Insect and Pest Control Newsletter

JOINT FAO/IAEA DIVISION OF NUCLEAR TECHNIQUES IN FOOD AND AGRICULTURE
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA

No. 46
August 1991

ISSN 1011-274X

CONTENTS

Commentary

Important advances against major pests have been made during the past year by means of the Sterile Insect Technique. Japanese workers based on Okinawa have eradicated the melon fly from most of the islands of Japan. Consequently, fruit production on Okinawa and other islands is increasing dramatically.

On 25 February 1991 Mexico was declared to be totally free of the New World Screwworm. The eradication campaign required 19 years and an investment of $ 413 million by the Governments of Mexico and the USA. Additionally, we hope that it will be possible to achieve eradication of this fearsome parasite of warm-blooded animals from the Libyan Arab Jamahiriya. No infestation has been found since 7 April 1991 and no indigenous screwworm has been trapped since 27 April 1991. Success in this campaign would remove a very grave threat to wildlife and livestock production in Africa.

Personnel in Libya, FAO/SECNA/Rome and IFAD/Rome deserve high praise for their diligence and effectiveness. Scientists gave generously of their time, talent and resources. Likewise, people in Seibersdorf and Vienna have made many contributions. Since 1989 we have been involved in programme planning, training and research and development. Dr. Don Lindquist was transferred from Vienna to Tripoli to lead the field programme. Mr. M. Taher was seconded from Seibersdorf to Tripoli to help establish the field laboratory and the quality control programme and help adapt the release technology. The Seibersdorf Laboratory conducted R&D on long distance transport of pupae, the development of a bait station, and other supplemental means to suppress the adult stage. Also, Seibersdorf procured specialized supplies and equipment on an emergency basis. Everyone was cognizant of the importance of putting everything in order so that the maximum pressure could be exerted against the total pest population as it emerged from winter dormancy. The result appears to be magnificent.

We hope that all will be encouraged by these advances to persist and to make additional gains against important pest species.

I. GENERAL INFORMATION

The Staff

Our staff, consisting of those in the Joint FAO/IAEA Division located in the Vienna International Centre and those in the IAEA's Seibersdorf Laboratory, are listed below with their nationality and the year they started working in Vienna. A few words describing their activities are included.

Name	Duties
JOINT FAO/IAEA DIVISION	
Björn Sigurbjörnsson, Director	
L. LaChance, Deputy Director	
Insect & Pest Control Section's Office	
D. Lindquist (USA, 1980)	Section Head
W. Klassen (USA, 1990)	Acting Section Head
A. Van der Vloedt (Belgium, 1974)	Technical Officer
L. Kruzic (Australia, 1983)	Secretary
M. Hallqvist (Sweden, 1990)	Secretary
Entomology Unit, Seibersdorf Laboratory	
R. Gingrich (USA, 1980)	Unit Head: microbial agents
U. Feldmann (Germany, 1988)	Tsetse Programme Leader: mass-rearing
M. Vreysen (Belgium, 1987)	FAO Associate Professional Officer: tsetse SIT
J. Hendrichs (Mexico, 1991)	Medfly Programme Leader: mass-rearing
G. Franz (Germany, 1989)	Medfly genetic sexing, molecular biology
P. Kerremans (Belgium, 1987)	FAO Associate Professional Officer: medfly genetics
H. Fay (Australia, 1990)	Temporary duty: medfly larval diets

D.A. Lindquist was transferred to Libya in August 1990 as Director of the FAO-led field programme for the Eradication of the New World Screwworm Programme (SEPNA/FP).

W. Klassen joined the Insect and Pest Control Section's staff in September 1990 and was appointed to serve as Acting Section Head while Dr. Lindquist is in Libya. He had served for 25 years in various capacities with the Agricultural Research Service, USA. He devoted most of his time to facilitating the development of ecologically selective methods of insect control.

M. Vreysen, after 2 1/2 years of involvement at the Seibersdorf tsetse laboratory, was transferred to the United Republic of Tanzania, and since October 1990 has been based on Zanzibar island, where he is participating in efforts to eradicate the tsetse fly species, Glossina austeni.

J. Hendrichs joined the Insect and Pest Control Section's staff in February 1991 after 3 1/2 years at the University of Massachusetts. For the previous 10 years he was involved in medfly eradication programmes in Mexico and Guatemala (Mexican Ministry of Agriculture) and Egypt (IAEA), and has worked on the behavioural ecology of fruit flies.

