WORLD HEALTH ORGANIZATION

SOUTH PACIFIC COMMISSION

REPORT ON THE FOURTH JOINT WHO/SPC SEMINAR ON FILARIASIS AND VECTOR CONTROL

Apia, Western Samoa

1 to 10 July 1974

WPRO-2202

FOURTH JOINT WHO/SPC SEMINAR ON FILARIASIS AND VECTOR CONTROL

Sponsored by the

WORLD HEALTH ORGANIZATION REGIONAL OFFICE FOR THE WESTERN PACIFIC

and the

SOUTH PACIFIC COMMISSION

Apia, Western Samoa
1-10 July 1974

FINAL REPORT

PRINTED AND DISTRIBUTED

by the

REGIONAL OFFICE FOR THE WESTERN PACIFIC
of the World Health Organization
Manila, Philippines
July 1974

NOTE

The views expressed in this report are those of the advisers and participants at the seminar and do not necessarily reflect the policy of the World Health Organization.

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INTRODUCTION

The Fourth Joint WHO/South Pacific Commission (SPC) Seminar on Filariasis and Vector Control was convened in Apia, Western Samoa, from 1 to 10 July 1974. Dr. Lanu Penaia was elected Chairman, Dr. Anthony Polloi, Vice-Chairman and Dr. Peter F. Beales and Dr. Jona U. Mataika, Rapporteurs.

In the opening ceremony, the Director of Health of Western Samoa welcomed the participants and briefly reviewed the excellent results obtained by the filariasis control project, which was assisted by WHO and UNICEF. Addresses sent by Dr. Francisco J. Dy, Director of WHO Regional Office for the Western Pacific, and Mr. G.F.D. Betham, Secretary-General of the South Pacific Commission, were read by their representatives. They thanked the Government of Western Samoa for its generosity in acting as host to the seminar and providing transportation as well as secretarial assistance. In officially opening the seminar, the Honourable Prime Minister expressed the appreciation of his Government to WHO and the Commission for holding the seminar in Apia.

The previous seminar on filariasis (The Second WHO/SPC Joint Seminar on Filariasis) was held also in Apia in August 1968. Since then, many new developments have taken place and much information accumulated. These include the results obtained from field trials on the practical usefulness of certain alternative methods of blood examination for microfilariae, from preliminary field trials on vector control and from mass drug administration in several countries and territories.

Both WHO and the SPC are concerned with the recent outbreaks of dengue fever/dengue haemorrhagic fever in many countries and territories in the South Pacific. It is, therefore, timely to discuss and promote programmes for the surveillance of the vector mosquitoes, particularly Aedes aegypti, and to plan long-term measures for vector control.

During the present seminar, new information and findings were discussed by the participants from 13 countries and territories (see Annex 1). A number of documents were distributed (see Annex 2). It is considered that they will serve as useful references. They are available for distribution to other filariasis workers who require more detailed information.

1. REVIEW OF FILARIASIS PROGRAMMES IN THE SOUTH PACIFIC

Filariasis occurs in 12 of the 13 participating countries and territories. The exception is Guam where there are no records to indicate that the disease is a public health problem. Systematic

measures for the control of filariasis, mainly by mass drug administration with diethylcarbamazine citrate (DEC), supplemented by improved sanitation for mosquito control, have been undertaken in American Samoa, Cook Islands, Fiji, French Polynesia, Gilbert and Ellice Islands, Trust Territory of the Pacific Islands, Niue and Western Samoa. At the time of the last filariasis seminar in Apia in 1968, only four countries or territories had mass drug administration programmes. In the British Solomon Islands Protectorate, New Hebrides and Papua New Guinea, where the filariasis vectors are the same as those of malaria, DDT residual spraying has been carried out for anti-malaria purpose.

The present status of filariasis in the South Pacific is briefly presented in Annex 3. Based on a completed questionnaire received from 11 countries and territories, a summary of filariasis control programmes and changes in endemicity is given in Table 1.

2. EPIDEMIOLOGICAL METHODS USED IN THE STUDY OF FILARIASIS

2.1 Standardization of methods

Emphasis was placed on the necessity to standardize both survey and reporting methods. The size and type of the sample are important. This should be determined, preferably in collaboration with a statistician, according to the aims and objectives of the survey. As much data as possible should be collected, including information on the work habits, social structure and age and sex distribution of the population.

Blood should be taken at night between 1900 hrs and 2400 hrs until the periodicity in the study area becomes known. Surveys can be carried out during the day in areas of subperiodic filariasis. A measured amount of blood must be examined in every case.

2.2 Alternative methods of blood examination

The examination of stained thick blood films for the presence of microfilariae is known to be unsatisfactory and many low level densities of microfilariaemia are likely to be missed by this method. Consequently, there has been a search for more accurate and reliable methods.

2.2.1 Counting chamber method

This is a useful technique in areas where the identities of microfilariae are known. The loss of microfilariae reported when using thick blood films is considerably reduced by this method. It has been used

successfully for surveys in East Africa. Improvised counting chambers can be made using regular microscope slides and X-ray film or cellophane tape.

