

FAO Emergency Prevention System for Transboundary Animal and Plant Pest and  
Diseases (EMPRES)

Desert Locust Component

**Project GCP/INT/651/NOR**

**Improving pesticide application techniques for Desert  
Locust control**

Evaluation Mission Report

26 February – 16 March 2001

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## Summary

An independent Mission composed of 3 technical experts (representing Norway: Mr. Preben Ottesen, the locust-affected countries: Mr. Said Ghaout, and FAO: Mr. Bernhard Zelazny) evaluated the Norwegian FAO Trust Fund project “Improving Pesticide Application Techniques for Desert Locust Control” (GCP/INT/651/NOR) between 26 February and 16 March 2001. The project is designed as an international project under the Desert Locust component of the FAO Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES). It is based in Mauritania and was so far mainly active in that country.

The Mission concludes that the overall goal of the project, “**to reduce costs and environmental impact of Desert Locust control operations by improving pesticide application techniques and decreasing dosages**”, is a very important part of the aims of the FAO EMPRES programme. The high cost of locust control and the risk of the application of chemical pesticides to humans and the environment have been of growing concern to donors and locust-affected countries since the last Desert Locust plague (1986-1989), to which donors alone contributed about US\$ 250 million in emergency aid.

The original project design, which relied mainly on an FAO Associate Professional Officer for implementing the project, was too ambitious and progress of the project was slow during the first 2½ years. However, among others, unconventional, but highly successful methods of rearing locusts were developed during that time. Project implementation became extremely efficient after an FAO Chief Technical Adviser was recruited to the project in May 1999. The Mission reports that the project has produced very impressive results and that most of the planned outputs have been achieved. By the end of 2001 the project will have made important contributions to developing and introducing safer and more cost-effective procedures for Desert Locust control operations. The Desert Locust control teams in Mauritania have benefited considerably from the project activities and are already using some of these improved procedures.

Of particular significance are the project findings that pesticide dosages can be reduced to less than half, if advanced guidance and monitoring systems are used when applying them against the Desert Locust. This confirmed earlier research by Norwegian scientists on other locust and grasshopper species. Development and testing of monitoring/guidance systems for aerial locust-control operations has been completed and the technology is in the process of being introduced to locust control services. A similar system for ground-spraying operations is still under development. The project has also made important progress with introducing routine procedures for monitoring accidental exposure to pesticides on spray operators and livestock.

The project had fewer opportunities to conduct field trials than originally envisaged and has therefore been more active in laboratory trials and training activities. (The reasons for a reduction in locust outbreaks during the last years are usually seen as a combination of less suitable environmental conditions and successful preventive control operations.) The Mission does not regard this shift in focus as a negative development, since it still produced very valuable results and was in line with the project objectives. However, it left the need to conduct, as soon as possible, more field trials with locust infestations.

In view of the considerable achievements of the project, the Mission strongly feels that a second phase of the project is justified, at least for an additional 2 years. Apart from taking advantage of a well functioning and very productive project set-up, the Mission sees a need for continuing work in four main areas:

1. Transferring the results, the experience gained, and the achievements of the project to other countries affected by the Desert Locust.
2. Further development work, which builds on the results of the project, and which is likely to result in significant additional reductions of the use of pesticides for locust control operations.
3. Collaboration with other projects in field testing of alternatives to chemicals pesticides like biopesticides and pheromones.
4. The conduct of field trials at various scales to confirm and complement the results achieved so far, as well as to gain more experience with the improved methods under operational conditions.

An outline of a proposal for a second phase, including justifications and expected results, has been prepared by the Mission, following discussions with the Mauritanian Government and FAO staff. It is attached as Annex 5 to the Mission report.

The Mission recommends that the CTA prepares, as soon as possible, a detailed project proposal for a 2<sup>nd</sup> project phase in consultation with the Government of Mauritania and other FAO EMPRES staff which is based on the outline which has been prepared by the Mission. Project activities during the remaining time of the project should focus on the above described areas, but attention should be also paid to completing project documentation and ensuring wider distribution of the project reports.

## Introduction

The Norwegian FAO project “Improving Pesticide Application Techniques for Desert Locust Control” (GCP/INT/651/NOR) started in late 1996. It underwent a major revision and extension in early 1999 and is now scheduled to be completed at the end of 2001. The current independent evaluation was conducted from 26 February to 16 March 2001 in order to assess the progress achieved during the last 4½ years, make recommendations for the remainder of the project duration, and draw conclusions on whether a further extension of the project (e.g. as a 2<sup>nd</sup> phase) would be justified.

The Evaluation Mission consisted of three technical experts who represented Norway (Mr. Preben Ottesen), the locust-affected countries (Mr. Said Ghaout) and FAO (Mr. Bernhard Zelazny). The Terms of Reference of the Mission are attached as Annex 1. The Mission visited FAO Headquarters for briefing and debriefing (total of five days) and Mauritania (11 days), where most of the project activities were implemented. The persons met by the Mission are listed in Annex 2 and the documents available to the Mission are provided in Annex 3.

## Background and Context

The Desert Locust is regarded as the most destructive of all locust species. It threatens agricultural crops and pastures in up to 60 countries of northern and central Africa, the Near East and South-West Asia. After major rainfall events, when conditions for breeding are favourable, the Desert Locust aggregates into large swarms, sometimes more than 100 square kilometres in size. Breeding typically occurs in remote areas, where the wingless hoppers develop into the mature adult locusts. As swarms, the adults are able to fly over

long distances and can cause extensive crop losses hundreds, even thousands of kilometres away from their place of origin. The crop damage affects all aspects of agriculture, and especially endangers the livelihood security of subsistence and small holder farmers. Because the swarms often invade other countries, coordination and collaboration among the affected countries is essential for keeping this pest under control.

The Desert Locust plague (1986-89) has again exposed the vulnerability of the affected countries and made large-scale control campaigns necessary. About 15 million hectares of locust infestations had to be treated with chemical pesticides. The total costs of these emergency operations are unknown, but donor assistance alone reached US\$ 250 million. In 1992 a major Desert Locust upsurge developed again in countries around the Red Sea. In 1993 swarms, originating from Saudi Arabia and Sudan, migrated across Africa and invaded Mauritania. The invasion triggered numerous breeding cycles in West and North-West Africa which lasted until 1996. Again, large-scale control operations became necessary and a total of 1.7 million hectares of infestations had to be treated between 1993 and 1996 in that region. Mauritania was affected most severely and 65% of all areas treated in West and North-West Africa were located in that country.

The large-scale use of chemical pesticides in ecologically fragile environments, the associated health risks to workers and the general public, as well as the high costs of these control operations have been of growing concern to donors and locust-affected countries. In addition, the locust control operations contributed to the large stocks of obsolete pesticides in Africa, because the development of locust infestations is erratic and largely unpredictable. Since ordering and shipping the pesticides takes several months and cannot be always planned to coincide with the appearance of infestations, large surplus stocks may be left after a major campaign.

In 1994 FAO established the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES), which, on the plant protection side places initial focus on the Desert Locust. The Desert Locust component of EMPRES aims at strengthening the early warning, early reaction and research capacities of the affected countries. Emphasis is placed on developing a preventive system in which significant Desert Locust infestations (those which are likely to develop into swarms) are detected and eliminated at an early stage of the breeding cycles, even in remote areas. It is expected that in most situations it would then be possible to contain the upsurges and prevent major migrations of swarms to other countries. Early interventions should translate into major cost savings as well as reduce the risks of crop damage. At the same time EMPRES addresses concerns about the safety and environmental impact of pesticides. Apart from early interventions, which are expected to reduce overall pesticide use, methods are being developed and introduced which are safer, make more efficient use of the pesticides and have less impact on the environment.

