as a magnet to attract ancillary funding for more basic, strategic research.

C. Cassava Mealybug, Hornworm and Whitefly

The biological control of these three pests offers some unique opportunities for PROFISMA. For example, the mealybug, *Phenacoccus herreni*, presents an opportunity

to utilize classical biological control techniques developed in Africa for *P. manihoti*. Exploration in the probable site of origin has yielded a number of parasites and predators, plus a fungus. Three of these parasites have been selected for further study, including their interactions in caged environments at CIAT. The EAC especially approves of the recently initiated studies to track parasite spread following release in Brazil, and to make assessments of the environmental impact of these releases.

Recommendation 9. Based on the outstanding results of the African project with parasites of *P. manihoti*, PROFISMA should engage in an expanded release program of the parasites of *P. herreni* in Brazil. Concurrently, the search should continue for additional natural enemies.

The biological control of cassava hornworm involves the use of a naturally occurring baculovirus, a group of insect-specific viruses of virtually no threat to non-target organisms. This virus presents an excellent opportunity for participatory research and development with farmers. For example, grower cooperatives could produce and store virus preparations for use when needed by member farmers.

Studies on whitefly control by PROFISMA emphasize the use of a fungus, *Cladosporium* sp. There is virtually nothing known outside of Brazil on this fungus, and studies on its biology, production and applied use are encouraged by the EAC.

D. Environmental Assessment

The EAC commends PROFISMA for planning to conduct studies on the effect of their pest control efforts on non-target organisms. However, the proposed research appeared to be solely on negative effects, and also included laboratory tests on vertebrates.

Recommendation 10. Because of the strong likelihood that none of the biological control agents under consideration will have any adverse environmental impact, studies should concentrate on potential beneficial impacts, as well as adverse ones, and should be structured so that the data collected are useful to the overall biological control endeavor.

Recommendation 11. Because of the requirements for registration of biological pesticides, any testing of microbial or viral pesticides on vertebrates, if required, should be done in a laboratory certified by the appropriate registration agency.

E. Crop Loss Assessment

Extensive studies are underway by PROFISMA in which pesticides (microbial and chemical) are used experimentally to kill one or more pests selectively and to leave others on the test plants. These experiments require different treatments in different regions with different pest complexes. By selectively removing certain pests, the impact of others can be determined. The EAC considers this research to be important in providing area-wide baseline data on the impact of cassava pests. When analyzed statistically the voluminous data being collected can be used to justify research emphasis on the most important pests. They can also provide reference points against which new pest control treatments can be measured accurately, and they can be used as a basis for determining benefit/cost ratios for the IPM program.

Recommendation 12. Statistical analysis of the data on pest-caused crop losses should be expedited.

F. Root Rots

Root rots in the genera *Phytophthora* and *Fusariam* are predominant among the plethora of organisms inhabiting diseased cassava roots, and are judged to be the cause of substantial losses in certain circumstances. A long-standing research program at CNPMF has yielded a number of management methods that could readily be applied in growers' fields. These methods include: the use of tolerant varieties; compatible interplantings; treatments of cuttings with antagonistic microorganisms, mycorrhyzal fungi and endophytes; planting on furrowed ridges; and rotation with other crops to reduce inocula.

Recommendation 13. Consideration should be given by PROFISMA to the rapid incorporation of these methods into the IPM program in conjunction with methods to be used against other pests.

E. Witches Broom Mycoplasma

This disease has caused a major problem in the state of Ceara, and could spread to other areas. Research to determine its vector(s), including ribosomal-based PCR analysis is well underway. In addition, a commendable project is field-testing five resistant varieties with 70 farmers in 10 communities. Research is also continuing on disease distribution and yield loss assessment.

H. Cassava Vein Mosaic Virus (CVMV)

The most serious foliar disease in the project region is CVMV. It differs substantially from the cassava mosaic virus in Africa, India and Sri Lanka in that it causes substantial leaf-vein clearing and stunting. The disease has been successfully transmitted experimentally only through infected stem cuttings and by top grafting. A recently-developed PCR-based detection technique will be useful in detecting virus in imported or exported cuttings, and may be used successfully in determining the vector(s). While crop losses due to CVMV have not yet been determined, they are hypothesized to be substantial. Disease symptoms can be greatly reduced by the use of high-quality planting material.