H. Fay, after 4 months of temporary assignment (20 August 1990 - 20 December 1990) with the medfly programme, returned to the Entomology Branch, Department of Primary Industries, Mareeba, Qld, Australia.

II. MEETINGS

A. Past

1. FAO/IAEA First Research Co-ordination Meeting on "Laboratory and Field Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes", Vienna, Austria, 24 - 28 September 1990

This meeting was attended by Dr. J. Seawright, Scientific Secretary (USA), Dr. M. Zapater (Argentina), Dr. A. Pereira Cardoso (Brazil), Dr. A. Zacharopoulou (Greece), Dr. G. Gasperi (Italy), Dr. Y. Nitzan and Dr. Y. Rössler (Israel), Dr. R. Wood (UK), Dr. M. Riva (Spain) and FAO/IAEA staff members: L. LaChance, W. Klassen, A. Van der Vloedt, R. Gingrich, H. Fay, G. Franz, P. Kerremans, E. Gencheva (fellow from Bulgaria), J. Goicoechea (fellow from Cuba) and A. Kafu (fellow from Libya).

The participants focused their presentations and discussions on ways of improving the currently existing genetic sexing strains and methods, and also on future development and refinement in genetic sexing. The following recommendations were made:

(a) Further laboratory evaluation of the stability of pupal colour genetic sexing strains should be pursued at the Joint FAO/IAEA Division's Seibersdorf Laboratory.

(b) The Seibersdorf medfly team should continue the work on the existing temperature-sensitive lethal mutation (tsl) for a full assessment of its biological attributes and suitability for genetic sexing. At the same time it is desirable to isolate additional tsl mutations.

(c) Basic biochemical and molecular studies on the alcohol dehydrogenase (Adh) system should be continued (in Pavia and Crete). Efforts to isolate new Adh null mutations should be supported (Spain and Argentina).

(d) Basic genetic and chromosomal studies of sex determination and sex ratio distribution should continue (Italy, Greece and UK). The study of spermiogenesis using electron microscopy should be encouraged.

(e) Studies on medfly population variation should be continued with biochemical variants and expanded to include cytogenetic and molecular studies (mt-DNA and RFLPs) (Italy and Greece).

(f) The Joint FAO/IAEA Division should continue to support and encourage the full development of appropriate research on the molecular biology of the medfly at the Seibersdorf Laboratory.

(g) Current research on reducing the cost of medfly production through modification of the diet (for example, the removal of bulking agents in the larval diet) should be approached with due consideration of the compatibility of such changes with genetic sexing strains.

(h) The efficacy of all-male releases should be demonstrated under various climatic conditions and agro-ecological situations.

2. FAO/IAEA Research Co-ordination Meeting on "Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes", Casablanca, Morocco, 5 - 9 November 1990

The meeting was attended by Dr. B. Katsoyannos (Greece), Dr. F. Hentze (Guatemala), Dr. W. Enkerlin (Mexico), Dr. A. Lekchiri (Morocco), Dr. A. Zümreoglu (Turkey), Dr. G. Zervas (Greece), 10 observers (from Italy, Greece, UK, Australia and USA (2)) including the 4 National Co-ordinators of the Maghreb Medfly Programme (Morocco, Algeria, Tunisia and Libya). The meeting was organized locally by Dr. A. Lekchiri and co-ordinated by Dr. A. Economopoulos (Greece). The Scientific Secretariat was headed by Dr. W. Klassen (Joint FAO/IAEA Division).

This CRP, initiated in 1986, was designed to test and compare the efficacy of a number of medfly traps (i.e. Jackson trap, International Pheromone McPhail trap, McPhail glass trap and two types of dry traps), lures (i.e. trimedlure plugs, nulure, borax) and toxicants (including DDVP) under various climatic and ecological conditions.

The participants recognized the need for additional information on some of the trapping systems and therefore recommended an extension of the present co-ordinated research programme for at least one more year.