The Norwegian Trust Fund project "Improving Pesticide Application Techniques for Desert Locust Control" has been one of the first components of the EMPRES programme. It has been designed as a major contribution to the aim of developing and introducing methods of reduced and safer use of chemical pesticides. The project started in September 1996 with an initial budget of US\$ 697,617 and a duration of two years. In a major revision in 1999, the project was extended and the budget was increased to US\$ 1,115,525. The project is currently scheduled to conclude at the end of 2001.

## Assessment of Project Objectives and Design

### Development objective and justification for the project

The overall goal of the project is “**to reduce costs and environmental impact of Desert Locust control operations by improving pesticide application techniques and decreasing dosages**”. In locust-affected countries, large quantities of pesticides are often applied incorrectly. For example, the applications may not give a uniform distribution of the recommended amount of pesticides over the treated areas, or they might result in health and environmental side effects. Various factors are usually connected to such problems. Most prominently is the desire from the side of the Government teams, to achieve fast and complete elimination of the locust infestations which can result in applying too high dosages. Other reasons may be that the application methods and the available equipment are not suitable for the local conditions or that workers are insufficiently trained. In addition, various potential technical improvements in application technology exist, but have not been adapted to locust control operations or tested under field conditions.

In view of the above, the Mission is of the opinion that the project addresses a very important component of the Desert Locust management system and has the potential to make significant contributions to increased efficacy, reduced costs, as well as to safer and more environmentally friendly control operations. In addition to the justifications given in the project document, the project also contributes to a reduced risk of accumulating obsolete stocks of pesticides, simply because improved application methods would result in a reduction of pesticide orders.

### Planned results of the project

The project expects to achieve 5 results:

1. Current procedures and techniques of pesticide application evaluated. Spraying practices during locust control operations can differ significantly from country to country. There is also a variety of equipment and recommendations available. Therefore, the Mission considers it essential that current knowledge and practices are reviewed and evaluated in order to provide baseline information for the project work, for developing recommendations, as well as for preparing operating and training manuals.

2. Reduced pesticide dosages and insect growth regulators tested. This component of the project attempts to develop methods and procedures which should result in a reduction of the amount of pesticides applied, while retaining and if possible even increasing efficacy of kill during locust control operations. The Mission considers this to be the most important component of the project which has the best prospects for significant improvements of locust control operations.

3. Improved evaluation and data collection systems for ground and aerial spraying operations developed. Some, but not all locust-affected countries, collect insufficient information on their control operations. This makes it difficult to plan efficiently during a campaign and to evaluate the campaigns afterwards. In addition, a standard reporting system accepted by all locust-affected countries would facilitate analysis and forecasting by FAO and other parties. The Mission feels that this is also an important component of the project, but sees the danger that a very elaborate system might distract control teams from other aspects of their work.

4. Routine procedures for monitoring safe pesticide applications and environmental impact developed. The Mission considers it important that routine procedures for monitoring possible health and environmental side effects due to pesticide applications are developed and introduced into the locust-affected countries. Few countries monitor accidental exposure of workers to pesticides and no country has a system in place for monitoring the environmental impact during locust campaigns.

5. Counterparts trained in improved application techniques. The Mission considers this to be an important aspect. A variety of specific training events involving staff from different levels of the national locust control services are needed to bring the project results to operational use.

## **Project design**

The Mission interprets the project design as a first step under the EMPRES programme to improve pesticide application technology and methods during locust campaigns. It was not foreseen to cover to a full extent all aspects of the topics addressed by the project nor to introduce improvements into all countries affected by the Desert Locust. Still, the Mission considers the project design ambitious for the original duration of two years and for the initial structure which relied mainly on an FAO Associate Professional Officer (APO) for implementing the project. It would have required a person with a level of qualification, experience and organizational skill which is not commonly found among candidates for APO positions. The modified structure (recruiting an FAO Chief Technical Adviser) and extending the project duration was more suitable for achieving the planned outputs.

The fact that the project was integrated into the FAO EMPRES programme is also seen by the Mission as significant for the performance of the project, since it resulted in several fruitful partnerships with other parts of this programme and facilitated the work in other affected countries.

## **Assessment of Project Implementation, Efficiency and Management**

From the start of the project in September 1996 until May 1999, implementation of the project relied mainly on the activities of an FAO Associate Professional Officer, Mr. Baard Johannessen. He was guided by a Team Leader, who visited the project regularly, as well as by consultants and FAO HQ staff. Although Mr. Johannessen brought considerable technical experience, enthusiasm and commitment to the project, it turned out to be difficult to supervise and guide him from a distance. Efforts by the Team Leader, by consultants and by FAO HQ in this direction are judged by the Mission to have been adequate. Instead, the Mission attributes these difficulties to the independent nature of Mr. Johannessen as well as his personal difficulties in organizing his work systematically and consistently according to his work-plan and written instructions. Additional constraints in that period were the lack of locust infestations in Mauritania during the 1997/98 and 1998/99 seasons, Mr. Johannessen's tendency to write few reports, as well as technical difficulties he experienced with the methodology of laboratory pesticide trials. As a result, progress was slow during this period of the project and no field trials were conducted during the 1996/97 season. On the other hand, Mr. Johannessen made some very valuable contributions to the project. Above all, he developed an unconventional but highly successful locust rearing facility. His efforts in modifying and equipping the building used

by the project have been very professional and have greatly assisted the implementation of the project.

In early 1999 the project was revised and the position of an FAO Chief Technical Adviser was created. Mr. Robert Aston was recruited to this position and started his duties in May 1999, shortly after the end of Mr. Johannessen's assignment. Since May 1999 the project implementation has been exceptionally efficient and professional. Although few locust infestations were available during the 1999/00 and 2000/01 seasons, maximum use was made of them for field trials. New laboratory pesticide trials were initiated and numerous analyses, training events and field activities were completed, which did not require the presence of locusts in the field. The locust rearing, initiated by Mr. Johannessen, facilitated some of these activities.

During the visit of the Evaluation Mission several Government representatives officially expressed their gratitude to the Government of Norway and to FAO for their work and assistance provided by the project. The Mission is of the opinion that the Mauritanian Government greatly contributed to the achievements of the project. Apart from hosting the project, the staff of the Locust Control Centre very actively participated in the project activities. It also provided logistics and various other inputs to the project activities. Two highly qualified and competent researchers (Mr. Ahmed ould El Hadj and Mr. Mohamed El Hadi ould Taleb) are presently working with the project and have made valuable contributions to the research and to other project activities. The organizational skills of Mr. Mohamed Abdallahi ould Babah, the Head of the Mauritanian Locust Control Centre, as well as his experience and commitment to the project has been an important factor for the success of the project.

Apart from Mauritania, the project has been active in Sudan and Senegal, and also assisted in a national training course in Morocco. Less international activities have been initiated than originally foreseen, but the Mission feels that the strong focus by the project on Mauritania was justified in view of the few locust infestations which were present in other countries during the project period. The Government of Mauritania was fully aware of, and supported, the international status of the project, but the FAO staff felt it was important first to initiate work on analyzing, developing and testing methods, rather than on training and technology transfer to other countries.

The Mission further feels that the excellent collaboration between the project and other projects have contributed to the achievements and to the dissemination of the project results. This collaboration was particularly fruitful with the LOCUSTOX project in Senegal which studies health and environment impacts during locust and grasshopper campaigns, with other components of the EMPRES programme, as well as with other relevant institutes and organizations. The collaboration between the project and the other parties involved resulted in well co-ordinated activities which complemented and stimulated each other.

The actual and planned expenditures of the project are shown in the following table. The Mission feels that the achievements of the project compare favourably to the size of the budget.