Recommendation 14. Because apparently disease-free plants can be produced from high-quality planting material, training of growers in good propagation techniques should be incorporated immediately in the participatory IPM program. The production of vigorous plants may also reduce the impact of other pests.

I. Agronomic Practices and Weed Control

The objectives of weed management in cassava are to reduce production costs, increase productivity and preserve soil fertility. Additional outcomes are the prevention of water loss and soil erosion and the provision of reservoir plants for beneficial insects. Because the complex of weed species differs even between local areas, continuing research into management systems will be needed.

Recommendation 15. Because the potential gains are great and management techniques for weeds are well advanced, weed management should be incorporated rapidly into grower participation IPM.

Recommendation 16. In addition to assessing the acceptability of weeds for beneficial insects occurring naturally in the field, collaborative research should be done which assesses the acceptability of various weed species as reservoir hosts for the phytoseiid mites being considered for classical biological control of the CGM.

Because of the vigorous, ongoing research on agronomic practices, an EMBRAPA plant physiologist, who was not previously in PROFISMA, has been attracted to work in the project. His work on the effect of various weed management regimes on the growth and water relations of cassava will assist in selecting the best cover crop treatment for improving the hydric conditions for the cassava crop.

In the field and in formal discussion the effect of cassava in depleting soil nutrients, particularly nitrogen, phosphorus, potassium, calcium and magnesium, was emphasized. Conversely, great gains in productivity can be achieved by such techniques as mulching. The EAC was intrigued by the very positive results of an ambitious project involving many growers in Ceara, in which cassava crops are mulched with debris from carnauba palm fronds harvested for their wax. It appears that such techniques would be useful in other arid areas.

J. Experimental Design

In general, the EAC found that in a cursory examination the experiments being conducted by PROFISMA were of sound design. Yet virtually all biological scientists, including members of the EAC, have encountered situations in which experiments that appeared to be of sound design, were rightly criticized for deficiencies found after the fact by external reviewers. In most cases there was insufficient time for the EAC to examine experimental design closely. It might have been useful had further discussion taken place when the EAC had concerns about such factors as adequate replication, size of field plots, buffer zones, testing more than one hypothesis in the same experiment, and the statistical analysis of data. The EAC noted that in most research groups, scientists discuss their proposed experiments with others (often heatedly), and in most government research stations in North America, the station statistician must approve the experimental design and the proposed alternatives for statistical analysis of the data prior to initiating an experiment.

Recommendation 17. PROFISMA should select a small group of scientists who are experienced in experimental design and analysis of data to serve as a consulting group for other scientists. The objectives of the consulting group would be to ensure that there is confidence in the expected results and that statistical analysis can be done rapidly and routinely after the experiment.

IV. PROJECT MANAGEMENT

Throughout its mission, the EAC was aware that it was evaluating both CIAT and CNPMF activities. This was not easy for two reasons: 1) lack of physical presence of the EAC in Columbia for first-hand observations of CIAT operations, and 2) the apparently harmonious integration of the activities of both institutions, so that it was difficult at times to tell where the efforts by one institution stopped and those of the other started. In part the integration of activities has been facilitated by the fact that one of the two Scientific Coordinators and the Training Coordinator of PROFISMA are CIAT employees seconded to CNPMF. The successful integration has been further facilitated by the efforts of CIAT and CNPMF personnel to make their work truly international in its scope. However, future EAC's would be well advised to compare progress, workplans and budgets to determine just how integrated the South American work really is.

The EAC met for the morning of 2 September with a group of administrators including the two Scientific Coordinators and the Training Coordinator of PROFISMA, a representative of CIAT, the Director and Heads of Finance and Technical Services of CNPMF, and the project Bookkeeper/Accountant.

The project monies are necessarily administered in a tortuous fashion involving initial disbursement of funds to CIAT, and secondary disbursement of the Brazilian component to an account in Brasilia from which EMBRAPA can draw. CIAT charges 14% overhead on its portion of the project budget and 4% of the EMBRAPA component. Initially there was no overhead returned to EMBRAPA, a 5% charge is now levied, and this may have to be increased in the future.

