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ATTACHMENT 1:

DETAILED FINDINGS AND RECOMMENDATIONS

PROJECT EVALUATION - USAID GRANT #698-0413.3

"BASES OF PLANT RESISTANCE TO INSECT ATTACK"

ICIPE, NAIROBI, KENYA

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I. INTRODUCTION

The International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya, entered into this project with USAID REDSO/EA on 29 September 1979. A total of $500,000 was obligated by AID. The duration of the project was to be two years, with an evaluation to be made at the end of the first 18 months. This review was performed to fulfill that obligation, and the team considered progress (research evaluation), organization, effectiveness, adherence to project plan and objectives, and potential research applications over the short-, medium-, and long-terms. Since further funding has been requested to continue the project, the team also developed comments and recommendations concerning the validity, scope, and improved design and implementation of continued research. Findings and recommendations are presented in detail in this document with the hope that they will be useful to project designers.

II. PROJECT CONDITIONS AND OBJECTIVES

A. Conditions

The document "Project Authorization and Request for Allotment of Funds" lists three "essential items and covenants" for initiation of negotiation and execution of the Grant Agreement:

(a) Socio-economic analysis. "ICIPE and AID agree to use their best efforts to obtain additional funding for an appropriate socio-economic analysis before the end of the project."

(b) Coordination with the Government of Kenya. "ICIPE agrees to initiate discussions with the Kenya Ministry of Agriculture and to attempt to formalize coordination of this project into the Ministry's current research and extension activities."

(c) Pesticides. Adherence to USAID rules governing project pesticide use.

B. Objectives

The Program Description lists four specific objectives:

"To the extent possible in the project's two-year time frame, the specific objectives are:

(1) Determination of promising plant selections,

(2) The availability of insects for testing and ecological studies of crops resistant to specific insects.

(3) Sound working relationships between basic support units in Nairobi and the field staff at Mbita Point.

(4) Formal working relationships with the Government of Kenya to promote coordinated effort in research and extension of findings to farmers.

(5) Publication of results."

The scientific objectives were stated in more detail by the Programme Leader, as quoted by Daugherty et al. in the REDSO/EA document "Perceptions of the International Center of Insect Physiology and Ecology:"

(1) Confirm resistance reported by other international research centers.

(2) Determine the mechanism of resistance (tolerance, antibiosis and non-acceptance), and identify the genetic or physiological mechanisms responsible for conferring resistance.

(3) Elucidate the genetic or physiological factors responsible for development of new biotypes in insects.

(4) Discover how resistant cultivars can be used advantageously in mixed cropping systems.

C. Comments

There was some confusion in Washington about what AID is funding: some

thought that the Crop Borers Programme is also receiving AID support. This confusion arises because the two programs handle the same crops and pests and cooperate very closely, approaching the same problems from different directions, often carrying out joint field work, and switching tasks when staffing or other considerations dictate. (We recommend below that these programs be combined.) The Crop Borers Programme is funded by IFAD and is well-staffed, currently with 9 scientists and 12 technicians (Dr. A. Raina, pers. comm.).

There were also questions in Washington about the overall goals of this project, and a realistic time frame for their accomplishment. (The "specific objectives" listed above are a general listing of administrative goals and of areas of research, and address neither the overall objective nor specific, time-related research goals.) The evaluation team feels that the project purpose can be described as follows:

In time, specific factors of host plant resistance are almost always overcome through the process of natural selection. As a result, the study of new resistant crop varieties is virtually a perpetual process. The purpose of this project should be the successful establishment of a productive, well-balanced, well-managed ongoing research program in the area of bases of host plant resistance. This is consistent with, and supportive of, ICIPE's goals: addressing critical pest problems in East Africa, increasing African scientific expertise, and training students and postdoctoral fellows. Such work will require funding on a continuing basis.

We agree with Daugherty et al. that this program can contribute to the increase of food production by small farmers in Africa, and thus is worthy of USAID support "as long as the objectives are clearly in mind and the procedures are acceptable."

III. FINDINGS

A. Research

1. Crops and Pests Addressed

The objectives stated above are presently being pursued to varying degrees with relation to seven pests on four crops: the borers Chilo, Busseola and Eldana attacking maize and sorghum, sorghum shootfly (Atherigona soccata), cowpea pod borer (Maruca testulalis), and brown planthopper and the borer Maliarpha separatella on rice. (The brown planthopper work is being carried on at IRRI with funding by Australia and is not reviewed here.)

This work is being pursued partially under cooperative agreements with other international applied agricultural research centers: ICRISAT (sorghum), CIMMYT (maize), IRRI (brown planthopper), IITA (cowpea), and WARDA (Maliarpha). These arrangements are scientifically fruitful and desirable if cooperation without duplication is effected, and are also advantageous for ICIPE in terms of its shift to an applied emphasis and its application for CGIAR membership.

Unfortunately, the program has not been fully staffed and the two entomologists and one agronomist are overburdened by this large number of commitments. The report of the TAC Mission to ICIPE mentioned this problem in April 1980: "Considering the available resources and the complex nature of the problem being investigated, it could be that extending work on host plant resistance to sorghum shootfly, the sorghum midge, thrips, pod-sucking bugs, and millet insects may be premature at this stage." Since that writing, shootfly and Maliarpha work has been undertaken with no augmentation of scientific staff and there is discussion of the sorghum and leafhoppers as well. Even at full staff strength (4 entomologists) this would exceed a minimum manageable research load of one scientist/one pest.