	1996	1997	1998	1999	2000	2001	Sum
International staff & consultant:	11 116	22 202	22 331	96 620	110 319	167 000	429 588
Administrative support					2 865		2 865
National experts				1 613	12 105	10 000	23 718
Travel	795	20 875	29 562	26 247	10 830	28 000	116 309
Contracts				1 500		5 000	6 500
General operating expenses		21 211	38 006	41 991	47 828	31 073	180 109
Expendable equipment				4 612	6 922	15 000	26 534
Non-expendable equipment	65 412	26 631	18 435	12 604	20 685	30 529	174 296
Training		450	1 209	1 157		24 455	27 271
Support costs	10 052	11 878	14 241	24 225	27 502	40 437	128 335
<b>Sum</b>	<b>87 375</b>	<b>103 247</b>	<b>123 784</b>	<b>210 569</b>	<b>239 056</b>	<b>351 494</b>	<b>1 115 525</b>

Currently, the project employs 9 support staff on a temporary basis. While this is more than in most projects of this size, it has involved only modest expenditures and has, no doubt, facilitated project activities, especially during field work. However, it created the situation that the support staff by now relies on employment by the project, without having the status of fixed- or long-term contracts.

## Assessment of Results and Effectiveness

The following sections describe the main results of the project and the assessment of these by the Mission. A more detailed list of the activities and outputs of the project is provided in Annex 4. The numbering D.1 to D.5 has been used to facilitate comparison with the project document.

### D.1 Current procedures and techniques for pesticide applications evaluated

#### D.1.1 Review of current knowledge

The current state of knowledge on pesticide application techniques, as related to Desert Locust control, was reviewed through a contract. The review provides background information for identifying long-term research and development needs in this field. The Mission (and the project) considers this activity to be completed satisfactorily. However, the report covering this aspect should be distributed more widely (e.g. in the FAO Desert Locust Technical Series) and translated into French.

#### D.1.2 Analysis of current practices

Like the review, this activity aims at taking stock of the current situation, in order that project activities, like research or training, can be better targeted. The project implements this component as a continuing activity, which integrates elements like field operations, training and research. It mainly involves workshops to identify and analyze field operations, various training activities (including on the job training) and personal contacts and observations. Because of the continuing nature, this approach also provides information about the impact of the project on the target groups (the Desert Locust control teams). Advantages over conventional project planning (which involves detailed planning at the start of the project only) and evaluation procedures appear to include:

- The planning of project activities is based on a solid foundation by a systematic process of collecting data and information.

- All levels of the Locust Control Service are involved, not only the senior levels like in most project planning exercises.
- Since the process is dynamic, it provides instant and continuous feed back for improving project operations. Planning of future activities is integrated with evaluating past activities.

The Mission feels that the Chief Technical Adviser and his counterparts are doing excellent and pioneering work in developing suitable procedures for this unconventional approach. The experience gained by the project in this field will be valuable for other locust projects, possibly even for other development projects, and should be documented and publicized.

## **D.2 Reduced pesticide dosages and insect growth regulators tested**

### **D.2.1 Trials with reduced dosages**

This activity builds on previous studies by Norwegian scientists, which showed that a 50 to 90% reduction in pesticide dosages was possible if proper calibration, application and navigation techniques were used. However, the Desert Locust, by far the most damaging locust species, remained to be tested. The project confirmed these findings for Desert Locust hoppers in field trials. For example, it was shown that for 4<sup>th</sup> instar hoppers and using the pesticide fenitrothion, a dosage of 200 g a.i./ha is as efficient as the 450 g a.i./ha, which is regarded as effective by the FAO Pesticide Referee Group. In total 40 small-scale field trials have been conducted, but trials over 100 ha or more are needed, as well as trials with adult locust swarms

Since advanced navigation/monitoring systems for aerial spraying operations linked to satellite technology (DGPS or Differential Global Positioning System) have become available, reduced dosages may be more acceptable to campaign managers because under-exposure of spraying areas can be avoided. At the same time accidental exposure of sensitive areas like villages and water bodies can be excluded. The project has tested and demonstrated such equipment for aerial spraying operations. It has also made recommendations for improvements to one manufacturer. Although the cost of the equipment is currently in the order of around US\$ 40,000, the project calculated that with a 50% reduction in pesticide dosages, investments are returned after treating about 12,000 hectares. For comparison, more than 100,000 hectares were treated by air against locusts in Mauritania alone during 1995. As a result of the project activity, the FAO EMPRES programme has allocated funds in its budget for 2001 for the purchase of this system for demonstration and training of pilots and spray operators. In addition, after recommendations from the project the Technical Group of the FAO Desert Locust Control Committee recommended that such systems should be a standard requirement in all contracts for aerial spraying operations against locusts. It is expected that the Committee will formally endorse this recommendation when it meets in September 2001.

The project is also involved in the development and testing of a GPS-based system to improve ground-spraying operations. Ground spraying is particularly important for small- and medium-scale (preventive) control operations. While this was originally not planned for the project, the Mission very much welcomes this initiative. Much progress has been made, and the GPS-based guidance component of the system is likely to be completed before the end of 2001. However, the development of the spray-monitoring part will take more time.

Following a shortage of Desert Locust infestations in the field, the project developed a large-scale Desert Locust rearing using unconventional and innovative methods. The rearing proved very useful for various laboratory studies. It usually produces more locusts

than needed and egg pods are regularly shipped to other projects and to other locust control services. This has helped the collaboration with other countries and projects. The Mission is very impressed by the methods which have been developed. Compared to conventional rearings of the same size, the methods require significantly less manpower. It was felt that the rearing methods should be documented and publicized.

An important aspect of reducing pesticide dosages is the need to adjust more accurately the size and the distribution of pesticide droplets. The project has initiated valuable studies on the influence of various parameters on droplet size. Among others, it was found that wind speed is not as critical as assumed earlier. In addition, studies have started on improving the design of spraying equipment in collaboration with manufacturers. The Mission is very much encouraged by these new initiatives, which are likely to lead to improvements in procedures for testing and selecting spraying equipment.

As part of attempts to improve spraying operations, the project has also initiated collaboration with the Agricultural University of Norway, Dept. of Technical Studies, for testing a low cost/simple technology field vehicle for use during locust campaigns. This vehicle is constructed from available parts. The aim is to facilitate the use of vehicles in the difficult terrain which is often encountered during Desert Locust control operations. The Mission supports this initiative which has involved only modest expenditures by the project.

#### **D.2.2 Collaborative trials with IGRs**

Barrier spraying, i.e. spray swath applied at 1 km separation, may, if found effective, reduce costs and environmental impact dramatically. A problem is that the pesticide must be relatively persistent without causing unacceptable impact on the environment. One of the promising compounds is the insect growth regulator (IGR) teflubenzuron, for which Norwegian scientists earlier had recorded fewer side effect on non-target organisms than with conventional pesticides.

Small scale testing was done by the project in March and April 2000 with teflubenzuron. Hoppers passing two barriers were followed in the field for three weeks and were satisfactory controlled. There has been no opportunity so far to do large-scale collaborative field trials with IGRs.

### **D.3 Improved evaluation and data collection systems for ground and aerial spraying operations developed**

#### **D.3.1 Develop routine procedures for evaluating the efficiency of individual control operations**

A recurring question is how to record the efficiency of control operations. Locusts often stay alive for several days after spraying. In the case of adults, they might even fly off to other areas after treatment. The project has investigated various containers for collecting and keeping sprayed locusts after treatment for monitoring mortality. A new pesticide and mixtures of pesticides suspected of giving more rapid mortality have also been tested. So far it has not been possible to find a simple and practical method. The Mission is of the opinion that during locust campaigns it would be justified to deploy independent teams for assessing control efficacy. This method has been used in Mauritania during the last years. Further, the introduction of GPS-based spray guidance/monitoring systems will result in fewer errors during spray operations and will also automatically provide detailed and unbiased data documenting the operations.