3. Research Planning Workshop on the New World Screwworm relevant to the Eradication Campaign in North Africa, Vienna, Austria, 13 - 14 December 1990 (see also Special Report, page 11)

This research planning workshop was attended by Dr. E.P. Cunningham (Director, SECNA and Director AGA, FAO, Rome), Dr. M. Vargas-Teran (FAO), Dr. R. Sutherst (Australia), Dr. D. Christensson (Sweden), Dr. R. Allsopp (NRI, UK), Dr. M. Hall (British Museum of Natural History, UK), Dr. R. Bram (USA) and IAEA staff, including Prof. M. Zifferero (Deputy Director-General, Department of Research and Isotopes), Dr. B. Sigurbjörnsson (Director, Joint FAO/IAEA Division), Dr. L. LaChance (Deputy Director, Joint FAO/IAEA Division), Dr. P. Danesi (Director, Agency Laboratory), Mr. A. Abu Bakr (Head, Africa Section, Department of Technical Co-operation), Dr. W. Klassen (Head, Insect and Pest Control Section), Dr. A. Van der Vloedt (Insect and Pest Control Section), Dr. R. Gingrich and Dr. U. Feldmann (Entomology

Unit), Dr. M. Hussain and Dr. W. Dautermann (Agrochemicals and Residues Unit) and Mr. R. El-Amir (Department of Technical Co-operation).

The objectives of the workshop were to:

(a) briefly review the current status of the New World Screwworm (NWS) eradication campaign as a basis for identifying uncertainties, unknowns and needs for adapting existing technologies or for developing new innovations;

(b) identify gaps in knowledge and desired improvements in technologies relevant to the eradication campaign; and

(c) reach agreement on who will take the lead in filling gaps of knowledge and improving technologies in accordance with a time-frame relevant to the eradication campaign.

High priority activities identified by the Research Planning Workshop included:

(d) evaluation of the impact of releases of sterile flies;

(e) establishment of criteria for judging whether the operational programme is succeeding;

(f) development of options to reduce cost of transport of flies from Mexico to North Africa (e.g. bulk shipment of pupae under anoxia or under chilling at ca. 10°C);

(g) development of bait station technology;

(h) determination of attractancy of male flies to host mammals using electric net technology;

(i) investigation of "jet lag" in sterile flies reared in Mexico and shipped to North Africa;

(j) development of additional insecticide formulations (emphasis on pour-on formulations) for use under North African conditions;

(k) refinement of Climex model for Europe, Near-East and Africa; and

(l) the study of genetic and behavioural heterogeneity of NWS in relation to the new mass-reared strain.

4. FAO/IAEA First Research Co-ordination Meeting on "Development of Practices for Area-wide Tsetse Eradication or Control with Emphasis on the Sterile Insect Technique", Muguga, Kenya, 11 - 15 February 1991

This meeting was held in conjunction with the large intersectional FAO/IAEA Seminar for Africa on "Animal Trypanosomiasis: Tsetse Control, Diagnosis and Chemotherapy Using Nuclear Techniques" in which the Insect and Pest Control Section, the Agrochemicals and Residues Section and the Animal

Production and Health Section were all involved. The seminar and research co-ordination meetings, including the one on "Development of Controlled-release Formulations of Pesticides Using Nuclear Techniques - Part Tsetse Control" were held at the Conference Centre of the Kenyan Trypanosomiasis Research Institute (KETRI).

Progress reports prepared by the scientists participating in the subject co-ordinated research programmes were an integral part of the seminar programme. Moreover, the fact that the Joint FAO/IAEA Division's Animal Production and Health Section is also co-ordinating the Netherlands Government-funded FAO/IAEA/ILRAD network activities on ELISA validation, and that KETRI scientists at Muguga are conducting research on the "Fate of Trypanocidal Drugs in Cattle", made it possible to incorporate sections dealing with diagnosis and chemotherapy of animal trypanosomiasis in the global meeting programme.

The meetings provided a useful forum for interdisciplinary discussion on recent advancements in the use of nuclear techniques for the control of tsetse-transmitted trypanosomiasis. A total of 106 registered participants and observers attended, including 17 nominated by various African countries (Botswana, Burkina Faso, Burundi, Congo, Côte d'Ivoire, Ethiopia, Guinea, Mali, Rwanda, Sierra Leone, Sudan, Uganda (2), United Republic of Tanzania (2), Zambia and Zimbabwe). IAEA research contract/agreement holders present came from Belgium, Canada, the Czech and Slovak Federal Republic, Ethiopia, Ghana, Kenya, Uganda, United Kingdom, United Republic of Tanzania, USA and Zimbabwe. Scientists and technologists from KETRI, ILRAD, ICIPE and the University of Nairobi also contributed substantially to specific technical sessions.