2.2.2 Stimulation method

In areas of nocturnally periodic filariasis, administration of a small dose of DEC will stimulate an increase of microfilariae in the peripheral blood one hour later. This will enable blood surveys to be carried out in the daytime. This method, however, can cause considerable febrile reaction in patients with Brugia infections.

In Tahiti, attempts to stimulate with DEC and increase the microfilaria (mf) count in persons with low parasitaemias were unsuccessful in a study of 100 cases.

2.2.3 Membrane filter concentration method

This is believed to be perhaps the most efficient method of detecting microfilariae in peripheral blood, but its practicability is in doubt. Venous blood is required and local populations, especially children, often resent venepuncture. In addition, depending on the size of the survey sample, this can be a much more expensive method in time, cost of supplies and personnel, especially if a physician is required to take the blood sample, as is the case for children and, in some countries, for medico-legal reasons.

The efficiency of the membrane technique compared to Knott's technique of examining the sediment of haemolysed blood is considered to be relatively the same.

Participants from eight countries or territories stated that venepuncture techniques would not be acceptable as routine procedures in their country or territory. Of the others, some felt that after adequate explanation, the population might accept such methods.

It was generally accepted that the membrane filter technique is a sensitive method, but that it should be reserved for special studies only and not used for general survey purposes.

The epidemiological significance of the very low microfilariemiae detected by this method is not known. However, mosquitoes have been infected in the laboratory from such low density microfilaria carriers.

2.3 Immunodiagnostic procedures

None of the immunodiagnostic methods available at this time are specific enough nor sufficiently understood to give reliable estimates of the prevalence or intensity of filarial infections in a population.

At present Dirofilaria immitis antigen is used for immunodiagnostic skin tests. This is because large quantities of adult Wuchereria bancrofti antigen are not readily available, but the possibility exists that in the future monkeys could be a valuable source of such antigen. D. immitis is very widely distributed throughout the Pacific and presumably the human population has been exposed to this parasite, making the value of positive skin tests doubtful. Persons with coin lesions due to D. immitis are generally serologically negative and this is believed to be because they have lost their serological response, presumably due to the death of the worms.

2.4 Clinical manifestations

The value of enlarged lymph nodes as a diagnostic sign is doubtful because there are numerous causes of enlargement other than filariasis. Clinically it is very difficult, if not impossible, to distinguish lymphadenopathy due to filariasis from that due to other causes.

For reference, the general clinical aspects of filariasis are summarized in Annex 4.

3. VECTOR SPECIES OF FILARIASIS, BIONOMICS AND CONTROL

3.1 Vector species and bionomics

Based on up-to-date information available, a revised list of the vector species in the South Pacific is given in Annex 5.

3.1.1 In the periodic Wuchereria bancrofti areas

In the eastern areas of the South Pacific, the predominant vectors are the "Anopheles punctulatus" group. They are night biters and usually breed in standing ground water. Anopheles farauti is widely distributed and consequently is one of the most important vectors in New Hebrides, Papua New Guinea and the Solomon Islands.

The vector species is unknown on one island (Bellona) of the Solomon Islands, where no anopheline mosquitoes have been found and filariasis is present. Mansonia melanesiensis was found naturally infected with W. bancrofti on Guadalcanal during World War II. Culex pipiens fatigans is reported as an important vector in the Caroline Islands, the Marianas, Gilbert Islands and Nauru.

3.1.2 In the subperiodic Wuchereria bancrofti areas

In the subperiodic W. bancrofti areas of the South Pacific, the Aedes scutellaris group is the major vector. There are many indigenous species, of which some are considered vectors only on epidemiological grounds. The whole Ae. scutellaris group is in need of taxonomic revision, including Ae. polynesiensis which is widely distributed and predominant and is the principal vector for most of the area. At least one undescribed species, the only member of the group on Niutoputapu and Tafahi Islands in Tonga, is an efficient vector in that hyperendemic area.

In both the larger Fijian Islands and in the Samoas, there are local species (Ae. pseudoscutellaris and Ae. upolensis), closely related to Ae. polynesiensis, that are found in the interior portions of the islands. It was mentioned that Ae. polynesiensis is seldom found more than half a mile from the coast on Vitilevu in Fiji. The Ae. scutellaris group breeds mainly in containers, utilising tree holes, coconuts, rock holes, artificial containers of all types, as well as crab holes (which in some areas are responsible for extremely high densities) and, on occasion, even leaf axils (especially where there are no indigenous leaf-axil breeders).

The biting cycle of Ae. pseudoscutellaris is similar to that of Ae. polynesiensis, as revealed recently by the studies in Fiji. It was also confirmed that Ae. (Ochlerotatus) vigilax bites mainly at night. The interval between blood meals of Ae. polynesiensis in Fiji is three and a half days, as shown by marking and releasing experiments.

In the western portion of the subperiodic W. bancrofti area, some species of another group of Aedes mosquito, the kochi group of the subgenus Finlaya, are effective vectors. Two species, Ae. samoanus and Ae. fijiensis, which are night-biting and leaf-axil breeding mosquitoes, are of local importance.

In the New Caledonia and Loyalty Islands, the vector is Ae. vigilax, a brackish-water breeder in mangrove swamps and salt marshes, as well as in ground pools and rock holes.