### **D.3.2 Develop routine procedures for collecting, storing and evaluating data related to control operations**

The project has assisted EMPRES activities aimed at developing and introducing improved method for collecting data on control operations in order to facilitate campaign planning and analysis. Development work has included recording data on control operations, and linking this to the GPS-based monitoring and guidance systems. For example, the project has tested a system for writing data in the field directly into a hand-held Psion computer with direct transfer via a short wave radio modem through the ordinary radio link to the national locust centre. The project has also assisted the efforts of other projects to develop a standard database which would store and evaluate those data.

## **D.4 Routine procedures for monitoring safe pesticide applications and environmental impact developed**

The project has developed procedures for monitoring the accidental exposure of locust control workers and livestock to pesticides. This was done in close collaboration with the FAO LOCUSTOX project which has done intensive research in this field in Senegal, but has started few activities in other countries and has not yet focused on transferring the research results to operational use. Thus, the project has complemented the activities of the LOCUSTOX project. The Mission is of the opinion that this aspect has been well covered by the project and that the achievements have actually gone beyond what was originally planned. In particular, the Mission appreciates the voluntary contribution by Mrs. Rose Aston to the project, who has developed a framework for an Environmental Impact Assessment of non-pesticide components of Desert Locust survey and control operations.

### **D.4.1 Monitoring exposure of spray operators to pesticides**

The technique for monitoring exposure of operators to commonly used pesticides (i.e. organophosphates and carbamates) through the analysis of blood samples was transferred from the LOCUSTOX project in Senegal to the Norwegian project in 1998. Since then, the project has conducted extensive studies on testing spray operators in collaboration with the Ministry of Health and the technology is now routinely used in Mauritania.

The project has started various related activities. These include studies on identifying sources of pesticide contamination on spray operators with fluorescent tracers, improving protective clothing, and modifying operating procedures in order to reduce exposure to pesticides. An example of the latter aspect has been the development by the project of a closed system for transferring pesticides from barrels to vehicles or aircraft. This avoids spilling of pesticides and accidental exposure of operators during this transfer.

### **D.4.2 Procedures for monitoring impact on wild birds**

The project has not started this activity since it would involve the introduction of highly sophisticated technology. Since a number studies in the field have been already done by other projects, even under conditions of locust control operations, the Mission agrees that there is no urgent need to start this activity during the remainder of the project.

### **D.4.3 Monitoring the pesticide impact on camels and other domestic animals**

The project has done extensive studies on monitoring the acetylcholinesterase levels in the blood of camels. The results so far do not indicate a major impact of pesticides applied for locust control on camels. While a large number of blood samples was analyzed, only some animals exposed to pesticides could be included in the studies, because nomads are very sensitive about experiments with camels, and there were few opportunities to study camels

accidentally exposed to pesticides. Therefore, it is premature to draw definite conclusions from these results.

## **D. 5 Counterparts trained in improved application techniques**

As explained under section D.1.2 the project has developed a system approach which links analytical methods with training and modifying research directions. This has been implemented through various workshops, training events, as well as informal observations and discussions with operators during field trips. These activities were mainly implemented in Mauritania, but also in Morocco and Sudan. The Mission found that in Mauritania the project has achieved an excellent level of collaboration with its main target group, i.e. the teams involved in locust control operations. The teams are well aware of the objectives and results of the project and have readily adopted new technologies and modifications in their operating procedures. Thus, the Mission feels that much progress has been made on this aspect, although so far it has been the Mauritania teams which benefited mainly from the project.

## **Conclusions and Recommendations**

### **Conclusions**

The Mission regards the Norwegian project “Improving Pesticide Application Techniques for Desert Locust Control” as an important component of the FAO Emergency Prevention Programme (EMPRES). After some difficulties during the first years, the project has achieved impressive results. By the end of 2001 the project will have made important contributions to developing and introducing safer and more cost-effective procedures for Desert Locust control operations. The Desert Locust control teams in Mauritania have benefited considerably from the project activities and are already using some of these improved procedures. While most of the project results are applicable to other locust-affected countries, not many project activities have yet been implemented outside of Mauritania.

To a large extent, the project has achieved the planned outputs and results. However, the project had few opportunities to conduct field trials, because relatively few Desert Locust infestations developed in Africa since the start of the project. (This was apparently due to a combination of unsuitable environmental conditions and successful preventive control operations.) As a result, the project focused more on other work, which did not require the availability of locust infestations in the field, including laboratory studies with reared locusts. The Mission does not regard this shift in focus as a negative development, since it still produced very valuable results and was in line with the project objectives. However, it left the need to conduct, as soon as possible, more field trials with locust infestations.

In view of the considerable achievements of the project, the Mission strongly feels that a second phase of the project is justified, at least for an additional two years. Apart from taking advantage of a well functioning and very productive project set-up, the Mission sees a need for continuing work in four main areas:

1. Transferring the results, the experience gained, and the achievements of the project to other countries affected by the Desert Locust.

2. Further development work, which builds on the results of the project, and which is likely to result in significant additional reductions of the use of pesticides for locust control operations.
3. Collaboration with other projects in field testing of alternatives to chemical pesticides like biopesticides and pheromones.
4. Conduct field trials at various scales to confirm and complement the results achieved so far, as well as to gain more experience with the improved methods under operational conditions.

An outline of a proposal for a second phase, including justifications and expected results, has been prepared by the Mission, following discussions with the Mauritanian Government and FAO staff. It is attached as Annex 5.

More specifically the Mission has reached the following conclusions:

### Project design and implementation

- The original project design and duration was ambitious and it was risky to rely mainly on an FAO Associate Professional Officer (Mr. Baard Johannessen) for implementing the project.
- Progress of the project was slow between its start in Sept. 1996 and May 1999, when an FAO Chief Technical Adviser (Mr. Robert Aston) was assigned to the project following the donor's approval of a major budget revision. However, it should be stressed, that during the first years Mr. Johannessen made valuable contributions to the project by developing an unconventional but highly successful locust-rearing and by modifying and equipping the building used by the project.
- Project implementation has been extremely efficient since May 1999. However, few locust infestations were available for field trials since 1997.
- The Mauritanian Government actively participates in the project activities and attaches great importance to the work of the project.
- The project has established fruitful collaboration with several other locust projects, especially with the LOCUSTOX project based in Senegal and the EMPRES Central Region programme. However, the project has not been as active outside of Mauritania as originally envisaged.

### Project results

- The project has developed procedures for analyzing current practices and for integrating the results into an innovative evaluation/planning approach. This means, the results of the analysis are used to review training procedures, research needs and other project activities on a continuing basis.
- The project has made significant progress in developing and testing methods which use reduced dosages of pesticides for aerial spraying operations in combination with a satellite guidance and spray monitoring system. Some trial results are ready to be presented to the FAO Pesticide Referee Group for changing the officially recognized effective dosages. In addition, the Mission attaches particular significance to an initiative by the project to start developing (in collaboration with manufacturers) a similar guidance/monitoring system for ground spraying operations. This would allow the use of reduced dosages during small- and medium-scale operations, which are common during preventive control operations.
- The project has made progress in developing procedures for collecting and managing information on locust control operations, including the assessment of locust mortality.
- Procedures for monitoring safe pesticide applications and environmental impact have been developed and are now being used. The Mission feels that little work remains to be done in this area, apart from transferring this technology to other countries.

- The project has been very active in training workers involved in locust control operations and in collaborating with them for developing and testing improved application methods and procedures. The Mission feels that this aspect has been well covered, especially for Mauritania.