2. Attainment of stated objectives

Table 1 summarizes project research activities to date (source: Quarterly Reports 1-5). We would like to commend the project scientists, Drs. Dabrowski and Ochieng and Mr. Omolo, for their hard work and achievements. The program has been founded and good progress achieved given the understaffing and inputs problems, and especially in view of the virtually total lack of facilities and the difficult working conditions at Mbita Point long after inception of the program.

a. Screening. Good progress has been made with screening for determination of promising plant selections. Screening methodology for sorghum and maize borers has been developed and written up in a photo format for use by personnel at Kenya Government agricultural research stations. Recently, the screening work has been assumed by the Crop Borers Programme, and lines confirmed as resistant will be given to Dr. Dabrowski for research on mechanisms. The Crop Borers and Bases of Plant Resistance programs may do some plant breeding on a small scale for research purposes: consolidation of resistance factors and purification of lines.

b. Mass rearing. Some progress has been achieved, but this aspect of the program has far to go. Facilities have been inadequate until now, and downright primitive at Mbita Point. When the insectary at Mbita Point is finished, efforts should be made to rear insect pests on a much larger scale and at a higher level of sophistication, using artificial diets. This is essential for the success of the program. Without the ability to artifically infest plants in the greenhouse and in the field, lack of consistent and even pest infestations will hinder the screening effort. This year, for instance, natural pest populations have been too low to screen successfully for anything but cowpea aphid and rice borers.

Chilo is being reared on artificial diet in glass jars. Rear-

ing Busseola and Eldana has been attempted, but results are not yet satisfactory Maruca mass-rearing studies were undertaken under an IITA contract. This pest is reared in large numbers from cowpea flowers in small plastic containers and progress has been made with handling/rearing methods on that diet. Flowers are sometimes unavailable and are more difficult to use than artificial diets. Diets are still being improved and tested for rearing Maruca. Lab-reared insects show behavior changes and susceptibility to disease after several generations, and it is presently necessary to add field material often to insure colony viability.

c. Determination of resistance mechanisms and identification of the responsible genetic or physiological factors. Some progress has been achieved, but understaffing of the program and emphasis on screening work has meant that some tentative hypotheses drawn from field experiments have not been verified and quantified, and some research avenues have been abandoned before useful data was collected. Quite a bit of field work has been done on oviposition and larval behavior of borers. The results have "suggested" useful facts (i.e., that there are three levels of interaction affecting plant colonization and damage by Chilo, that some varieties inspire leaf-sheath feeding by Chilo larvae, etc.) and should be confirmed and investigated further. Experiments were initiated, but then apparently discontinued, on gut and salivary enzymes of shootfly and the gut microflora of sorghum and maize borers. The second Quarterly Report mentioned that the former work was limited by lack of the proper equipment and chemicals, and technicians mentioned problems with timely and adequate supply of chemicals and the proper types of seed. Understaffing means inadequate supervision of the nine technicians, which decreases their ability to make meaningful research contributions. Some said that Dr. Dabrowski simply doesn't have time to give them the attention and guidance they would like.

d. Genetic or physiological factors reponsible for development of new biotypes in insects. Work in this category has not yet begun except for the comparison of the protein spectra of Maruca from Nigeria and Kenya. Dr. Singh, Grain Legume Entomologist at IITA, has asked ICIPE to investigate Maruca biotypes.

e. The use of resistant cultivars in mixed cropping systems. Moderately resistant varieties of maize, sorghum, and cowpea are being evaluated in farmers' field intercrops. This work was begun recently by the agronomist, Mr. Omolo, in cooperation with the Crop Borers Programme. Emphasis on screening in a farmer's field intercrop is well-placed, as the results will be valid for the context in which small farmers will grow these resistant varieties: with no fertilizer or pesticides, and under the pest infestations and plant physiological conditions typical of the intercrop.

f. Publication of results. As of this writing, project scientists have all prepared manuscripts, some of which have been accepted for publication. (Note: "Insect Science and its Application" is a new tropical entomology journal published by ICIPE.)

Accepted for publication:

(1) Okeyo-Owuor, J. B. and Ochieng, R. S., 1981 Studies on the legume pod borer, Maruca testulalis (Geyer). I. Ecology and biology; Insect Science and Its Application (in press).

(2) Ochieng, R. S., Okeyo-Owuor, J. B. and Dabrowski, Z. T. 1981; II. Mass rearing on natural food. Insect Science and Its Application (in press).

(3) Dabrowski, Z. T. and Patel, N. Y., 1981 Investigations on physiological components of Atherigona soccata larvae and sorghum interaction. I. Larval enzymes; Insect Science and Its Application (in press).

Submitted for publication:

(4) Dabrowski, Z. T., Omolo, E. O. and Nyangiri, E. O.; Resistance of maize to stem borers under Western Kenya conditions.

(5) Dabrowski, Z. T. and Kidiavai, E. L.; Resistance of some ICRISAT sorghum lines to shootfl and stem borers under Western Kenya conditions.

(6) Omolo, E. O. and Ogwaro, K. Effect of intercropping on pest status on maize, sorghum and cowpea.

(7) Dabrowski, Z. T., Ochieng, R. S., and Burger, M.; Studies on the legume pod borer, Maruca testulalis (Geyer). III. Methods used in screening for resistance.

The Quarterly Reports are the best account of research activities, but their timing does not reflect field realities (two rainfed growing seasons), and Dr. Dabrowski's workload has been made even more unmanageable by the task of writing four per year. Examination of the reports reveals that contents of some are "thin" because they are timed in the middle of a growing season, or simply because quarterly progress by a small program such as this is not great, especially when one of the two entomologists has to spend a goodly portion of his time report-writing! Data is presented without statistical analysis, which makes it difficult to ev luate. We were given to understand that the Biostatistics and Computer Service was weak, but being improved.