The practical importance of C.p. fatigans in the transmission of subperiodic W. bancrofti is doubtful, although it was reported that this mosquito can be a vector of this form of filariasis to a limited extent in Tahiti and Fiji.

3.2 Vector control

It is not possible to outline a single control measure against all the filariasis vectors, which involve many mosquito species and have a very diverse ecology.

3.2.1 Control of "Anopheles punctulatus" group

Theoretically, indoor residual spraying of DDT for anti-malaria purpose should interrupt, or at least reduce, the transmission of filariasis by this group of mosquitoes. An assessment of its effectiveness is, therefore, required and is planned to be undertaken in the New Hebrides, Papua New Guinea and the Solomon Islands.

3.2.2 Control of C.p. fatigans

The fundamental measure is efficient sanitation; larvicides can be used as a supplement. Biological and genetic control will not become operational in the near future.

3.2.3 Control of Aedes species

For Ae. polynesiensis control, sanitation by source reduction and health education are of primary importance.

Small-scale field control trials with adulticides and larvicides were undertaken in Western Samoa. Satisfactory control could not be obtained, mainly because of inaccessible and undetectable breeding sites scattered in the bushes where it was difficult to apply larvicides. In certain areas, crab holes are one of the important breeding sites of Ae. polynesiensis and pose a technical problem for their control.

Investigations are being carried out in Western Samoa and Fiji on the possibility of using Toxorhynchites spp. and existing microbial pathogens including Coelomomyces for biological control of vector mosquitoes. Trials may be undertaken using ultra-low volume (ULV) spraying by ground application for the control of outdoor-resting vector mosquitoes.

3.3 Insecticide susceptibility test

Recently, more tests have been carried out for Aedes mosquitoes in the South Pacific. No development of resistance to insecticides has been observed. Most of the test results, which have not yet been published, are given in Tables 2 and 3.

4. MASS DRUG ADMINISTRATION IN THE CONTROL OF FILARIASIS

Mass drug administration has the advantage of covering both known and unknown mf carriers. The number and variety of anti-filariasis drugs suitable for mass administration are extremely limited, and at present only DEC is recommended for this purpose. To date, W. bancrofti has not been shown to exhibit any resistance to this drug, although in some countries, microfilariae persist at low densities following repeated treatments.

4.1 Diethylcarbamazine citrate (DEC)

The precise action of DEC on the various stages of W. bancrofti in man is not known. However, it is believed to affect microfilariae in such a manner as to make them more susceptible to the natural defence mechanisms of the body. Microfilariae are apparently destroyed in the spleen and liver. The drug is also believed to kill some adult worms, and to permanently or temporarily sterilize others. Within 12-24 hours of giving the drug, microfilariae are affected and in some cases eliminated, but as early as five months following treatment, microfilariae can reappear in the peripheral blood. In man, the drug is excreted through the renal system.

4.1.1 Disadvantages of DEC

Drug reactions may be due to the drug itself or the dead or injured microfilariae, or to adult worms, or to a combination of them all.

The drug is a gastric irritant, although less so than aspirin, and this may be compounded when the side effects are treated with aspirin. The drug has a tranquilizing or hypnotic effect, causing drowsiness. For this reason, it is often recommended that it should be administered after the evening meal, and driving or other potentially dangerous occupations should be restricted. Other side effects include general weakness, malaise, headache, giddiness, fever, lymphadenitis, nausea and vomiting.

DEC may precipitate signs of the disease such as swellings and hydrocele or it may exacerbate signs that are already present.

4.1.2 Advantages of DEC

The drug is easily administered orally in tablet or in syrup form. It reduces or eliminates microfilariae from the peripheral blood, thereby reducing the possibility of transmission.

The antihelminthic effects of the drug can reduce the prevalence of ascariasis and other helminthes, with the exception of hookworm, in the population during a mass treatment campaign.

4.1.3 Formulations and dosage

Medicated salt and foodstuffs such as soup and orange juice have been utilised for the mass distribution of DEC in some parts of the world, but this can be effective only in those areas where strict control of the salt or foodstuff can be maintained.

For mass drug administration, the recommended dosage of DEC is 4-6 mg/kg body weight in a minimum total dosage regime of 72 mg/kg body weight. Spaced doses have been found to be more effective than consecutive daily doses, and are also more convenient for mass treatment programmes.

4.2 Organization of mass drug administration

A census should be taken and simultaneously a treatment register should be prepared to include personal identification, body weight, and number of tablets to be consumed by each individual. A preliminary sample survey from the whole country or pilot study area should be carried out prior to mass drug administration. A post-treatment survey should be made using the same methods.

The most effective means of distributing drug on a mass scale would appear to be to utilise a combination of medical authorities and voluntary health workers, the former supervising the programme. Campaigns should be of short duration to ensure continuing interest on the part of the volunteer workers and the public. Each distribution team should be limited to two to five persons with one individual as leader. Health education is very important and every available media should be utilised.

Some groups should be excluded from the mass treatment campaign. Among them would be the chronically sick, the aged, infants and those with drug idiosyncracies. Another group, such as the acutely sick and pregnant women, may need to have treatment postponed. As the programme progresses, adjustments must be made to account for the natural mortality and movement of populations.