## **Recommendations**

- The Mission recommends that the CTA prepares, as soon as possible, a detailed project proposal for a 2<sup>nd</sup> project phase in consultation with the Government of Mauritania and other FAO EMPRES staff. The proposal should be based on the outline which has been prepared by the Mission and which is attached as Annex 5.

For the remaining time of the current project the Mission recommends that particular attention is paid to the following areas:

- Training and transfer of the project results to locust control teams, particularly in countries other than Mauritania.
- Completing the documentation of project results, including a terminal report, a presentation to the FAO Pesticide Referee Group, a report summarizing the experience gained with the analysis of current practices and making use of its results, as well as specifications/guidelines for FAO emergency operations.
- Important project documents and reports should be more widely distributed, including availability on the Internet, and should be, if possible, translated into other languages. Advantage should be also taken of the planned EMPRES (West Africa) workshop on research to publicize the project results.
- Continuation of the development of a guidance/monitoring system for ground-based locust control operations.
- Field trials with locust infestations if these become available, particularly the treatment of swarms.
- The mission recommends that the project should closely coordinate its activities with the phase II of the EMPRES-Central Region Programme (2001-2004), which, among others, aims at introducing “efficient and environmentally safer control methods”.

### Annex 1: Terms of references

#### TERMS OF REFERENCE

#### JOINT EVALUATION MISSION BY NORWAY, FAO AND A REPRESENTATIVE OF THE REGION OF

#### PROJECT GCP/INT/651/NOR

#### “IMPROVING PESTICIDE APPLICATION TECHNIQUES FOR DESERT LOCUST CONTROL”

#### BACKGROUND

The Project GCP/INT/651/NOR “Improving Pesticide Application Techniques for Desert Locust Control” was approved in October 1996. The project was seen as a contribution to the Special Programme EMPRES (Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases) – Desert Locust component. It focused on improving application techniques and on investigating reduced pesticide dosages for locust control, with the overall objective of achieving effective control with less pesticide, and a consequent benefit to the environment. The project was hosted by Mauritania and expected to work mainly in West and North-West Africa (Western Region), but also in the other EMPRES Regions if necessary.

No full time international staff were allocated to the project and it was expected that the project would be guided by the consultant/Team Leader from Norway, with other consultancy inputs, and with support from the Technical Backstopping Officer (TBO) in the Locust Group, FAO Rome. A Norwegian Associate Professional Officer was also expected to contribute to the implementation of the project. The supervision of the APO was to be shared between the Team Leader, the TBO and for administrative purposes the FAO Representative in Nouakchott.

In the event, initial progress of the project was slow. The amount of time that the Team Leader could devote to the project was limited and from 1997 onwards there were hardly any locust populations in the wild on which to test improved application techniques. The supervision of the APO proved problematic. In October 1998 a joint assessment of progress was made by the Team Leader and the TBO. It was recommended that, if the project was to have a chance to achieve its objectives, a full-time international Chief Technical Adviser should be recruited. Agreement was obtained from the donor and the CTA was recruited in May 1999 arriving in Mauritania just after the APO had completed his contract and left. Following the approval by the Norwegian authorities of a no-cost extension, the project is now scheduled to end on 31 December 2001.

During the life of the project, Desert Locust populations have been at a relatively low level. Almost all of the locust control in the Region has been carried out in Mauritania. As a result, project field activities have almost exclusively taken place in the host country. Visits for training and research purposes have been made to Morocco and Egypt, and one visit has been made to Sudan in order to develop close collaboration with EMPRES Central Region. An important trial of aerial spraying equipment (DGPS) designed to

reduce pesticide usage and monitor control performance was also carried out in Sudan in the expectation that the trial could be conducted on a locust outbreak population. Apart from these few visits, and because Mauritania has of necessity been the operational focus of almost all project activities, it is considered sufficient for the Evaluation Mission only to visit this country, in addition to the briefing and debriefing to be provided at FAO in Rome.

## SCOPE OF THE EVALUATION

In general, the Evaluation Mission is intended, as the project draws to a close, to review the extent to which the project has achieved its objectives and to which it has contributed to the EMPRES Program. The Mission will recommend what further steps should be taken to ensure that the objectives are achieved before the end of the project and any further need for external assistance will be identified. Specific items to be assessed and where appropriate for recommendations to be made include the following:-

- a) Relevance of the project objective and approach to development priorities and needs of Desert Locust management and to the mandate of FAO;
- b) Realism and clarity of the project design, including the structure of the project, its activities, outputs, inputs and time frame;
- c) Adequacy of institutional relationships, partnerships and links to related activities by FAO, other donors, participating countries and regional organizations;
- d) Efficiency of project implementation: planned activities, availability of funds and resources, technical/operational backstopping, the work of project staff and counterparts, monitoring and reporting arrangements. Implementation constraints will be identified and remedial actions recommended.
- e) Effectiveness in achieving project objectives including planned outputs and the progress towards the targets defined for the project, especially regarding:-
  - improving application techniques and organizational aspects of Desert Locust control, resulting in the probability of significantly reduced environmental side-effects;
  - collecting data on reduced dosages for aerial control with conventional pesticides, in combination with advanced navigation systems;
  - the introduction of simple and practical procedures for collecting data on control operations including their efficacy;
  - training activities to transfer project results to the Locust Units of Sahelian countries, leading to improved and safer control practices, and the avoidance of overdosing;
- f) Based on the above analysis, the Evaluation Mission will draw specific conclusions about the efficiency and effectiveness of the project and its likely impact on Desert Locust control practices and reducing environmental effects in locust habitats. The Mission will make recommendations on the future of the project, including the options of ending the project on schedule (end December 2001), or developing a new Phase.

## COMPOSITION OF THE MISSION

The Mission will comprise:-

- A representative of Norway, with experience of project evaluations, and preferably of agricultural pest/locust control, in developing countries;
- A independent representative of FAO, with experience in project evaluations, in locust management issues, and of the FAO system;

- A representative of locust-affected countries in the Region (West or North-West Africa).

#### TIMETABLE AND ITINERARY OF THE MISSION

The Mission members will assemble in Rome on the evening of 26 February 2001. They will decide among themselves which if any of the members will act as Team Leader. The proposed itinerary is given below:-

26/2/01	members assemble in Rome
27-28/2	briefing of Mission by the FAO Locust Group, AGPP, and by the Evaluation Service, PBEE.
2/3	departure for Nouakchott, Mauritania
2/3	arrival Nouakchott
3-13/3	discussions with project staff, counterpart staff and with Government officials; field visits, as appropriate, to observe field activities; preparation and discussion of summary report.
13/3	dept. Nouakchott
14/3	arr. Rome
15-16/3	completion of report
16/3	departure for home

#### CONSULTATIONS

The Mission will maintain close liaison with the Representatives of the donor and of FAO and the concerned national agencies, as well as with national and international project staff. Although the Mission should feel free to discuss with the authorities concerned anything relevant to its assignment, it is not authorized to make any commitments on behalf of the host Government, the donor or FAO.

#### REPORTING

The Mission is fully responsible for its independent report which may not necessarily reflect the views of the host Government, the donor or FAO. The report will be written in conformity with standard headings (to be provided during briefing by PBEE). The outline of the report will be completed, to the extent possible, in the country and the findings and recommendations fully discussed with all concerned parties, and wherever possible, consensus achieved. The Mission will also complete the FAO Project Evaluation Questionnaire. The completed report is expected to be submitted to FAO before departure. FAO will submit the report to the donor with its comments, and it will also be copied to the host Government for information, and to other interested parties.