Sessions related to the insect vector encompassed studies on tsetse populations, tsetse physiology in relation to infection and irradiation, and vectorial capacity of colonized flies. With regard to vector control, presentations and recommendations dealt with the prospects of controlling tsetse populations by techniques other than the conventional use of insecticides. These included the role of tsetse host-immunity relationships, bait technology, chemical sterilization of natural populations of tsetse using a juvenile hormone mimic, interspecific hybrid sterility, use of "satyrs" (i.e. males of one species mating with females of another species), and the Sterile Insect Technique (SIT).

B. Future

1. FAO/IAEA Third Research Co-ordination Meeting on "Radiation-induced F-1 Sterility in Lepidoptera for Area-wide Control", Western Cotton Research Laboratory, USDA-ARS, Phoenix, Arizona, USA, 9 - 13 September 1991.

2. Consultants' Group Meeting on "Engineering, Systems Analysis and Production Modelling for Tsetse Fly Mass-rearing and the Use of Sterile Flies in Eradication Programmes", Vienna and Seibersdorf, Austria, 23 - 27 September 1991.

3. FAO/IAEA Final Research Co-ordination Meeting on "Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes", Vienna, Austria, 2 - 6 December 1991.

4. Consultants' Group Meeting on "Tsetse Genetics and Reproduction", Vienna, Austria, January or February 1992.

5. FAO/IAEA Second Research Co-ordination Meeting on "Laboratory and Field Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes".

   The University of Pavia, Dipartimento di Biologia Animale (Director Prof. R. Milani), Pavia, Italy, has informally agreed to host the research co-ordination meeting during the second half of June 1992.

6. FAO/IAEA Second Research Co-ordination Meeting on "Genetic Engineering Technology for Improvement of the Sterile Insect Technique", Vienna, Austria, second half of October 1992.

   It is intended to convene this research co-ordination meeting in conjunction with the planned International Symposium on Isotopes, Radiation and Biotechnology for Insect Control or Eradication.

III. TRAINING COURSES

A. FAO/IAEA Regional Training Course on the Sterile Insect Technique and F-1 Sterility for Insect Control

(1) Place: Malaysian Agricultural Research and Development Institute (MARDI), Kuala Lumpur, Malaysia and Okinawa Agricultural Experiment Station, Sakiyama-cho, Naha, Okinawa, Japan.

(2) Date: 4 - 30 November 1991; 3 weeks in Malaysia (4 - 23 November) and 1 week in Japan (24 - 30 November)

(3) Deadline for Nominations: 30 August 1991.

(4) Participants: The course is open for nominations from developing Member States of the FAO and the IAEA in the Asia and Pacific Region. The number of participants will be 15 - 20. Participants must have either university training in the area of insect control or a recognized diploma in pest

control with emphasis on plant protection. Preference will be given to those candidates who are involved or are likely to be involved in the near future in integrated plant pest control which includes the SIT and inherited or F-1 sterility.

(5) Purpose: The purpose of the course is to provide training to senior technical governmental officers and university staff who are, or soon will be, engaged in integrated pest control programmes directed towards insects for which the SIT or F-1 sterility has a good probability of success. The participants will receive training on the basic principles and application of these techniques as well as requirements for a successful programme.

(6) Language of Course: English

(7) Course Programme: Through lectures, seminars and field trips, including visits to the melon fly production plant and the eradication area in Okinawa, participants will be exposed to the use of population suppression methods and their integration with the release of radio-sterilized insects in area-wide control programmes. The topics of the course include:

- the reproductive system in Diptera and Lepidoptera;
- the use of isotopes and radiation in entomology;
- the cellular and cytogenetic basis of sterility, dominant lethal mutations and inherited sterility;
- strategies, tactics and systems in managing insect pests;
- the SIT: case studies;
- inherited sterility: case studies;
- insect nutrition, mass-rearing and quality control;
- genetic sexing mechanisms;
- ecological studies: survey and monitoring procedures;
- population dynamics and population modelling;
- population suppression techniques;
- the planning and management of large pest management programmes;
- the evaluation of programmes; and
- IAEA programmes and capabilities.

(8) Application Procedure: Nominations should be submitted in duplicate on the standard IAEA application forms for training courses. Completed forms should be endorsed by, and returned through, the official established channels (the Ministry of Foreign Affairs, the National Atomic Energy Authority, the Office of the United Nations Development Programme or the FAO Country Representative); they must be received by the International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria not later than 30 August 1991. Only nominations forwarded through the proper governmental channels and received by that date can be considered.