RESEARCH ACTIVITIES

"BASES OF PLANT RESISTANCE TO INSECT ATTACK" (Excluding Australian-funded brown planthopper work at IRRI)

January 1980 - March 1981

I. MAIZE RESISTANCE TO BORERS	II. SORGHUM RESISTANCE TO BORERS	III. SORGHUM RESISTANCE TO SHOOTFLY	IV. COWPEA RESISTANCE TO *HARUCA TESTULALIS*	V. STATUS OF PEST POPULATIONS UNDER MIXED CROPPING SYSTEMS
Jan - March 1980				
1. Study of the dispersion of *Chilo* and *Busseola* eggs on maize, as basis for artificial egg placement. 2. Comparison of field and greenhouse maize screening techniques. 3. Screened Katumani maize for borer attack; undamaged plants selfed to form S_1 families, some of which will be screened further.		1. Study of shootfly salivary glands and alimentary canal. 2. Preliminary identification of salivary gland and gut enzymes (due to lack of equipment and chemicals, not all enzymes could be studied, and none quantitatively).	1. Developed a rearing method using screens so that larvae don't have to be handled; tested desirable larval and adult densities and pupation substrates. 2. Preliminary experiments on diet and feeding behavior.	
April - June 1980				
1. Preliminary identification of a maize resistance mechanism by the comparison of oviposition & larval feeding in choice and nonchoice situations on lines with varying susceptibility. Pilosity of upper leaf surfaces appears to decrease oviposition.	1. 208 EEAFRO cultivars and local collections from east and west of the Rift Valley screened for borers and shootfly (planted in April). 2. 4 ICRISAT collections of *Chilo* resistant lines sown for screening in May. Some shootfly resistence observed. 3. 39 USDA aphid-and midge-	2. 35 ICRISAT and 40 Texas lines, and 3 sugarcane X sorghum populations screened: 7 promising ICRISAT cultivars selected for study of resistance mechanisms.	1. Progress in determining optimum natural foods for adults and larvae; some improvements in handling of larvae. 2. Testing of some artificial diets.	1. Experiments tried and then abandoned as too difficult and too different from the program's mandate; it was suggested that the Crop Borers Programme should study the effect of mixed cropping on insect populations and this program could join the team later when new resistant (or partly resis-

I.	II.	III.	IV.	V.
2. 36 Katumani S_1 screened, with collection of plant injury and pest number data. 3. 2000 Kitale Synthetic plants screened; undamaged plants were selfed to form S_1 families for further screening; the Kitale lines are to be crossed with Katumani lines to create medium-maturing, subhumid tropical maize for release in the Lake Victoria region; resistant lines showed tolerance of tunneling.	resistant lines screened for borers (may have escaped infestation because of early planting).	ontinued work on the ethodology for identification of gut and salivary gland enzymes.	3. Feeding attractant effect found in methanol extract of cowpea flowers and pods.	tant) cultivars of maize, sorghum and cowpea will be selected for mixed cropping.
4. Initial observations on gut microflora of sorghum and maize borers, with a view to investigating their interaction with host plant chemicals.				
July - Sept 1980				
1. First attempts to rear Busseola in the laboratory. 2. Screening: 250 CIMMYT families, 100 S_1 families of Katumani maize (some lines selected for further studies)	1. EEAFRO cultivar "Serena" selfed and progeny screened; 23 tolerant lines identified for further testing; much shootfly-induced tillering noted. 2. Field data suggest that the number of Chilo exit holes correlates with tunneling damage, and that counting holes can be a timesaving method for preliminary	1. Preliminary experiments on preference testing	1. Continued with modifications of artificial diets and experiments with feeding stimulation by extracts from cowpea leaves, flowers, pods. 2. Study of Maruca oviposition behavior; found that leaves are the preferred site.	

Planned Research, . - March 1981, (Screening work given to Crop Borers Programme - Dabrowski, personal communication)

I:	II.	III.	IV.	V.
1. Mass rearing of Chilo and Eldana.	1. Study of the effect of some ICRISAT lines on Chilo development and behavior.	1. Continue observations on oviposition & larval behavior.	1. Continue maize rearing/ oviposition studies.	NEW PROJECTS:
2. Confirmation of resistance in CIMMYT lines at diverse sites (joint project with Ministry of Agriculture).	2. Crop losses to Chilo.	2. Effect of sorghum growth stages on the expression of resistance.	2. Screening methodology with artificial infestation.	1. Feeding and oviposition behavior of Maliarpha separatella on rice; Maliarpha mass-rearing on natural foods (cooperative research with WARDA).
3. Continue work on resistance mechanisms.	3. Chilo oviposition choice studies.		3. Plant properties responsible for mortality on TVu 946.	2. Farmer's field intercrop studies: a. Performance of selected sorghum and maize lines with thrips- and aphid-resistant cowpeas. b. Effect of Chilo infestation on yields of sorghum and maize.
	4. Effect of sorghum allelochemicals on Chilo and Eldana feeding, behavior and development.		4. Screening of thrips- and aphid-resistant varieties in farmers' intercrops.	

I.	II.	III.	IV.	V.
	screening; also that plant colonization and damage by Chilo differs at 3 junctures: - non-acceptance for oviposition - 1st instar feeding on leaves - tunneling of older instars in stems (some varieties appear to have leaf sheaths attacked in lieu of other plant parts) 3. Preliminary glass tube experiments with diet and antifeedants for bicassay of larval feeding and tunneling.			
Oct - Dec 1980				
1. Testing of artificial diets for the mass-rearing of Eldana; high survival on some diets, but fecundity lower than that of field populations. 2. Screened 450 CIMMYT lines; promising selections will be tested in farmers' intercrops. 3. Continue observations of borer tunneling in resistant and susceptible lines.	1. Results of four screening experiments analyzed; some lines selected for study of resistance mechanisms; promising selections will be tested in farmer's intercrops. 2. Continued observation of Chilo oviposition and damage on resistant and susceptible lines.	1. Started experiments on shootfly oviposition behavior, larval feeding sites/behavior.	1. Continued testing of artificial diets; testing of artificial oviposition substrates. 2. Because of data showing different oviposition site preferences in Nigerian & Kenyan Maruca strains, their protein spectra were compared and some differences found.	

g. General

We note that little data on the economic basis of pest management (crop loss and economic injury levels) has been collected. Dr. Suh, a recently-arrived postdoc in the Crop Borers Programme, has begun experiments on crop loss to Maruca, and cowpea's ability to compensate for damage. Staff of the Bases of Resistance Programme recently began measurement of farmer's field losses to Chilo.

Only one trip has been authorized thus far for a project scientist. at this writing, Dr. Dabrowski was leaving to meet with colleagues in Nigeria and Liberia. Especially in a program with so much cooperative work, travel is necessary to keep scientists current on research developments, reduce duplication of researchers' efforts, and enhance ICIPE's contribution internationally. For example, some of this project's experiments with borer larvae were duplicated by COPR/ICRISAT, and Dr. Dabrowski didn't realize it until he saw the publication.