#### **Itinerary for Consultant Mr. Ghaout:**

Agadir, Morocco/Casablanca/Rome/Nouakchott, Mauritania/Rome/Casablanca/Agadir

#### **Itinerary for Consultant Mr. Ottesen:**

Oslo/Rome/Nouakchott/Rome/Oslo

#### **Itinerary for Consultant Mr. Zelazny:**

Griesheim/Frankfurt/Rome/Nouakchott/Rome/Frankfurt/Griesheim

**Duration of Consultancy (for all three consultants):** 19 days

**Duty Station (for all three consultants):** Rome (briefing/debriefing); Nouakchott

## **Annex 2: List of places visited and key persons met by the Mission**

### **Rome, Italy**

#### ***FAO Headquarters***

Mr. Abderrahmane Hafraoui, Senior Officer, AGPP  
Mr. Clive C.H. Elliott, Senior Officer, AGPP  
Ms. Annie Monard, Locust Officer, AGPP  
Mr. Keith Cressman, Locust Forecasting Officer, AGPP  
Mr. Bernd Bultemeier, Evaluation Service, PBEE

### **Nouakchott, Mauritania**

#### ***Norwegian project, GCP/INT/651/NOR***

Dr. Robert Aston, Chief Technical Advisor (CTA)  
Dr. El Hadi ould Taleb, National UN Volunteer  
Mr. Ahmed ould El Hadj, National UN Volunteer  
Mr. Amar ould Amar, Administrative assistant

#### ***FAO Representation***

Mr. Adnan H. Al Fares, FAO Representative

#### ***Ministry of Health***

Dr. A. ould Horma Babana, Coordinator, National program against AIDS

#### ***Direction de l'élevage et de l'agriculture (DEA)***

Dr. Mohamed ould El Ghaouth, Director  
Dr. Fall Moctar, Deputy Director

#### ***Locust Centre (CLAA)***

Mr. Mohamed Abdallahi ould Babah, Chief of Centre (main project counterpart)  
Mr. Sidi Camara, Chief of prospectors  
Mr. Ba Khalidou, Information officer  
Mr. Fall Ahmed Maouloud, Responsible for Aioun base  
Mr. Mohamed Lemine ould Yedali, Prospector, Responsible for application techniques  
Mr. Mohamed ould Biya, Prospector  
Mr. Diallo Amadou, Prospector

#### ***EMPRES Western Region***

Mr. Mohamed Lemine, NPO

#### ***LOCUSTOX***

Mr. Wim C. Mullié, Research coordinator, GCP/SEN/053/NET

## **Annex 3: List of documents and other reference materials consulted by the Mission**

### ***Project documents***

1. Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) (Desert Locust component). 17. May 1996. Improving pesticide application techniques for Desert Locust control. Project No: GCP/INT/651/NOR. 18 pp.
2. FAO 2001. Atelier de planification des activités du programme EMPRES de lutte préventive contre le Criquet Pèlerin en région occidentale. Pasa 1: Janvier 2001 – Décembre 2004. 37 pp.

### ***Workplans***

3. Project GCP/INT/651/NOR Workplan. EMPRES: Improving pesticide application techniques for Desert Locust control. 1. December 1996 - 31. December 1997. 13 pp.
4. Project GCP/INT/651/NOR Workplan. EMPRES: Improving pesticide application techniques for Desert Locust control. Background and Workplan 1999. 8 pp.

Since 1999, workplans have been produced every six months.

### ***Consultant reports***

5. van der Valk, H. 1997. Rapport de la visite au projet du 7 – 14th Septembre 1997. 11 pp.
6. Mullié, W.C. 1997. Aide mémoire pour les médecins et les infirmiers impliqués dans le suivi des manipulateurs des pesticides inhibiteurs de cholinésterase. Contenant des procédures pour l'utilisation du Test – mate OP spectrophotomètre portable. 18 pp.
7. Dobson, H. 2000. A review of the current knowledge on pesticide application techniques related to Desert Locust Control. Contract consultant report, FAO Project GCP/INT/651/NOR. 52 pp.
8. Mullié, W.C., Bâ, A. & Sambou, N. 2000. Report of a mission in the framework of the collaboration between GCP/INT/651/NOR and GCP/SEN/053/NET (Locustox). 10 pp.
9. Spurgin, P.A. 2000. Report on mission to Mauritania February 5-15 2000. Contract consultant report, FAO Project GCP/INT/651/NOR. 25 pp.

### ***Backstopping reports***

10. Ottesen, P.S. 1996. 27. Oct. – 21. Nov. 1996. 8 pp.
11. Elliott, C.C.H. 1997. 17. – 26. Oct. 1997. 16 pp.
12. Ottesen, P.S. 1997. 12. – 27. Oct. 1997. 15 pp.

13. Elliott, C.C.H. 1999. 8. – 12. Oct. 1999. 6 pp.

### ***Scientific/Technical papers***

14. Ould Babah, M.A. 1998. Le rôle de l'Armée Nationale en lutte antiacridienne en Mauritanie. 15 pp.
15. Ould Babah, M.A. 1998. La contribution du Centre de Lutte Antiacridienne en Mauritanie dans l'amélioration des appareils de traitement et les conditions de sécurité des applicateurs de la lutte Antiacridienne. 15 pp.
16. Ottesen, P.S., Butrous, M., Corbett, M., Fosslund, S., Jaffar, M., Johannessen, B. & Sander, T. 1998. Field tests on an integrated Differential GPS navigation and spray monitoring system for aerial Desert Locust control operations. FAO Desert Locust Technical Series 29: 1-32.
17. Ould Taleb, M.E. 1999. Généralités sur l'élevage des dromadaires en Mauritanie. 9 pp.
18. Aston, R. 1999. Investigation of the accuracy of hand held GPS units for Desert Locust control operations. FAO Project GCP/INT/651/NOR Technote 1/99. 8 pp.
19. Aston, R. 1999. Preliminary trials on the release-spray-recapture technique. FAO Project GCP/INT/651/NOR Technote 2/99. 7 pp.
20. El Hadj, A. 1999. Identification des causes de la mortalité dans les témoins des tests de toxicité aiguë. FAO Project GCP/INT/651/NOR Technote 4/99. 6 pp.
21. El Hadj, A. 1999. Protocole cadre pour l'élaboration des essais des pesticides contre les acridiens. FAO Project GCP/INT/651/NOR Technote 5/99. 7 pp.
22. Ould Taleb, M.E. & El Hadj, A. 1999. Reduced dosage trials with fenitrothion. FAO Project GCP/INT/651/NOR Technote 7/99. 11 pp.
23. Coyne, R. 1999. Team operations – A preliminary environmental impact assessment scoping exercise. FAO Project GCP/INT/651/NOR Technote 9/99. 19 pp.
24. Aston, R. 1999. The human resources implications of team operations. FAO Project GCP/INT/651/NOR Technote 10/99. 10 pp.
25. Aston, R. 1999. Workshop on personal safety and training materials development. 23 pp.
26. Aston, R., El Hadj, A. & Ould Taleb, M.E. 1999. Field studies on operator monitoring for pesticide exposure in Desert locust control operations – field validation of methods. 38 pp.
27. Aston, R. Ould Taleb, M.E., El Hadj, A.O. & Ould Babah, M.A. 2000. Field studies on operator monitoring for pesticide exposure in Desert Locust Control operations campaign 1999 - 2000. 39 pp.