B. Interregional Training Course on the Use of Radiation and Isotopes in Insect Control and Entomology

This training course is tentatively scheduled for the period 3 May to 13 June 1992 and will be held in Gainesville, Florida, USA. Detailed information on it will be given in the next issue of the Newsletter.

IV. DEVELOPMENTS AT THE SECTION'S LABORATORY UNIT, SEIBERSDORF

A. Tsetse Fly

The tsetse fly team continued with its research, training and rearing programme in support of projects in Africa. The size of the *Glossina tachinoides* stock colony was increased to over 100,000 female flies and its operational and production parameters re-adjusted to guarantee a monthly distributable excess of 50,000-60,000 pupae. In addition to continuing bioassay work with fly material from the experimental colonies (*G. p. palpalis*, *G. f. fuscipes*, *G. m. submorsitans*, *G. austeni*, *G. pallidipes*, *G. brevipalpis*), emphasis remained on simplification of holding and handling methods, procedures that offer potential for separation of males from females in pre-adult stages, and for stock-piling of pupae.

During the reporting period, the following African fellows successfully completed training at Seibersdorf:

Ms. E. Sebitosi (Uganda)
Mr. Y. Sakara (Ghana)
Mr. A. Gidudu Masaba (Uganda)

B. Medfly

1. Rearing Diets

Under the guidance of Dr. H. Fay, the team conducted experiments to determine the relative importance of wheat bran attributes in medfly larval diet, the effect of yeast-based starter diet as compared to the bran starter on the survival of young and older larvae, and larval survival when a range of artificial substrates as substitutes for bran are used. The results of these tests are documented in "Activities of the Entomology Unit, Report No. 2, 1990".

2. Bacillus thuringiensis

Work continued on chromatographic characterization of soluble *B.t.* exotoxin fractions after changing the concentrations of nutrients in the culture media as well as on qualitative and quantitative changes in the toxicity of the chromatographic fractions for adult male and female medflies.

3. Genetic Sexing

The team working on medfly genetic sexing continued its efforts in constructing strains that do not show breakdown when they are reared for several generations without artificial selection. The important components of ongoing research are the determination of chromosome structure and genetic analysis of Y-autosome translocations, as well as screening of strain stability and fly quality.

C. Screwworm

Quality control monitoring on irradiated NWS pupae received from Mexico continued at Seibersdorf. Part of the emerging adult flies were also used by the colleagues of the Agrochemicals Unit for bioassay work on improvement of bait stations and testing of insecticide formulations.

V. SPECIAL REPORT (submitted March 1991)

The New World Screwworm in North Africa

D.A. Lindquist and M. Abusowa, SECNA/FP, Tripoli, Libya

Introduction

The New World Screwworm, *Cochliomyia hominivorax* (Coq.) was discovered in north-west Libya in the fall of 1988 by Libyan veterinarians. Positive taxonomic identification of the pest was made by British scientists. FAO confirmed the presence of the disease in Libya in March 1989.

The Government of the Libyan Arab Jamahiriya implemented a large-scale control and containment programme in mid-1989. This programme involved inspection of livestock by veterinary teams, collection of larvae associated with wounds, identification of these larvae, treatment of animals, and control of animal movement to prevent the spread of the disease.

The presence of the New World Screwworm (NWS) in Libya was viewed as a potential major disaster for North Africa, the Mediterranean Basin and the whole of Africa. Based on the cost of controlling the disease in the Americas, it was estimated by FAO that the cost of inspection and treatment of livestock would be about US$ 5.00 per head per year. Thus, the cost of control in North Africa, with about 60 million head of livestock, would be about US$ 250 million per year. Further, the impact on wildlife in Africa south of the Sahara would be severe. Data from the USA indicated that up to 80% of newborn deer died from the disease. Mortality rates this high of some of the African wildlife could result in extinction.

The movement of the NWS is both by the adult insect flying long distances in search of food or hosts, and much more commonly, by the movement of infested livestock and wildlife. Since control of livestock movement is difficult and never complete, and control of the movement of wildlife impossible, FAO determined that the disease would spread.

Thus, it was decided in a Joint FAO/IAEA Division Consultants' Report (January 1990) that unless something was done very rapidly, the disease would spread throughout North Africa, Africa south of the Sahara and throughout much of the Mediterranean Basin.