B. Funding/Expenditures

The Bases of Plant Resistance Programme was not entirely funded by USAID for this two-year period. The salary of Dr. Dabrowski, the Programme Leader, who is Polish, is paid by UNDP ($35,000). The Australian government funds the brown planthopper research at IRRI ($100,000). Contract funds from IITA (for Maruca mass-rearing), and from ICRISAT (for sorghum work) have been received.

Routine financial reporting to REDSO/EA does not include disbursement of funds from other sources (such as contracts with IITA and ICRISAT), and disbursement of AID funds is reported in three broad categories without itemization: salaries, travel, and supplies and materials. The evaluation team found this level of reporting inadequate for the sort of "cost/benefit analysis" mandated, and for effective monitoring by REDSO/EA.

At present, ICIPE grants the Programme Leader authority to disburse funds for expendable items only. For all other purchases, for additional scientist salaries, travel, etc. he must get approval from ICIPE administrators. The funds are regarded primarily as ICIPE money rather than program money, and though AID's aim is to fund research, final spending decisions are not made by program scientists. This places a heavy burden on ICIPE's administrative staff, makes coherent and scientifically valid research planning difficult, and saps the time and energy of the Programme Leader.

According to the budget provided in the project description, "The grant will provide full financial support for the staff for the agronomic and plant resistance sub-project and for related operating expenses," and "USAID will not finance equipment, furniture, or vehicles." The distribution of the funds was intended to be as follows:

COST ELEMENT	TOTAL ESTIMATE US DOLLARS	PERCENT OF TOTAL
Salaries	$419,204.	84 %
Travel	23,670.	5
Supplies & Materials	57,126	11
TOTAL	$500,000	100 %

According to documents provided by ICIPE officials, the present and planned distribution of funds is as follows:

COST ELEMENT	TOTAL ESTIMATE THROUGH MARCH 1981 US DOLLARS	PERCENT OF TOTAL	TOTAL ESTIMATE THROUGH AUGUST 1981 US DOLLARS	PERCENT OF TOTAL
Salaries	$164,020.	56 %	$225,483.	45 %
Travel	4,174.	14	9,174.	2
Supplies & Materials	125,702	30	265,343.	53
TOTAL	$293,896.	100 %	$500,000.	100 %

Upon request, ICIPE's Financial Manager provided us with a more detailed accounting of AID funds:

NOTES TO THE FINANCIAL STATEMENT FOR THE 18 MONTHS PERIOD 1st SEPTEMBER, 1979 TO 25th FEBRUARY, 1981

1. SALARIES

A. PLANT RESISTANCE SUB PROJECT STAFF

NAME	POSITION	PERIOD COVERED (months)	COST (U.S. $)
Dr. R. S. Ochieng	Research Scientist (Entomologist), mass rearing	14	$21,700.
E. O. Nyangiri	Sr. Technicia.. (mass rearing, Mbita Point)	18	12,637.
F. O. Onyango	Technician (maize resistance to Chilo, Mbita Point)	18	9,736.
S. O. Obiero	Technician (chemist, Nairobi)	14	5,971.
O. E. O. Arigi	Technician (chemist, Nairobi)	14	6,096.
E. L. Kidiavai	Technician (sorghum resistance to Chilo, Mbita Point)	14	4,070.
P. E. W. Njoroge	Technician, Nairobi	14	4,180.
A. A. Ragot	Technical Assistant (mass rearing, Nairobi)	14	5,387.

M. O. O. Bungu	Technician (cowpea resistance, Mbita Point)	14	4,772.
M. O. Arwa	Technician (agronomy, Mbita Point)	14	4,533.
			$79,082.

B. AGRONOMIC STAFF

NAME	POSITION	PERIOD COVERED (months)	COST (U.S. $)
E. O. Omolo	Agronomist (Mbita Point)	18	45,592.
B. S. K. Masyanga	Farm Controller (Mbita Point)	14	24,492.
P. O. Auta	Mbita Point field staff	10	983.
J. M. Sagini	Mbita Point field staff	10	1,251.
N. M. Sangura	Mbita Point field staff	6	503.
P. O. Ouma	Mbita Point field staff	6	503.
J. A. Nundu	Mbita Point field staff	4	399.
L. P. Agunda	Mbita Point field staff	4	405.
J. W. Achola	Mbita Point field staff	4	405.
P. O. Owino	Mbita Point field staff	4	415.
S. O. Maramba	Mbita Point field staff	4	415.
			$75,363.

Note: Cost of the Programme Leader and other staff are charged entirely to the UNDP and Australian Grants

TOTAL $154,445.

2. TRAVEL

Field travels by staff on the programme and expenses	$1,833.
Programme Leader's travel to IITA, Nigeria - airfare and other travel costs	2,341.
	$4,174.

3. SUPPLIES AND MATERIALS

These include chemicals, field expenses, photographic supplies, shovels, miscellaneous materials for screenhouse, pipes, etc.

The above data indicate a pattern of deviation from the project budget that has hindered vital aspects of the research program. A far lesser amount is being expended for scientists' salaries and travel, and a far greater amount for supplies and equipment. Even so, discussions with scientists and technicians leave the impression that equipment and supplies are very difficult to obtain because of a shortage of funds.

Adherence to the original budget was impeded because important classes of inputs were not provided for in the project design: overhead costs, contribution by research units, research support costs (equipment, maintenance, etc.) and field station overhead. When these costs are not budgeted for, and no core funding is provided to cover them, trying to preserve the integrity of a research project budget is unrealistic. This problem is exacerbated by ICIPE's present situation. ICIPE is in an institution-building phase involving ambitious, multi-million dollar building projects, addition of programs, and extensive establishment of cooperative links with other international centres. ICIPE needs better facilities and liaison with other institutions. However, in this context, we feel that research progress and quality of research in the Bases of Plant Resistance program has been given second priority, and that this is reflected in the pattern of project expenditures and in excessive cooperative research commitments. This is unfortunate because ICIPE's reputation and qualification for

AID support should stand or fall on its research output.