4.3 Results of mass drug administration

In the countries and territories where mass drug administration has been undertaken, the mf rates and densities have been greatly reduced. Detailed information from these countries and territories is not available either to workers in the Pacific area or to those elsewhere. The results are, therefore, given in Annex 3.

In French Polynesia and American Samoa, there is a small group of people who are recurrent or persistent mf carriers despite repeated treatment with DEC. The reason is not known.

A study on the efficacy of a single dose of DEC was carried out in French Polynesia, and the results are promising.

Now that two rounds of mass treatment with DEC have been completed in the Samoas with a consequent reduction in the mf rates and mean mf densities, the migration of carriers with high densities into these areas constitutes a problem.

There is considerable movement of the population in the Pacific, not only within, but also between the countries and territories. The most movement occurs between American Samoa and Western Samoa, and between American Samoa and the United States of America.

In American Samoa, for some years now, regulations have been in force requiring treatment at the port of entry of infected persons from Western Samoa and Tonga. These regulations have recently been changed in co-operation with the authorities of Western Samoa, and now only documentary evidence is required that an incoming passenger from a filariasis endemic area is mf negative. This requirement does not restrict the free movement of people between territories, but any person not producing adequate documentation on entering American Samoa, is required to undergo testing and treatment if found to be an mf carrier.

Western Samoa and Niue are expected to adopt similar regulations in the near future.

5. SURGICAL TREATMENT

For many years surgeons have been operating on hydrocele and elephantiasis of the male genitalia throughout the Pacific Islands. In Western Samoa, for example, approximately 100-200 hydrocele operations are performed every year.

There remains a group of individuals with elephantiasis of the limbs, who are seriously handicapped physically and socially. In Western Samoa, 24 cases of elephantiasis of the limbs due to filariasis have been treated surgically using Thompson's technique. After one to four years of post-operative observation, the results for 75% of these patients have been assessed as "good" or "satisfactory".

Thompson's technique consists essentially of inserting a flap of dermis, denuded of its epidermis, into a conveniently located intramuscular crevice, so that it is in contact with unobstructed perivascular lymphatics, after the oedematous fibro-fatty tissues and fascia have been excised. This operation results in improved lymph flow.

Surgical correction of elephantiasis is considered to be a necessary adjunct to a successful filariasis control programme.

6. RESEARCH IN FILARIASIS

6.1 Current research in the South Pacific

6.1.1 Fluctuation in mf density

Investigations in French Polynesia have shown a regular fluctuation of mf densities of subperiodic filariasis in man, with a peak occurring approximately every 80 days. Further studies showed two oscillations, one with a seven-day cycle, believed to be due to host factors, and the other an eleven-day cycle, believed to be due to parasite factors. These synchronized every 77 days, which would explain the peak observed in the initial studies. The same phenomenon has been found in rodents and cats. The significance of this in relation to mosquito biting habits is not known.

6.1.2 Vector transmission

In natural vectors of filariasis, the parasitic reduction (i.e., the difference between the input of microfilariae and the output of the infective larvae) is never proportional. It appears that two main types occur in the vector mosquitoes - "limitation" for *Aedes* and *Culex* and "facilitation" for *Anopheles*. Studies are being carried out in Tahiti to construct a mathematical model to describe this phenomenon.

6.2 Trends

Over the past several years studies in filariasis have centred upon three major areas:

(a) surveys of human filariasis;

(b) zoonotic filariasis; and

(c) development of animal models for studies of filarial biology, pathology and chemotherapy.

6.2.1 Surveys of human filariasis

There has been increased interest in surveying human populations because of the introduction of newer, more sophisticated methods for detecting the presence of microfilariae. These methods, including the counting chamber and the membrane filter concentration techniques, detect low levels of microfilaremia which are often missed by thick film examination. Work is also continuing on improving and developing serodiagnostic tests.

6.2.2 Zoonotic filariasis

Increasing attention has been paid to filarial worms which are normally parasites of animals but which may cause diseases in man. Examples of these are *Dirofilaria immitis* found normally in dogs, *D. repens* in dogs and *Onchocerca* species in cattle and horses.

6.2.3 Animal models

Much effort has gone into finding a suitable animal in which to establish *W. bancrofti* so that comprehensive studies of the parasite may be accomplished. To date cats, dogs, primates and rodents have been the animals mainly utilized. Unfortunately, *W. bancrofti* cannot be satisfactorily established in gerbils. However, recent work with monkeys shows promising results.

7. PROSPECTS OF FILARIASIS CONTROL

When reviewing the future of filariasis control, one must consider direct attack on the parasites, as well as vector control.

As mentioned earlier, when discussing the control of the "Anopheles punctulatus" group, DDT residual spraying for anti-malarial purpose should, at the same time, control filariasis. Basic sanitation is important in controlling C.p. fatigans and Ae. polynesiensis. So far, there is no single suitable method for the control of outdoor-resting mosquitoes or larvae of certain vector species of Aedes. Biological and genetic control will not become operational in the near future. If economically feasible, all available practical means of vector control should be utilized.