Based on the high cost of living with the disease and with the fact that the disease would spread, the decision was made early in 1989 that the only solution to the potential disaster was to eradicate the NWS from Libya.

Once this decision was made, planning of the eradication programme was initiated. The only proven technology available for eradication is the Sterile Insect Technique (SIT) combined with intensive surveillance, animal treatment and animal movement control. With the assistance of FAO, UNDP, IFAD and IAEA, the Libyan surveillance and animal movement control activities were strengthened with the object of preparing for the eradication programme. The neighbouring countries (Egypt, Sudan, Chad, Niger, Algeria and Tunisia) also were assisted in strengthening their surveillance and quarantine activities. Training of veterinarians and biologists from Libya and the neighbouring countries in NWS control and identification was sponsored by FAO. Planning for the eradication programme was undertaken by IAEA and FAO.

Initial funding for the programme was obtained from FAO, UNDP, IFAD and IAEA. Donors were contacted and as additional funds became available, staff and equipment were deployed to Libya. IFAD provided special funds to conduct a Preparatory Phase Project on the SIT and to strengthen the quarantine/animal movement and communications activities. SIDA provided funds for technical backstopping activities.

The NWS was introduced into Libya from the Western Hemisphere, the only area of the world where it previously existed. The mode of introduction and the country from which the pest came is unknown.

The NWS in Libya

After the discovery of the NWS in Libya, the Veterinary Services established surveillance teams throughout the country. Most of these teams are located in the NWS infested area. Each team has a prescribed area to cover. A team, each with a vehicle, 3 people, insecticide and larval sampling kits, inspects all animals in its assigned area at 15 - 20 day intervals. The teams collect larvae from myiasis cases, treat all wounds with insecticide and discuss with the animal owners control techniques and the overall eradication programme, and encourage the owners to inspect, collect worms and treat animals.

The data and larval samples collected by the teams are submitted daily to the central Veterinary Clinic of their municipality. These data are sent to the Programme HQ in Tripoli at least once a week. Identification of larval samples is done in the HQ laboratory. The data are summarized and combined with data from other municipalities daily, weekly and monthly.

In the primary agricultural area of Libya, i.e. along the coast, animal production is not the major income producer. Most of the owners have full-time jobs and keep relatively few animals (predominately sheep). In addition, veterinary treatment and drugs are provided free of charge in Libya. Thus there is little incentive for owners to inspect and treat their own animals. It is therefore obvious that the surveillance teams have a paramount role in Libya in obtaining data on the number and distribution of NWS infested animals. During 1989 the impact of the NWS on Libyan livestock production was not great. The number of myiasis cases was not enough for the livestock producers to be alarmed. Many people and organizations, including FAO and IAEA, had predicted a very serious NWS problem in 1989. This prediction was based on the common occurrence of population explosions of insects when they invade new areas. Based on this prediction, the Libyan Government implemented an effective publicity campaign to alert livestock owners and the general public of the serious problem to be faced in 1989. When the problem did not mount as predicted, the livestock owners began to doubt the serious nature of the NWS, and did not inspect their animals as thoroughly as was needed. This attitude carried over into 1990.

In 1990 the number of livestock cases of NWS myiasis increased dramatically (from 102 in January to 917 in June and 2,932 in September) primarily because of the mild 1989/90 winter. Also, a much larger number of cases was reported because the surveillance teams had become more efficient in locating cases. In addition, the strain of NWS in Libya may have adapted effectively to local conditions and hosts and become more virulent. In any case, there were sufficient cases in 1990 for the livestock producers to be concerned and to co-operate very well with the surveillance teams.

Although the NWS attacks humans, few cases have been reported in Libya. The first cases were reported from hospitals in 1988 and in Tripoli Central Hospital several cases were treated. During 1989 and 1990, after the medical profession had been alerted to the NWS threat, special care was taken in hospitals. Reports of the number of cases in 1989 and 1990 have not been published.

The increase in NWS cases in livestock during 1990 as compared to 1989 was not accompanied with a great increase in the total infested area. In late 1989 the infested area was estimated at 20,000 km^2. This had increased to an estimated 25,000 km^2 by December 1990. Natural barriers probably were the primary determining factor in limiting the spread of the disease.

Quarantine/animal movement control activities were started in the fall of 1990 after equipment was received. The quarantine stations are movable to permit flexibility. Most of these are fixed stations located on roads used by livestock producers, but mobile stations (the quarantine vehicle and people that move to the animals) also are used. Data on animal movement into and out of the NWS infested area, number of wounds, NWS positive cases and number of animals treated are recorded.