C. Staff

Positions provided for in the project description were staffed as follows:

POSITION		INCUMBENT
1 Programme Leader (Sr. Research Scientist)		Dr. Z. T. Dabrowski
2. Research Scientists		
1 - Brown planthopper, IRRI		Dr. R. C. Saxena
1 - ICIPE		Dr. R. S. Ochieng (postdoc during most of the period covered)
1 Agronomist		Dr. E. Omolo
2 Postdoctoral fellows		vacant (Dr. Ochieng was a postdoc during most of the period covered)
9 Technical staff		
2 - Brown planthopper, IRRI		staffed
1 - Sr. Technician 1 - Technician 2 - Technical assistants	agronomic and field testing aspects of plant resistance	7 technical staff projected at ICIPE, 9 hired (see salary listing in III. B.)
1 - Principal Technician 2 - Junior Technicians	plant resistance and insect mass-rearing	

Actual hiring, when contrasted with the original projection, has been heavy on technicians and light on scientists. A Ph.D student from Swaziland, Dr. Masina, has recently joined the program with funding from the British Council.

ICIPE has made efforts to fill the PDF positions. A Sierra Leonean, Dr. MacTroy, was offered a place but was unexpectedly required to return to his country. Dr. Bunting from the University of Reading wishes to come but is having political difficulties because he was born in South Africa. Two additional

African postdoctoral candidates have been identified. We are not sure why filling the PDF positions has taken so long. Professor Odhiambo said that ICIPE does not have recruitment problems, and several scientists have been hired into the Crop Borers Programme during the past 18 months. On the other hand, the professor said it is difficult to staff a program that has been funded only for a short period.

During our visit, we noted a high scientific staff turnover rate at ICIPE in the crop pests programs. Mbita Point, where the program will be based, presents hardships for families because of its lack of schools for older children, recreational and shopping facilities, etc. Logistical problems also arise because of the distance between the research site and the service laboratories in Nairobi. Interviews with many individuals revealed disagreement and conflict between scientists/technicians and administrators concerning the staffing and running of the research programs, expenditure of funds, etc. Scientists feel that the ICIPE administration plays too strong a role in decisions that should be based on technical considerations, and that this interferes with the effectiveness of the programs.

D. Administration

1. Attainment of Stated Objectives

a. Sound working relationships between basic support units in Nairobi and the field staff at Mbita Point.

Dr. Dabrowski expressed satisfaction with backup by ICIPE's basic research units (Sensory Physiology, Chemistry, and Biochemistry, Histology and Fine Structure). He said they were always ready to help with significant and interesting problems.

Liaison between project staff at Nairobi and at Mbita Point appears to be adequate, and Dr. Dabrowski travels between the two locations often. This involves a day's tiring road travel each way, however, and the access road to

Mbita Point is occasionally impassable. Office, laboratory and living facilities will be completed soon at Mbita Point, and when they are ready the Programme Leader should be based there for close supervision of research activities.

b. Formal working relationships with the Government of Kenya to promote coordinated effort in research and extension of findings to farmers.

ICIPE has not attempted to create formal relationships. Only one agreement exists on paper, a letter concerning limited access to the Ministry of Agriculture maize germ plasm for screening by ICIPE.

Dr. Dabrowski has initiated informal screening/breeding cooperation between the Bases of Resistance Programme and several Kenya government agricultural research stations. Ministry officials declare themselves satisfied with these arrangements. Interviews with Mr. Gilbert Kibata and Dr. Fred Wangati at the National Agricultural Laboratories, and with Dr. J. H. G. Waithaka, Deputy Director of Agriculture (Food Crops) stressed the following issues with reference to liaison with ICIPE:

1) Formal working relationships. Necessary only for jointly-funded co-operative projects. The Ministry does not have adequate staff at present to design and propose any. Liaison exists in that ICIPE is partially funded by the Kenya government and has a Ministry official on its governing board.

2) Training. Six Ministry staff have attended ICIPE's Integrated Pest Management Course, and more should follow. The Ministry would like ICIPE training for entomologists pursuing higher degrees because excellent scientific guidance is available nowhere else in Kenya. However, the Ministry is so understaffed with entomologists that they are hard put to field candidates. Concern was expressed because such degree recipients tend not to return to their relatively low-power, low-paying slots with the Ministry. Dr. Wangati suggested a formal "secondment system" which would restrict Kenyan scientists' length of tenure or offers of

permanent employment with ICIPE after earning higher degrees.

3. Extension. Ministry officers were emphatic that ICIPE should leave this activity to their organization.

4. Cropping systems collaboration. ICIPE's entomology input is to be integrated by the Ministry into overall crop management schemes. Resistant varieties that need adaptation to the Kenya environment should be given to Ministry breeders. Complementary agronomy experiments using resistant varieties (i.e. cropping systems, fertilizer rates, planting dates, spacing, etc.) also should be done by the Ministry. Dr. Waithaka said that no Ministry employees presently near Mbita Point have research credentials, but that researchers could be made available for cooperative work there. Programs that might use ICIPE insect pest management input include the FAO/UNDP Dryland Farming Research Program, Katumani, the USAID Cropping Systems for Semi-Arid Areas program at KARI, and individual research stations including the rice station at Ahero.

c. Socioeconomic Analysis

No additional funding was granted to conduct the analysis before the end of the project. Therefore, this objective could not be implemented.

d. Pesticides

Precautions agreed to in the "Project Authorization and Request for Allotment of Funds" insure compliance with USAID regulations. Dimethoate, endosulfan and malathion are being applied to cowpea, and endosulfan and carbofuran granules are used against cereal stem borers. As is shown in the following table, these pesticides are covered by EPA tolerances, and there would be no problem with ICIPE making recommendations for such uses in an IPM package which might be extended to farmers.