28. Aston, R. & El Hadj, A. 2000. Improving machinery for Desert Locust control - modification of the Micronair AU7010. FAO Project GCP/INT/651/NOR Technote 1/00. 5 pp.
29. Aston, R. 2000. Implications for operator monitoring in Desert Locust control operations – an analysis of the 1993/1994 campaign in Mauritania. 26 pp.
30. Aston, R. 2000. The role of GPS technologies in Desert Locust control – a report presented to the DLCC TG Rome, June 2000. 9 pp.
31. Anonymous, 2000. Atelier d’Aïoun du 29/07/2000 - 04/08/2000. FAO Project GCP/INT/651/NOR Technote 12/99. 15 pp.
32. Ould Taleb, M.E. 2000. Enquête sur l’élevage des chameaux en Mauritanie (Octobre – Décembre 1999). 13 pp.
33. Ould Taleb, M.E. 2000. Etude de l’effet potentiel des traitements antacridiens sur les animaux domestiques et particulièrement les chameaux. 42 pp.
34. Ould Taleb, M.E. 2001. Etude de l’effet du dépôt des gouttelettes du fenitrothion sur la mortalité du Criquet pèlerin, FAO Project GCP/INT/651/NOR Technote 2/2001. 16 pp.

### ***Photo records***

35. Coyne, R. 2000. Field visit to Daouas. FAO Project GCP/INT/651/NOR Photo Record Echo 2
36. Coyne, R. 2000. Field visit to Inchiri. FAO Project GCP/INT/651/NOR Photo Record Echo 3
37. Coyne, R. 2000. Field visit to Oued Sfaya. FAO Project GCP/INT/651/NOR Photo Record Echo 4
38. Coyne, R. 2000. Field visit to Daouas. FAO Project GCP/INT/651/NOR Photo Record Echo 5
39. Coyne, R. 2000. Field visit to Tourassin. FAO Project GCP/INT/651/NOR Photo Record Echo 6
40. Coyne, R. 2000. Field visit to Tourassin. FAO Project GCP/INT/651/NOR Photo Record Echo 7

### ***Posters***

A total of 26 posters of high quality and informative value, describing all activities of the project, were exhibited in the project meeting, prepared for the EMPRES meeting in February 2001.

## Annex 4: List of project activities and outputs

Dates	Activity or Output	Reference*
<u><i>D.1.1 Review of current knowledge</i></u>		
1997 to end of 1999	Review prepared through a contract, with inputs by the project	7
<u><i>D.1.2 Analysis of current practices</i></u>		
since 1998	Studies, workshops and field observations in Mauritania	14, 15, 18, 24, 25, 29
<u><i>D.2.1 Trials with reduced dosages</i></u>		
since mid 1997	Large-scale Desert Locust rearing developed and maintained	(no report)
Sept. 1997	Consultancy visit to introduce laboratory studies on pesticide mixtures	5
Mar./Apr. 1998	Field trials in the Sudan, studies on DGPS for aerial spraying operations	16
since mid 1999	Studies to develop a GPS-based guidance and spray-monitoring system for ground operations	18, 30
since late 1999	Field trials using reduced pesticide dosages	19, 21, 22
since 2000	Studies on suitability of spraying equipment, including laboratory studies on droplet size	28, 34
Febr. 2000	Consultancy visit to advise on spraying operations	9
<u><i>D.2.2 Collaborative trials with IGRs</i></u>		
late 2000	Small scale field trials with teflubenzuron	(no reports)
<u><i>D.3.1 Develop routine procedures for evaluating the efficiency of individual control operations</i></u>		
Oct. 1997 to end 1998	Laboratory trials with pesticide mixtures	(no report)
since mid 1999	Studies to develop methods for monitoring the mortality of locusts after field application of pesticides	20
<u><i>D.3.2 Develop routine procedures for collecting, storing and evaluating data related to control operations</i></u>		
since 1999	Development of form for field teams, testing of data-input and transmission systems for field teams, assistance provided for the development of the RAMSES database for Mauritania (UK contribution to EMPRES) and for integrating it with the LOCDAT database (German assistance)	(no report)

D.4.1 Monitor exposure of spray operators to pesticides

mid 1997	Consultancy visit to introduce and train on monitoring the acetylcholinesterase level in blood samples	6
since mid 1999	Studies on acetylcholinesterase levels in spray operators	26, 27

D.4.2 Procedures for monitoring impact on wild birds (no activities initiated)

D.4.3 Monitoring the pesticide impact on camels and other domestic animals

mid 1997 to early 2000	Studies on acetylcholinesterase levels in camels	17, 32, 33
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Other environmental impact studies

since 1999	Studies on the environmental impact of non-pesticide components of locust control operations	23
Jan. 2000	Consultancy visit to advise on blood sampling and environmental impact	8

D.5.1 Regional workshop on project results (not yet initiated)

D.5.2 National courses on safe and efficient spraying operations

since mid 1999	Workshops and on the job training in Mauritania	25, 31
late 1999	National training course in Morocco	(travel report of CTA)
mid 2000	Training in Sudan	(travel report of CTA)

\* the numbers refer to the documents listed in Annex 2

## Annex 5: Outline of proposal for 2<sup>nd</sup> phase

### ***Justification***

By the end of 2001 the project will have made important contributions to developing safer and more effective pesticide application methods against Desert Locusts. These include, for example, methods for more accurate target spraying, enabling the use of reduced dosages, or procedures which monitor and avoid/reduce the impact of pesticides on humans and the environment. Research and development work has been directed in particular to the conditions and requirements of Mauritania, and field-testing has been done in close collaboration with the teams of the Mauritanian Locust Control Centre. Also most of the training exercises were done in that country. There is a need to transfer the project achievements to other countries affected by the Desert Locust as well as to analyse the current spraying practices in those countries as was done in Mauritania. This analysis would be important for determining training needs and might also identify needs for new research and development work.

So far, the project has carried out a series of small-scale control trials against Desert Locust hoppers, but has not had the opportunity to become involved in larger scale trials (e.g. 100 hectare and more), to conduct trials against swarms, or to test some of the technology developed (e.g. the spray monitoring/guidance system for aircraft) under operational conditions. Large-scale field trials and trials under operational conditions are an important requirement for completing the development and training work, and for transferring the technology to operational use. Similarly, the project had no opportunity to conduct trials with chitin-synthesis inhibitors applied as barriers. This method has the potential to reduce costs and environmental impact dramatically, although special procedures need to be developed and tested to monitor locust mortality after treatment, because of the slow action of these compounds. Such work would, of course, depend on the availability of suitable locust infestations.

During the last years new technology and research results have become available. These open the possibility to develop control methods against the Desert Locust which would result in further improvements and in a further reduction of the amount of pesticides used. In addition, it may be possible in the future to replace chemical pesticides with alternatives like biopesticides and pheromones in many situations. The project has started work in some of these areas, but will not be able to complete the development before the end of 2001. This included the development of a spray monitoring system for ground operations and the testing (in collaboration with the Agricultural University of Norway) of a new low-cost field vehicle, particularly suitable for Desert Locust campaigns.

Considerable progress has also been made in the development of a biological mycopesticide (based on the fungal disease *Metarhizium anisopliae*) for locust and grasshopper control, which poses no risk to humans and livestock and has minimal impact on other non-target organisms. Large-scale use of this agent is now being introduced against locusts in Australia. The work of several projects in Africa has also reached the stage of operational use of this agent against several locust and grasshoppers species, e.g. the brown locust in South Africa. However, there have been few field tests done so far with the Desert Locust. Studies and operational trials are needed to see whether the storage properties of the product (the shelf life of the agent is several months at 25° C and several hours at 50° C), the relatively slow action (about a week before the mortality can be assessed), as well as the higher costs (currently about double that of chemical pesticides) allow the large-scale use against Desert Locusts.