Severe limitations in the progress of the PROFISMA effort have occurred in the inability of the EMBRAPA bureaucracy to respond to the PROFISMA need for rapid purchases of equipment, e.g. the phase-contrast microscope needed for the predaceous mite work or a rotary evaporator required in the weed science project. Various solutions

to this dilemma were explored, e.g. procurement through UNDP, or having CIAT make purchases and donating the items to EMBRAPA, with a corresponding reduction in the EMBRAPA component of the budget.

Recommendation 18. EMBRAPA/CNPMF should do its utmost to streamline its procurement procedures so that PROFISMA activities are not delayed. If this is not possible, PROFISMA, with the assistance of UNDP, should find a way to bypass EMBRAPA.

A review of the 1993 and 1994 budgets disclosed a substantial surplus from 1993 and projected under expenditures for 1994. These have resulted from such factors as late start of the project (even though payment was made retroactive to 1 January 1993) as well as delays in hiring personnel or retaining consultants for whom salaries had been budgeted, and correspondingly reduced needs for logistic and material support. It was noted that UNDP permits the carry-over of budget surpluses into succeeding years, and that the developing PROFISMA program will easily absorb these surpluses with essential expenditures, e.g. the screen-house for mite rearing, and extra vehicles needed because of the huge geographic area covered by this ambitious project.

The degree of flexibility that PROFISMA has with respect to reallocation of budget items was also explored. It was noted by the EAC that UNDP will tolerate approximately ±5% leeway on expenditures for most budgeted items. However, further deviations, e.g. using money originally allocated for consultants to purchase a vehicle, would require a revised budget, and if necessary a revised workplan, to be approved by UNDP before any expenditures were made.

The members of the EAC, who are all scientists with experience managing very large research projects, felt that UNDP budgetary procedures were very restrictive. Most research granting agencies allow the researcher full budget flexibility. They "audit" projects primarily on whether or not the scientific and technological output is of the highest quality, in sufficient amount, and more or less on target. (Targets are often met incompletely because scientific research, unlike engineering, always has unanticipated uncertainties that redirect the course of an investigation). However, the EAC felt that in this case, it would be unwise to allow such flexibility in budget administration unless there was very rigorous examination by future EAC's to ensure that expenditures had been made on items that were truly consistent with PROFISMA's objectives.

Some problems associated with personnel were noted by the EAC. The delay in appointing a National Training Coordinator has impeded progress of the work by the PROFISMA Training Coordinator in grower-related projects. EMBRAPA had an appointee selected who opted for another opportunity, and a renewed recruitment process is well underway.

There is a particular problem with health care benefits for PROFISMA employees, who are administratively classed as employees of IICA, rather than EMBRAPA, and thus are ineligible for benefits. The alternatives explored to date are prohibitively expensive, leaving most PROFISMA staff without coverage.

Recommendation 19. PROFISMA/EMBRAPA should continue to search diligently for a solution to the health care plan dilemma for PROFISMA employees. One possible solution would be for the arrangement of a special contract with EMBRAPA to cover benefits only for the duration of PROFISMA.

During the hearings, the EAC witnessed two projects by collaborating scientists, a plant physiologist and a virologist, who had been attracted to work in the project by the opportunities for collaborative work in return for minor supporting budgets, but not salaries. A large project like this can be a magnet for such collaborations, which in turn can provide useful returns to the project.

Recommendation 20. As opportunities are disclosed during the course of research, PROFISMA should seek further collaboration with external scientists in areas that would contribute to meeting the project's objectives. There should be sufficient budget flexibility anticipated by UNDP to accommodate provision of funds for such collaborations.

During the entire week of review, the EAC heard much of impacts caused by various practices and pests, and gains that could be achieved through a multitude of horticultural and pest management tactics. However, almost never were there monetary values placed on such impacts. If available, such values would provide strong supporting evidence of the true value of the PROFISMA effort and would allow benefit/cost analysis to begin immediately.

Recommendation 21. PROFISMA should consider hiring a practically-oriented economist, perhaps as a consultant, to place monetary values on impacts and benefits associated with the IPM program, and to initiate benefit/cost studies that can predict the future pay-off of the program.