EPA TOLERANCES

	Dimethoate	Endosulfan	Malathion	Carbofuran
Cowpeas	Yes[1]	Yes[2]	Yes	N/A
Cereals	N/A	Yes	N/A	Yes

N/A - Not applicable

Yes[1] - EPA tolerances are for dry beans, lima beans and snap beans, i.e., interpreted as being "a similar use".

Yes[2] - EPA tolerance is for succulent peas, i.e., interpreted as being "a similar use".

If, in future, other pesticides are considered in the context of an IPM program for cowpeas and cereals, project staff should determine whether EPA tolerances or FAO/WHO Maximum Residue Limits have been established for the pesticide(s) in question. If neither of these is in place, residue data would have to be gathered and evaluated before the AID Office of Agriculture could endorse such use in an AID-funded project.

Mbita Point scientists said that pesticides are applied by trained field technicians. This is as it should be: untrained field laborers should never be given this task. Use of safety clothing and equipment by applicators is apparently variable and marginal, susally only boots and maybe a lab coat over normal clothing. There are no masks available.

IV. RECOMMENDATIONS

A. Research

1. Crops and Pests Addressed

a. Pests and crops presently studied should be prioritized, using economic data as far as possible, for decision making re project efforts and funding. The program is presently overburdened with research commitments, and

without significant addition of scientists, the number of research problems should be reduced. Research should address fewer topics in greater depth than at present.

b. When research problems are prioritized, some not presently addressed should be considered. None should be undertaken unless scientific strength permits.

Phaseolus is a major East African crop which ICIPE's programs do not deal with at present. If the Kenyan/Dutch bean program at Thika identifies insect-resistant lines, the program could do the complementary work on bases of resistance. Careful liaison should be maintained with CIAT if this is undertaken.

According to Dr. Dabrowski, cowpea aphid would be a relatively simple problem and easy to work with, and would yield interesting results on biotypes. This is an appropriate topic, since they cause a reduction in yield in the Mbita region (though crop loss assessments remain to be done), and IITA has developed cowpea lines which have been confirmed there as strikingly resistant. This should be undertaken with careful preliminary study of the work of Dr. Asafa Ansari at IITA.

c. REDSO/EA should not assume funding of the brown planthopper work at IRRI, as funds are limited and this is not an African problem.

2. General

a. If Maliarpha work continues, it should be done at the Ahero Rice Irrigation Scheme, as suggested by the International Scientific Working Group on Cereal Stem-Borers and Legume Pod-Borers (September 1980). This would aggregate rice scientists, relieve pressure on the small field area at Mbita Point, put research where rice is customarily grown, and enhance cooperation with the Ministry of Agriculture.

b. Mass Rearing. This area of endeavor is vital to the success of the program, and more support should be given in the form of facilities and highly-qualified scientists. The new Mbita Point insectary will be a great improvement, but it should be noted that rearing insects on a larger scale will require extra materials and specially built trays, cages, etc. that should be provided for in the project budget if financing has not been committed from another source.

Care must be taken to rigorously and continuously evaluate lab-reared pests in relation to natural populations.

We note that Dr. Singh, a mass-rearing specialist, is coming to ICIPE for 6 months. This will be constructive. The permanent hiring of such a person would be better. The program will require someone with solid experience in the areas of mass-rearing and insect nutrition to put the rearing effort on the larger scale and more sophisticated level that will be required. Dr. Ochieng has done a good job under difficult circumstances, and his ecology training has enabled him to improve rearing techniques through a better understanding of pest biology and behavior. His expertise is needed and could probably be used to greater advantage, however, in the more field-oriented parts of the program.

Because the Bases of Resistance Programme is to supply mass-reared pests to government agricultural research stations for use in their screening programs, centrally located rearing facilities may be necessary at Nairobi. Great care should be taken to avoid expensive and unnecessary duplication of facilities at the two sites.

c. More careful attention should be paid to replications, statistical analysis and repetition of experiments during more than one rainfed growing season (necessary for valid data reflecting farmer's field conditions). Project scientists should maintain good liaison with the Biostatistics and Computer

11.4

Service and involve biometricians in experimental design as well as in the analysis of data.

d. Increased emphasis should be placed on the economic basis of successful pest management. Crop loss and economic injury level data should be collected for pests from farmers' fields during rainfed growing seasons. This is essential for evaluating the usefulness of resistance identified in crop lines, and the degree to which such resistance must be augmented by other pest management strategies to keep insect pests under adequate control; baseline information for evaluating pest management strategies, and with a view to possible cropping system modelling for future decision making; and for prioritizing project research, since the numbers of problems studied must be limited to enhance quality of research.

Such studies are a long-term endeavor, and the Scientific Working Group on Cereal Stem-Borers and Legume Pod-Borers observed (September 1980): "The Committee felt that economic surveys would be beyond the scope of ICIPE's current programme and that possibly this was a national programme endeavor. The Committee recommended that ICIPE should develop methods of crop loss assessment suitable for use in surveys carried out by national programmes. Work has begun on crop loss to Maruca and to Chilo in the Crop Borers Programme We would like to point out that the development of methodology, if properly pursued, will generate the necessary data for the Mbita Point area. Hopefully national programs could then apply the methodology elsewhere.

With such information the value of crop loss can be ascertained under alternative circumstances, and used to develop cost of production budgets reflecting differing input levels with alternative cultural practices and varieties, and differing yields. Such budgets are helpful in determining the relative profitability of the various alternatives scientists might advocate

as a result of their research. Presumably the more profitable the practice the more rapid its adoption rate. Cost of production budgets can also be used to determine the cost and benefit of one alternative compared to other practices over the current or existing practices.

With yield loss information, cost of production data, and information concerning available land, labor, storage facilities and other possible constraints to production, a typical farm can be modeled in the simplest of mathematical terms. Such a model can be used to examine the impact of alternative insect protection practices on the production and cropping pattern of the local community. Such information can also be aggregated for the national level and used to examine how well alternative practices and recommendations assist in meeting national goals, needs and priorities for food and livestock production.