Communications play an important role in large, visible programmes such as the NWS eradication programme in Libya. The livestock owners, other rural people and the general public must be informed and support eradication programme activities. Communication activities were initiated by the Libyan Government as soon as NWS surveillance and control activities were started. These included TV and radio programmes and posters. These activities continued and by the fall of 1990 there were few people in Libya who were not aware of the NWS threat to Libya and the region and the on-going and planned programme activities.

The aerial release of sterile NWS was initiated on 18 December 1990 with 3.5 million flies per week. The number of sterile flies released increased, as did the area treated, to 28 million by late February 1991. Initially, dispersal of sterile flies was over an area of about 5,000 km^2 in the north-west part of the NWS infested area. The 28 million sterile flies are released over the entire NWS infested area twice a week.

Various quality control tests on the sterile NWS received from Mexico showed that the transatlantic shipment and handling in Libya did not measurably reduce fly quality. These tests, standard in the Mexico-US Screwworm Eradication Programme, include adult emergence, longevity and ability to fly. Previous studies had demonstrated that the NWS strain in Libya was sexually compatible with the Mexican strain.

The number of reported NWS infested animals fell dramatically during the winter of 1990/91. This was primarily because the cold winter reduced NWS reproduction and because of the effectiveness of the surveillance teams in locating and treating infested animals.

This reduced NWS population offers an opportunity to eradicate the NWS in a shorter period of time than had the population been high. Providing that sufficient numbers of good quality sterile NWS can be continuously dispersed over the infested and barrier areas twice each week, eradication can be achieved within 9 months or less. This assumes that there is no great increase in the infested area and that no new infestation occurs at a distant location which will require additional sterile flies and resources.

The NWS Eradication Programme

By the end of April 1991, the full eradication programme is scheduled to be operational. This will involve the weekly aerial release of 40 to 50 million sterile NWS throughout the infested area and the border areas. An average of about 1,000 sterile NWS per km^2 per week will be released over the entire area. This release rate is somewhat higher than routinely used in the eradication programme in the New World. However, the long transport from Mexico to Libya may cause reduced quality that is not detected by the standard quality control tests, thus more sterile flies may be required to rapidly effect eradication. Ideally, sterile NWS would be released twice a week over the entire area with a 3 - 4 day interval between releases.

Traps baited with an attractant (swormlure) for the NWS fly are deployed throughout the area, primarily in the infested area. The purpose of these traps is two-fold. Firstly, the trap catches of sterile NWS adults indicate the distribution of sterile flies. Sterility is easily determined in female flies using a dissecting microscope. Determination of sterility in male flies by microscopic examination is very difficult and not accurate. Thus sterility is determined only in females. Traps which do not catch sterile flies are cause for concern and are investigated immediately to determine if the trap location is suitable and that there is sufficient attractant. If these factors are satisfactory visual observations of the aerial release are made to verify that the release aircrafts are flying the correct pattern. When all of these factors are correct, sterile flies are captured in 95% of the traps. The second use of traps is to estimate the ratio of sterile to wild NWS adults. A ratio of 10:1 is needed initially. Higher ratios will result as the effects of the released sterile NWS reduce the reproductive rate of the wild population. Also, when the wild population is very low, the capture of any fertile NWS adults identifies a potential problem area which needs special surveillance and supplementary treatment.

Sentinel animals are used to estimate the degree of sterility in the wild population. Sterile females do not lay egg masses. However, a native female which has mated with a sterile male will lay egg masses, but they will not hatch. If she has mated with a wild male, the egg masses will hatch. The sentinel animals (sheep) are surgically wounded with a sterile scalpel after shaving the hair/wool from a selected body site. This wound is an attractive site for the female NWS to deposit egg masses. Sentinel animals are located throughout the infested area and inspected twice daily. Any egg masses found are carefully removed, taken to the HQ laboratory and placed in an incubator to determine if they hatch.

As the eradication programme proceeds and reduces the wild population, traps and sentinel animals become increasingly important but also increasingly difficult to evaluate. Few wild flies will be captured and few egg masses will be obtained from sentinel animals because of the very low population of adult NWS. Thus surveillance to detect infested animals becomes the major, and finally the only, indicator of eradication. Surveillance is the foundation of the entire eradication campaign.