The only suitable drug available to attack the parasite is DEC. Mass treatment utilizing this drug in various regimes seems effective in reducing the mf rate so that mosquitoes cannot become infected. The single dose treatment regime discussed earlier may well be sufficient to eliminate the parasite in a large percentage of carriers. Mass treatment programmes must be economically feasible; and before considering the need for a subsequent round of drug distribution, a thorough search should be made for mf carriers so that they may be treated.

It may be that DEC alone is unable to interrupt transmission in areas with high densities of efficient vector mosquitoes and, therefore, vector control methods, as practical and feasible, should be also utilized.

8. DENGUE FEVER/DENGUE HAEMORRHAGIC FEVER IN THE SOUTH PACIFIC

8.1 Current information

During World War II, major epidemics of dengue fever occurred in at least 12 of the 19 South Pacific countries and territories. After that, no epidemics were reported for 20 years until outbreaks of dengue type 3 occurred in French Polynesia in 1964 and 1969. In early 1971, simultaneous outbreaks in Fiji and Tahiti heralded a series of pan-Pacific epidemics. Dengue type 2 was confirmed in the laboratory from nine separate outbreaks. Small numbers of cases have since been reported regularly from Fiji and Tahiti.

A low level epidemic of dengue type 2 is currently in progress in the Kingdom of Tonga. Cases of dengue type 3 have just been confirmed in the Marshall Islands, while an unknown type of dengue is active at present in Nauru.

Dengue fever with haemorrhagic manifestations has been reported in a range of less than 1% up to 25% of clinical cases. During the recent epidemic on Niue, there were at least 23 cases with severe haemorrhagic manifestations, resulting in 12 deaths.

Detailed information on dengue fever/dengue haemorrhagic fever in the South Pacific is given in Annex 6.

Because of these recent epidemics, a special project on dengue has been started by the South Pacific Commission. The aims of this project include:

(a) the establishment of a centre for gathering and disseminating information on dengue occurrence and research;

(b) the support of serological services to determine the susceptibility level of different populations, and research on the various strains and levels of viraemia associated with different types of clinical illness;

(c) the support of vector surveillance and control; and

(d) technical assistance in controlling outbreaks.

This project is being conducted in co-operation with WHO, the Pasteur Institutes of Paris and New Caledonia and the Institut de Recherches Médicales "Louis Malardé" of French Polynesia.

WHO entomologists have also assisted in vector surveillance in certain countries and territories in the South Pacific. During the present seminar, technical guides on the diagnosis, treatment, surveillance and control of dengue haemorrhagic fever and its vector mosquitoes were distributed. These were prepared during the first meeting of the WHO Technical Advisory Committee on Dengue Haemorrhagic Fever held in Manila in March 1974.

8.2 Vector survey and distribution

Usually, the occurrence of an outbreak of dengue fever/dengue haemorrhagic fever is associated with *Ae. aegypti*. *Ae. albopictus* is considered a vector of classical dengue fever and is, most probably,

the vector of dengue in wild monkeys. Epidemiological observations have suggested that Ae. scutellaris serves as a vector of dengue in Papua New Guinea and Ae. polynesiensis in French Polynesia. However, during the recent outbreak in Rabaul, Papua New Guinea, Ae. aegypti constituted 71% of all the mosquito larvae collected. Ae. cooki was suspected to be a vector during the recent outbreak of dengue fever/ dengue haemorrhagic fever on Niue.

It is of the utmost importance to have basic information on the distribution and density of Ae. aegypti, as well as its closely-related Stegomyia species. Standardization of vector surveillance methods is necessary for global surveillance, so that data from different countries are comparable.

In countries or areas where only one species occurs or predominates, the single-larva-per-container collecting method is recommended. In areas where basic information on vector species distribution is still lacking, it is advisable to collect 10 larvae per water-holding container. Another alternative method is to collect a single larva, using the single-larva-per-container collecting method, and then to collect a few more larvae from the same container and place them into a separate collecting bottle for detailed studies.

The following indices at least should be obtained:

(1) "Breteau index" - number of positive containers per hundred houses;

(2) "Premise index" - percentage of houses positive for larvae.

A search for larvae should be made in all the water-holding containers inside and outside the house, including automobile tyres, discarded tins, etc. Other possible breeding sites in schools, hospitals, churches and cemeteries should be searched. Roof gutters and plant containers close to houses should also be examined.

Ae. aegypti is widely distributed in the South Pacific. Up-to-date information on its distribution in individual countries and territories is given in Annex 6.

8.3 Vector control

There are several methods of controlling Ae. aegypti whether required for a long-term programme or for an emergency when an epidemic of dengue haemorrhagic fever occurs.

The fundamental measure for a long-term control programme is basic sanitation through source reduction and health education. If necessary, it can be supplemented by applying Abate 1% sand granule at a dosage of 1 ppm as a larvicide. Epidemiological and entomological surveillance data should be used to direct control operations to those areas which have the highest vector densities and previous histories of outbreaks.

In an emergency, two ground applications of ULV spraying with technical malathion or fenitrothion at 438 ml/ha using vehicle-mounted or portable aerosol equipment should be applied at an interval of 10 days. Priority should be given to those areas with concentrated cases and to nearby schools and hospitals.

When and if necessary, ULV spraying can be applied by aircraft.