Research at the International Centre of Insect Physiology and Ecology (ICIPE) in Nairobi has opened the possibility that a pheromone could be developed for Desert Locust control. The most interesting among several Desert Locust pheromones discovered at ICIPE is phenylacetoneitrile (PAN) which is the main component of the adult gregarization pheromone complex. Laboratory and field trials by ICIPE have indicated that when this compound is applied on Desert Locust hopper bands at very low concentrations (0.2 ml or about 10 drops per hectare) it can cause high mortality among hoppers, apparently mainly by triggering a de-gregarization process which results in a general disruption of the biology of the hoppers, stress and increased susceptibility to predators. The technology is still very much in the research stage, but is exciting, because it opens the possibility of a low-cost control method without risks to humans and the environment.

### **Context**

The project will be a component of the EMPRES Western Region Programme (West and North-West Africa) and will be mainly active in the front-line countries of that region (Chad, Mali, Mauritania and Niger). These are the countries where most of the preventive control operations against the Desert Locust are necessary. However, details on which countries should be covered by the project need to be clarified by the donor.

Under the EMPRES Western Region Programme (which is scheduled for implementation during 2001-2004), the project will contribute to the following planned results:

#### ***Result 2 – Early reaction is implemented by the national control units***

The project will strengthen the locust-control services of the front-line countries by providing some of the equipment needed for efficient early control operations, including GPS-guidance systems for ground spraying, and test kits for blood samples.

#### ***Result 5 – The human resource capacity of the national units is strengthened***

The project will contribute to the training activities of the EMPRES programme, specifically for control operations. This includes the identification of training needs, the implementation of training courses and the preparation of training manuals. Operating manuals will also be prepared.

#### ***Result 6 – A programme for operational research is designed and initiated***

The project will strengthen the capacity in the region for applied research in the field of pesticide application. This will include identifying research needs, conducting field trials and studies in collaboration with the front-line countries and transferring the results to the operational stage.

The FAO Desert Locust Control Commission for the Western Region (CLCPRO) is in the process of becoming established through a union five member countries of the Desert Locust Control Commission for North-West Africa (Algeria, Libya, Mauritania, Morocco, and Tunisia) and four member countries of the regional organization OCLALAV (Chad, Mali, Niger, and Senegal). CLCPRO will form the umbrella organization for the EMPRES Western Region Programme and will ensure the long-term sustainability of its achievements. The mandate of the Commission covers mainly training, promoting research, and providing emergency assistance for countries affected by the Desert Locust. In order to ensure the sustainability of the project achievements, the project will collaborate with the Commission in the fields of training and strengthening the research capacity of the region when appropriate.

The EMPRES Central Region Programme (mainly the countries bordering the Red Sea) has recently started phase II (2001-2003). It contains a component which aims at

strengthening the capacity for preventive control operations, including the improvement of control methods. The project will collaborate with that component of the EMPRES-Central Region programme in order to facilitate the transfer of the project results and achievements to that region, as well as to learn from the experience of other locust control services and other EMPRES activities.

### ***Development Goal***

The overall goal of the 2<sup>nd</sup> project phase is “**to achieve operational use of improved pesticide application methods during Desert Locust campaigns which translate into increased safety to humans and the environment, as well as in a reduction in the amount of pesticides applied**”.

### ***Indicator for the Development Goal***

At the end of the 2<sup>nd</sup> project phase it is expected that the amount of pesticides used per hectare during control operations against the Desert Locust in Chad, Mali, Mauritania and Niger will have been reduced by 30%, compared to recent campaigns.

### ***Expected Results***

It should be noted that a number of the planned results will depend on the presence of Desert Locust infestations. While the project will mainly work in the front-line countries of the Western Region, it should have the flexibility to conduct field trials wherever suitable Desert Locust infestations occur. It is expected that the locust rearing which was established during the first phase of the project will be still needed at the beginning of phase II, but can then be closed down.

#### **1. Current practices of pesticide applications analyzed and improved in the main target countries**

Based on the methods developed in Mauritania, analyses of current practices, integrated with training events, will be conducted in Mali, Niger and Chad. Training will cover:

- closed systems of transferring pesticides from barrels to vehicle/aircraft,
- proper calibration techniques for spraying equipment,
- ground GPS navigation and use of spray monitoring systems, combined with the use of reduced pesticide dosages,
- hand held minicomputers and short wave radio modems for transfer of field records to national headquarters,
- methods for estimating impact of control operations,
- routine testing of AChE-levels in blood sample,
- use of antidotes for organophosphates and carbamates.

Additional training will be conducted in Mauritania as needed. Operating manuals will be produced for the above-mentioned countries.

#### **2. Project results and achievements disseminated to other countries**

Activities will include visits of project staff to the Central Region and participation in CLCPRO activities which are relevant to training and to research on locust control operations.

### **3. Research and development work on improved locust control operations conducted and results documented and made available to locust-affected countries**

It should be noted that some of the planned field trials would depend on the availability of suitable Desert Locust infestations. In case not enough suitable infestations exist in the Western Region the project will collaborate with other regions, in order to conduct such trials.

#### *3a. Improved spraying technology, linked to reduced dosages, developed*

- Development of a spray-monitoring and regulatory system and its integration into a GPS-based guidance system. This will allow to regulate the amount of pesticide emission according to driving speed and direction. This and the following activity will be done in collaboration with the Agricultural University of Norway, Institute of Technical Studies
- Testing of a simple and low-cost field vehicle for locust control operations in difficult terrain.
- Field trials against Desert Locust hoppers with reduced dosages applied from the air, if possible as part of Desert Locust control operations.
- Additional field trials against Desert Locust hoppers with reduced dosages applied from the ground, taking into account the requirements of the FAO Pesticide Referee Group.
- Field trials with reduced dosages against adult locust swarms.
- Large-scale field trials with chitin-synthesis inhibitors applied as barriers.
- Complete development and transfer to the operational stage improved systems for monitoring control efficacy and for recording and reporting data on control operations.

#### *3b. Acetylcholinesterase levels of spraying operators routinely monitored*

- Blood sampling methods will be introduced into the front-line countries of the Western Region and will be used routinely by staff of the ministries of agriculture, in collaboration with the ministries of health.

#### *3c. Procedures to study the exposure of camels to pesticides introduced*

- Blood sampling methods for camels will be introduced into the front-line countries of the Western Region, and will be used during large-scale campaigns to study possible effects of pesticides on camels.

#### *3d. Collaborative field trials with alternatives to chemical pesticides conducted*

- Field trials with mycopesticides in collaboration with relevant projects and institutes will be conducted.
- Field trials will be conducted with the pheromone phenylacetone nitril in collaboration with ICIPE.
- Practical and operational methods will be developed to monitor the efficacy of slow-acting control agents like chitin-synthesis inhibitors, mycopesticides or pheromones.

### **Outline of Budget (US\$)**

<b>Budget line</b>	<b>2002</b>	<b>2003</b>	<b>Total</b>
International staff & consultants	125,000	125,000	<b>250,000</b>
Project evaluation		30,000	<b>30,000</b>
National and support staff	15,000	15,000	<b>30,000</b>
Contracts for flying hours	15,000	15,000	<b>30,000</b>
Contracts with research institutes	10,000	10,000	<b>20,000</b>
Travel for project staff and counterparts (including travel to attend workshops and training courses)	45,000	50,000	<b>95,000</b>
Equipment*	50,000	20,000	<b>70,000</b>
General Operating Expenses**	70,000	70,000	<b>140,000</b>
subtotal	(330,000)	(335,000)	<b>(665,000)</b>
FAO support costs (13%)	42,900	43,550	<b>86,450</b>
<b>Grand Total</b>	<b>372,900</b>	<b>378,550</b>	<b>751,450</b>

\* To include 1 pick-up vehicle for Mauritania, GPS-guidance systems for ground spraying, and test kits for blood samples to monitor pesticide exposure of operators

\*\* To include vehicle hire, petrol, spare parts, office operation and various other expenses, e.g. to hire casual workers to help in field trials.