The importance of flexibility of quarantine/animal movement control activities becomes more important as the eradication campaign progresses. Changing the location of quarantine stations is necessary as areas are declared free of NWS. The intensity of these activities also must increase, particularly with regard to unofficial movement of animals.

Communications must continue to effectively inform producer and others of the importance of inspecting and treating animals, reporting to programme personnel all myiasis diseased animals and following quarantine regulations.

Any large action programme requires supporting research and development to immediately solve problems which prevent success. Long-term research is not a part of the NWS eradication programme in North Africa. However, there are problems which require attention. The first of these was to determine if the Libyan NWS strain was compatible with the strain reared at the Mexico plant. Libyan material was hand-carried to the Laboratory of the Agriculture Research Service, US Department of Agriculture, Fargo, North Dakota, USA. The Mexican NWS strain is maintained in a quarantine facility at this laboratory. Tests showed the two strains to be compatible. Other tests demonstrated that the sterile NWS could be successfully shipped by air from Mexico to Libya.

If an infestation of NWS is discovered in a neighbouring country or in another part of Libya, it will take several weeks before sterile flies can be released in the newly infested area. Before these releases can be initiated, everything possible must be done to reduce the chances of further spread and to reduce the infestation. Animal inspection and treatment will be the first activity. However, an additional control technology will be needed. Thus, research has been undertaken to develop a bait station. This device includes the attractant, swormlure, a feeding attractant (dried blood and sugar) and an insecticide. If needed, several thousand of these devices can be very rapidly installed in a newly infested area as an additional NWS control technology. Also, pour-on insecticide formulations may be effective in reducing the wild fly population. These materials, to be effective, must be distributed over the animal in sufficient concentration to kill adult females attracted to any wound which may be on the animal.

Conclusion

It has taken two years from the time that the NWS infestation in Libya was confirmed to initiate the SIT part of the eradication programme. Fortunately, the activities initiated by the Libyan Government, and subsequently strengthened by UN organizations, helped control the pest. The NWS has not spread excessively; it remains only in Libya. Had the pest moved into Tunisia, eradication would be much more difficult. Tunisian officials have yet to permit the release of sterile NWS in that country, despite the fact that the pest is within 40 km of the Tunisian border. The release of sterile NWS in Tunisia along the border with Libya would be insurance against the pest moving into Tunisia and becoming established before it can be detected. Should this occur, the total cost of the eradication programme will increase dramatically.

The apparent low NWS population density in early 1991 offers the opportunity of achieving eradication rapidly, providing the essential basic requirements of utilizing the SIT are met. In early March 1991 it appeared likely that the NWS can be eradicated from North Africa within 9 months. However, this will not be the end of the programme, as the release of some sterile flies will be required for an additional 4 to 6 months and surveillance activities will be required for at least an additional 12 months.

Additional Information on the Current Status of the NWS Eradication Campaign

Since the submission of the above special report on the NWS campaign in North Africa, the following progress has been made (as reported in the latest issues of the FAO/SECNA NWS Newsletters):

- Number of myiasis cases during 1991: January (3), February (2), March (0), April (1), May (0), June (0).
- Since May 1991 direct charter flights replace the previous system of truck transport to Mexico City Airport, a scheduled flight to Frankfurt and then transfer of the NWS to a charter aircraft for the final leg to Tripoli. The new system allows the transport of 50 million pupae per flight, compared to the previous limit of 17.5 million. The present pattern of operations is a weekly delivery of 40 million sterile insects, which are then distributed by four Libyan Aeroclub Twin-Otters (total of 16 - 18 flights, each 2 - 4 hours) over the succeeding four days at distribution densities ranging from 500 to 1,200 per km^2.
- SECNA has extended the area of sterile fly dispersal from 26,000 km^2 to 41,000 km^2 to establish a secure buffer zone (including 2,500 km^2 on Tunisian territory) around the NWS infested area.
- Intensive surveillance of all livestock in the affected area has continued with approximately 444,000 animals being inspected each week.
- The last myiasis case was detected on 7 April 1991.
- Assuming no further fertile NWS are detected and SECNA is able to continue dispersal of sterile flies without interruption, Libya will be declared free of the pest sometime during the fall of 1991.

Insect and Pest Control Newsletter
Joint FAO/IAEA Division of Nuclear Techniques
in Food and Agriculture
International Atomic Energy Agency
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna, Austria

Printed by the IAEA in Austria
August 1991

91-03347