9. CONCLUSIONS

After having reviewed the recommendations made during the filariasis seminar held in Apia in 1968, the following conclusions were reached:

9.1 At least one round of mass drug administration with diethylcarbamazine citrate at a dosage of 4 to 6 mg/kg body weight should be used in each country/territory where filariasis is known to occur. The total dosage given should be not less than 72 mg/kg body weight. The timing of the dosage should be determined by local conditions. Post-treatment survey and retreatment should be performed as outlined in the Third Report of the WHO Expert Committee on Filariasis.[1] The resurvey may include a sample survey using a concentration method;

9.2 WHO and the SPC should consider supporting further large-scale trials of a single dose of diethylcarbamazine citrate given at long intervals. Suitable areas for such trials can be found in the Kingdom of Tonga;

9.3 Studies should be undertaken on the epidemiological significance of very low levels of microfilariaemia. Western Samoa is a suitable area for such investigations;

9.4 Further studies should be conducted on other methods of filariasis diagnosis, including serological and immunological methods;

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[1] Wld Hlth Org. techn. Rep. Ser., 1974, 542

9.5 Surgical treatment of hydrocele and elephantiasis of the extremities and genitalia now gives more promising results and surgeons should be encouraged to use the latest techniques. Information regarding these techniques should be readily available, and they should be demonstrated at suitable centres;

9.6 There should be greater co-operation between countries and territories to ensure that migrants are not microfilaria carriers;

9.7 When possible, surveys for the identification of animal filariae should be carried out;

9.8 More investigations should be carried out on the determination/confirmation and bionomics of filariasis vectors, as well as methods for their control;

9.9 A reference collection of insects of public health importance in the South Pacific should be established in a suitable centre, e.g., the Institut de Recherches medicales "Louis Malardé", Papeete, Tahiti. This Institute is also able to provide training facilities, particularly for mosquito identification. A note on methods of collection and the despatch of specimens should be prepared and sent to entomological workers in the South Pacific;

9.10 It is of the utmost importance to have continuous basic information on the distribution and density of Ae. aegypti, as well as other Stegomyia species involved in dengue fever/dengue haemorrhagic fever transmission. The information should include the Breteau and premise indices of vector species and should be transmitted to WHO and the SPC for correlation and dissemination;

9.11 National programmes on vector control on a long-term basis should be established as soon as possible in countries and territories where there is a risk of an outbreak of dengue fever/dengue haemorrhagic fever. If possible, equipment for ULV spraying and insecticides of ULV grade should be made available, particularly for emergency use;

9.12 Training courses on the surveillance and control of vector-borne diseases in the South Pacific should be organised and conducted by WHO/SPC when requested by the countries and territories;

9.13 The SPC should be requested to publish a technical guide booklet for the use of public works engineers, health inspectors, architects, contractors, etc., on the effective measures to be taken and the methodology to be used in avoiding the creation of new breeding sites for vector mosquitoes, and also for the destruction or alteration of existing sites in all rural and town development programmes;

9.14 There is a great need for the exchange of epidemiological and technical information on vector-borne disease in the South Pacific. It is essential for countries and territories to provide WHO and the SPC with the necessary information as soon as possible for correlation and dissemination.

9.15 Administrative and logistic support should be provided by governments so that control measures may be carried out more effectively.

ANNEX 1

LIST OF PARTICIPANTS

Countries or Territories	Name of Participant	Title and Official Address
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ANNEX 1 (cont'd)

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ANNEX 1 (cont'd)

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ANNEX 1 (cont'd)

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ANNEX 2

LIST OF DOCUMENTATION DISTRIBUTED[1]

A. On filariasis

WHO documentation:

(1) Chow, C.Y. (1973) Filariasis vectors in the Western Pacific Region. (Unpublished document WPR/VBC/10)

(2) Chow, C.Y. & T. Suzuki (1974) Filariasis vectors and their control in the South Pacific. (Unpublished working document WPR/Fil/9)

(3) Edeson, J.F.B. (1974) Epidemiological methods used in the studies of filariasis in general. (Unpublished working document WPR/Fil/8)

(4) Tin Maung Maung (1974) Clinical aspects of filariasis. (Unpublished working document WPR/Fil/10)

(5) Tin Maung Maung (1974) Filariasis control by the application of mass drug administration in Western Samoa, Ellice Islands and Niue. (Unpublished working document WPR/Fil/11)

(6) World Health Organization (1974) Third Report of the WHO Expert Committee on Filariasis. Wld Hlth Org. techn. Rep. Ser., No. 542

Other unpublished documentation made available to the seminar:

(7) Ash, L.R. (1974) Trends in filariasis research and their applicability to filariasis in the South Pacific.

(8) Hitchcock, J.C. (1974) Filariasis surveys in the Kingdom of Tonga.

(9) Kaeuffer, H, M. Merlin & J. Laigret (1974) Study of a brute antigenic extract of Dirofilaria immitis applied to the immunologic diagnosis of the lymphatic filariasis of Wuchereria bancrofti var. pacifica.

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[1] Copies can be obtained from WHO Regional Office for the Western Pacific, P.O. Box 2932, Manila, Philippines.

ANNEX 2 (cont'd)

(10) Laigret, J. (1974) Efficiency of 18 days treatment of diethylcarbamazine administered to microfilaria carriers.