We recommend that the program fund and recruit a doctoral candidate in economics who will assist the biological scientists in the design and development of field experiments to collect crop loss data. This could be either an east African or a U.S. student, based in the U.S. and with field soujourns in Kenya during the cropping season. He or she should be assigned the responsibility for collecting information (in collaboration with the biological scientists) on traditional production practices in the area. Cost/revenue information should be used to develop production budgets. The economist should then develop a simple mathematical model which will be used to assess the impacts and feasibility (i.e., a cost/benefit analysis) of present and potential insect pest management strategies. This work could serve as a Ph.D dissertation as well as a document for national planning purposes.

The UNDP Mission (December, 1980) also addressed this point: "A solid IPM-type systems scientist could oversee many ongoing projects and

analyze the overall balance of events...In our opinion, many ICIPE projects have passed the stage of basic data collection and now are entering the stage of analysis and modelling. With the help of systems scientists they may be further advanced to the stage of fine-tuning."

3. Staff/Training

a. If funding is continued, the empty scientific positions should be filled as soon as possible, and the number of positions increased. Each scientist should work on no more than one pest on one crop. Research commitments should be reduced toward that goal if necessary. More expertise is required in the fields of insect behavior, insect genetics, insect physiology (nutrition), and plant physiology and genetics.

b. One of the most cost-effective methods of conducting research is with the contribution of postdocs and properly-supervised graduate students. AID should take advantage of this type of program. This will also contribute toward ICIPE's laudable goal of increasing African scientific expertise. Preference should be given to Africans. As many postdocs and graduate students should be incorporated into the program as supervisory capacity will allow.

Funding should be made available for some East African graduate students for work under the guidance of program scientists. Funds should be earmarked for their supplies and travel as well as for stipends. Senior Research Scientists should play an active role in locating such students.

c. The most qualified and promising program technicians should be further educated at university or appropriate technical institutions, in fields that will enhance their future contributions to program research. Candidates should be identified by program scientists.

4. Travel

More provision should be made for scientists' travel than heretofore. Attendance at relevant meetings and visits to cooperating institutions keep scientists current on research developments, reduce duplication of effort, and enhance ICIPE's contribution to international efforts.

5. Organization

The Crop Borers and Bases of Plant Resistance Programmes should be merged. At present their objectives and efforts overlap, and ICIPE documents sometimes refer to them as "subprojects" of the crop pests program. Research effectiveness would be enhanced if one very senior scientist was named leader of the combined projects and, based at Mbita Point, provided firm direction and coordination of the research effort.

A similar conclusion was reached by the International Scientific Group on Cereal Stem-Borers and Legume Pod-Borers (September, 1980): "The Committee recommended that there should be a research leader who will be a resident scientist at Mbita Point and in charge of the Station. This would ensure maximum coordination, collaboration and effectiveness."

6. Reporting

Progress reports should be prepared only twice a year. The midyear report should be brief. Progress, plans, and problems should be included, along with an accounting of funds spent. The annual report should be similar but more detailed, and it should be provided to evaluation teams as the framework for review. Data in all reports should be accompanied by statistical analysis where applicable.

B. Project Design/Budget

1. Increased Accountability

a. Reporting. Program expenditures should be reported in detail every six months. This should include itemized listings for supplies, materials, equipment and travel, and all the components of salary figures, including social security, taxes withheld, and fringe benefits, such as housing allowance, home leave, etc.

This reporting should include disbursement of funds from all donors contributing to the program (in the past this would have included contract funds from IITA for Maruca mass-rearing, UNDP's payment of Dr. Dabrowski's salary, etc.) and all donors should receive a copy. REDSO/EA needs this information for meaningful monitoring of the program, to facilitate donor cooperation and make sure funding will dovetail rather than overlap.

b. Joint Funding. Program funds from different donors should not be commingled, but rather kept in separate accounts with disbursements reported as above.

2. Tenure of Project

Funding should be committed over a period of at least three years to insure continuity of research effort and minimize the fundraising effort.

3. Project Design

a. Design participants. The Programme Leader and other program scientists, the ICIPE Deputy Director (Research), outside consultant(s) identified by AID, AID project officers, and representatives of other program donors should all participate in project design and budgeting.

b. Scope of the project paper. The USAID project paper should be detailed and comprehensive, so that all the needs of the program will be anticipated and reviews can focus on specific areas of responsibility and accountability. This should also facilitate the attainment of project goals.

When money from several donors will be employed toward achievement of project goals, those funds should be carefully budgeted by concerned parties. in a complimentary manner.

The project paper should go into as much detail as possible about specific positions to be funded, materials and equipment to be purchased, travel allotments, and reporting of disbursements and research activities. The PP should include an organizational chart and explicit delineation of position responsibilities. Each scientist, each technician should be aware of his/her responsibilities and those of others. Such questions must be resolved before an effective research program can be established and successfully executed.

To insure that research funds are adequate and available as budgeted, specific proportions of the project budget should be allocated for ICIPE overhead. ICIPE Management Paper No. 14, "ICIPE Policy on Overhead Costs" (Attachment II) details cost items. A general overhead rate of 20% is quoted, which we consider reasonable (Section 7a). Program-specific overhead (Section 7b) includes contribution by research units (10%), research support services (15%), and cost of field station overhead (1/3 of Mbita Point overhead). These items should be budgeted separately and in detail in the project paper with careful attention to program needs. It should be noted that AID's contribution to Mbita Point overhead is apparently presently made in the form of salaries for field staff.

c. Provision for flexibility. Because research paths/priorities, and therefore budget and personnel needs, will inevitably evolve as a research program progresses, the program framework stipulated in the PP must be open

to amendment. When program scientists draw up the annual report, they should propose and justify perceived necessary changes. Such amendments could then be implemented with the concurrence of responsible REDSO/EA staff.

C. Administration

1. USAID/ICIPE Liaison

All AID funding of ICIPE should be brought under a single administrative umbrella in Nairobi. This would simplify and facilitate monitoring, reduce potential duplication of effort, and enhance the AID/ICIPE working relationship.

2. Division of Administrative Tasks

Overhead funds should be disbursed and accounted for by ICIPE administrative staff. Within the budget framework of the project paper, funds earmarked for research should be administered and accounted for by the Programme Leader. This would result in better planning, increased efficiency, higher morale, and more effective research, while reducing the burdens of ICIPE's Director and administrative staff.

3. Cooperation with the Kenya Government

Present informal cooperation should be maintained and enhanced. Formal cooperation should be instituted for jointly-funded projects.

ICIPE should enhance liaison and cooperation by organizing more national symposia on IPM, ecology, and systematics.

4. Compliance with Pesticide Regulations

Gloves and safety masks should be budgeted for in the PP, and Mbita Point field staff should pay more attention to appropriate use of safety equipment and protective clothing.

D. Reviews

If the Bases of Plant Resistance Programme is funded further, reviews should be implemented halfway through the project period and again at the end. These should examine research progress/priorities/problems, adherence to plans

stipulated in the PP (including adequate and timely provision services by ICIPE in return for overhead allocations, staffing, availability of vehicles, equipment, supplies, etc. listed as purchased), organization and necessary changes foreseen.

E. Summary

We find the goals of the programme laudable and worthy of increased support by USAID within the framework recommended above. We wish to commend ICIPE and program staff on progress to date, and respectfully submit this report in the hope that it will prove useful toward future project design and attainment of the goals of the project, of ICIPE and of USAID.

ATTACHMENT II

THE INTERNATIONAL CENTRE OF
INSECT PHYSIOLOGY AND ECOLOGY
P.O. BOX 30772, NAIROBI, KENYA

REF: S5/MANPAP/45/34 12th March 1981

MANAGEMENT PAPER NO. 14

ICIPE POLICY ON OVERHEAD COSTS

1. General Definition

In accounting, overhead costs are defined as operating expenses that are not directly related to the volume of production. They are normally fixed or semi-fixed costs and vary little with operations, that is, they are costs incurred in maintaining a basic organization of an institution.

2. ICIPE Policy

The ICIPE is a research and training institute. Because conventional allocation of costs would result in extra record keeping costs which would exceed any apparent benefits from tracing such individual costs to research and training, the ICIPE has adopted a flexible and broad policy on cost allocation. All costs incurred in research and training and in those activities which support or dessiminate and communicate research and training output are defined as direct costs. The remaining costs, which provide a basic organization, are regarded as overhea costs.

3. Cost Categories

(a) Direct Costs

Core Research Programmes

- Bases of Plant Resistance to Insect Attack
- Crop Borers
- African Armyworm
- Grassland Termites
- Livestock Ticks
- Tsetse
- Medical Vectors

Research Units

- Chemistry and Bioassay Research Unit
- Histology and Fine Structure Research Unit

- Sensory Physiology Research Unit
- Insect Pathology and Pest Management
- Biostatistics and Computer Service

Research Support Services

- Laboratory Management
- Insect and Animal Breeding Unit
- Field Stations
- Library and Documentation
- Workshops and Maintenance
- Transport Unit

Training and Communication

- Training
- Communication
- Conferences and Study Workshops

(b) Overhead Costs

Management and General Operations

- Governing Board and Committees
- Office of the Director
- Accounting
- Supplies
- Personnel and Office Management
- Security and Janitorial Services
- Utilities

4. Cost Behaviour Patterns

The costs defined above have been analysed for the period 1976 - 1980 on the basis of audited accounts. The pattern is presented here as percentages of total expenditure in each year:

Direct Costs	1976	1977	1978	1979	1980
Core Research	36.5	37.7	39.7	40.4	41.4
Research Units	15.5	10.6	10.5	10.1	8.1
Research Support Services	18.7	13.8	16.4	15.6	15.5
Training & Communication	5.8	13.7	14.9	13.5	14.1
Overhead Costs					
Management and General Operations	23.5	24.2	18.5	20.4	20.8

5. Unit Costs

ICIPE's output is measured by the productivity of its scientific and training staff: and therefore it is reasonable to develop a Unit Cost based on international professional staff. A pattern of direct unit cost (in US $) is presented here, using the audited accounts for the period 1976 - 1980:

	1976	1977	1978	1979	1980
Unit Cost (US $)	83,260	90,300	84,000	84,000	83,400

An overall planning rate of US $ 100,000 per international professional staff is recommended.

6. Unit overhead costs have no economic significance because overhead costs do not change as operations fluctuate. However, an overhead rate of application has been developed here as a percentage of total expenditure. Its pattern is as follows:

	1976	1977	1978	1979	1980
Overhead Rate %	24	24	18	20	20

A rate of 20% is recommended for planning purposes.

7. Overhead Cost Items

(a) General for ICIPE

An overhead cost rate of 20% should be applied, and covers cost of:

- Governing Board and Committees
- Office of the Director
- Accounting Services
- Supplies
- Personnel and Office Management
- Security and Janitorial Services
- Utilities - Electricity and Water
  - Rates on Land and Property
  - Telephone, Postage and Telex
  - Printing and Stationery

Note:

Self-Financing Units are those Units which provide services in direct support to research and training or indirectly through the improved welfare of the staff. They are expected in the long-run to generate adequate funds to cover their operating costs. Meanwhile, they receive grants-in-aid from the General Fund of the ICIPE to meet shortfalls between their income and

Three such units have been established:

- International Guest Centre System
- Mbita Point International School
- Medical and Clinical Service

(b) Specific to Programmes

Where Research and Training Programmes are budgeted as individual projects, the following overhead costs are added:

Contribution by Research Units, at 10%
Research Support Services at 15%

- Maintenance of Equipment
- Supply of Insects and Animals
- Maintenance of Motor Vehicles

Cost of Field Station Overheads shared between programmes depending on the number of Research Programmes based at a particular station. For example two Research programmes (Bases of Plant Resistance to Insect Attack and Crop Borers) are based wholly at Mbita Point Field Station and two others (Tsetse and Livestock Ticks are based there partly). This makes the equivalent of 3 full programmes sharing the overhead on the basis of $\frac{1}{3}$ of the overhead costs per full programme.

March 1981