(11) Laigret, J., M. Merlin, M. Chantin, E. Tuira & G. Fagneaux (1974) Efficiency of one single dose of diethylcarbamazine on microfilaremia of Wuchereria bancrofti microfilaria carriers.

(12) Mataika, J.U. & V. Cagimaivei (1974) Filariasis in Fiji.

(13) Pichon, G. (1974) Quantitative aspects in filariasis. 1. Parasitic reduction in the vector and possible influence on regulation of parasite populations.

(14) Vermeulen, W.J. (1974) New trends in surgery of elephantiasis due to filariasis.

(15) Webber, R.H. (1974) Filariasis in the Solomon Islands.

B. On dengue haemorrhagic fever

WHO documentation:

(1) Chow, C.Y. (1973) Aedes aegypti surveillance and control, with special reference to the South Pacific. (Unpublished document WPR/VBC/13)

(2) WHO (1974) Report on the First Meeting of the Technical Advisory Committee on Dengue Haemorrhagic Fever, Manila, Philippines, 5-7 March 1974

SPC documentation:

(3) SPC Dengue Newsletter, Vol. 1, July 1974

Other unpublished documentation made available to the seminar:

(4) Reed, D. (1974) Annotated bibliography of studies of control of Aedes aegypti during emergency situations.

(5) Suzuki, T. (1974) Tentative manual of Aedes aegypti survey by single-larva-per-container method in the South Pacific.

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C. On vector biology and control

WHO documentation:

(1) Chow, C.Y. (1970) The identification, biology and control of fleas. (Unpublished document WPR/VBC/2)

(2) Chow, C.Y. (1972) Alternative methods of mosquito control. (Unpublished document WPR/VBC/8)

(3) Chow, C.Y. (1972) Control of vectors of mosquito-borne diseases in the Western Pacific Region. (Unpublished document WPR/VBC/9)

(4) Chow, C.Y. (1973) Biology and control of the cockroaches. (Unpublished document WPR/VBC/12)

(5) Dy, F.J. & C.Y. Chow (1971) Insects of public health importance in the Western Pacific Region. (Unpublished document WPR/VBC/7)

Other unpublished documentation made available to the seminar:

(6) Richard, C. (1974) Sanitary engineering and mosquito control in the South Pacific.

ANNEX 3

PRESENT STATUS OF FILARIASIS AND ITS CONTROL IN THE SOUTH PACIFIC

American Samoa

Surveys in 1962, before the first mass drug administration, revealed a mean mf rate of 21% in 1000 persons examined in five selected pilot villages on the Island of Tutuila. Mass treatment using 6 mg/kg body weight of DEC was commenced in 1963. A total dosage of 72 mg/kg body weight was administered over a period of one year. Post-treatment surveys in 1965 indicated an mf rate of 3.11% in 1135 persons examined in the same five pilot villages. After the second round of mass drug administration, starting in 1965, the mf rate was 0.2% out of 1053 persons examined in twelve villages.

The latest mass blood and clinical surveys conducted in 1970-1972, involving 79.7% of the total population, revealed an overall mf rate of 0.9%, a mean mf density in positive blood films of 10.7 per 20 mm^3 of blood, an elephantiasis rate of 0.9%, a recurrent lymphangitis rate of 1.1%, and a hydrocele rate of 2.1%. All persons found to be positive were treated.

British Solomon Islands Protectorate

There is no specific anti-filariasis campaign, but the anti-malaria measures by DDT residual spraying carried out since 1960 reduced the mf rate from 25.1% to 18.2% in one area after three years of spraying. In another area, after 10 years of spraying, the elephantiasis rate was 1.87% and the mf rate was almost negligible; while in a similar area where spraying for only two years had been carried out, the elephantiasis rate was 0.81%, but the mf rate was 15%.

Cook Islands

Mass drug administration started on the Island of Aitutaki in 1968 reduced the mf rate from more than 30% to 0.8% in 1969 and 0.2% in 1971.

Fiji

Due to the geography of the islands and the population distribution, simultaneous mass drug administration for the entire country has not been feasible. Thus, the following five stage mass treatment programme with DEC was begun in 1969:

ANNEX 3 (cont'd)

Stage I: 1969-1971 - Southern part of Northern Island and Rotuma Islands

II: 1970-1972 - Northern part of Northern Island and Lau group

III: 1971-1973 - Eastern Division and Yasawa group

IV: 1972-1974 - Central Division

V: 1973-1975 - Western Division

The programme continued for two years in each of these five areas. The DEC dosage was 5 mg/kg body weight weekly for 6 weeks and then monthly for 22 months, with a total dosage of 140 mg/kg body weight. Post-treatment surveys of the 16-60 year age group only will be carried out, as this group showed the highest mf rate before treatment. Since the inception of mass drug administration, there has been a dramatic reduction in hospital admissions due to filariasis. Post-treatment surveys show a decrease in mf rate to 1% or less.

French Polynesia

Mass drug administration with DEC commenced between 1950 and 1960 and has reduced the mf rate from 34% to 4% and the mf density from 78 to 11 per 20 mm^3 blood in positive films.

In 1963, only mf carriers were treated, resulting in an increase in prevalence to 7% and in density to 80 mf/20 mm^3 of blood. Between 1966 and 1968, mass drug administration was carried out only in certain areas. From 1968 to 1972, quarterly mass drug administration and monthly distribution of the drug in schools was tried but the incidence remained static. From 1973 up to the present, quarterly mass drug administration has been undertaken. The mf rate is now 4.5% and the density in positive blood films is 20 per 20 mm^3 blood.

A study on the efficacy of a single dose was carried out, with promising results. The study involved 143 mf carriers who were followed up for more than a year by taking the mean of two 20 mm^3 blood. The results are as follows:

ANNEX 3 (cont'd)

Months after DEC	No. mf carriers examined	No. negative for mf	No. positive for mf	% of remaining carriers with reduced microfilaraemia
3-4 months	133	36	97	77
6-7 "	89	40	49	80
9-10 "	73	38	35	80
12-13 "	30	18	12	92

It was concluded that after a single dose of DEC, the mf rate was reduced by 36-60% over a period of one year and the average mf density and median count were also reduced. Those carriers with low mf densities have become negative, and those with high densities are still positive but with reduced mf densities. It is, therefore, suggested that a single dose may be employed monthly, quarterly, semi-annually or annually, depending upon the availability of resources.

Gilbert and Ellice Islands

On the 17 Gilbert islands, there does not appear to be a significant filariasis problem. However, it is a major public health problem on the eight Ellice Islands. Mass drug administration was started in 1972 with the assistance of the WHO inter-country filariasis advisory team. Pre-treatment surveys in Funafuti indicated an mf rate of 14.7% and an average mf count per carrier of 85.5 per 20 mm^3 of blood. A preliminary post-treatment survey shows reduction of the mf rate to 0.9%.

Guam

There are no records to indicate the occurrence of *W. bancrofti* at present. However, many dogs have been found heavily infected with *D. immitis*.

New Hebrides

There is no specific anti-filariasis campaign, since this disease is not considered to be a major public health problem at present. It has become apparent that the distribution of filariasis is patchy, where malaria reaches the level of meso-endemicity, filariasis is endemic. In some areas, the mf rate was 15% with low mf densities and the elephantiasis rate was 2-3%.

ANNEX 3 (cont'd)

Niue

A mass drug administration programme was launched in mid-1972 with the assistance of the WHO inter-country filariasis advisory team. DEC was given at a dosage of 6 mg/kg body weight once a week for 12 weeks and followed by once a month for 12 months. Pre-treatment surveys revealed an mf rate of 16.3% and an average mf count per carrier of 30.6 per 20 mm^3 of blood. Post-treatment surveys have now started.

Papua New Guinea

There is no specific anti-filariasis programme. DDT residual spraying has been undertaken for anti-malaria purpose. A systematic study will be undertaken to evaluate the influence on filariasis of DDT indoor residual spraying used as an anti-malaria measure.

Tonga

It is planned to start an anti-filariasis programme in 1975 or 1976. Blood and clinical surveys were started in 1968. Results obtained in a village (Hihifo) on Niuatoputapu in 1970 showed an mf rate of 16.4% out of 680 persons examined. From the same village, 55 children (5 to 9 years of age) showed an mf rate of 71% when blood was examined by the membrane filter concentration technique, but only 9% when 60 mm^3 of blood film taken simultaneously were examined. Of 2496 dissected mosquitoes (an undescribed species of the Ae. scutellaris group) from the same area, the infection rate of all stage larvae was about 6% and the infective rate 1%.

Trust Territory of the Pacific Islands

Of the numerous islands in this group, Palau and the other islands of Yap, Ponate and Truk have a significant filariasis problem. Palau had an mf rate of 12.6% in 1967. Mass drug administration with DEC at a dosage of 5 mg/kg body weight once every other month for two years was started in 1970. The post-treatment survey revealed an mf rate of 0.3% out of 1000 persons examined. Plans are being drawn up for mass drug administration in the other three groups of islands.

Western Samoa

The WHO/UNICEF assisted pilot project was established in 1965. The first round of mass-drug administration with DEC at 5 mg/kg body weight once a week for 6 weeks followed by a monthly dose for 12 months was completed in 1967. The average 18-dose coverage was 21%. Volunteers

ANNEX 3 (cont'd)

of the Women's Health Committees assisted in the distribution of the drug. The mf rate was reduced from 19.06% to 1.63%, and the average mf count from 58 per 20 mm^3 blood film of positive carriers to 9. The second round with DEC at 6 mg/kg body weight, monthly for 12 months, was undertaken from January to December 1971 and has reduced the mf rate from 2.26% in 1969 to 0.14% in 1973 and 0.11% in April 1974.

ANNEX 4

CLINICAL ASPECTS OF FILARIASIS

There is still much to be learnt about the life cycle and pathology of W. bancrofti in man.

The incubation period may vary but clinical signs may be seen one month after infection. The pathogenesis of filariasis can be summarised as stages of inflammation, obstruction, hyperplasia and elephantiasis, mainly affecting the lymphatic system initially but later involving other tissues.

The clinical manifestations can be described according to the pathological process. Thus, during the inflammatory stage, lymphangitis, lymphadenitis, allergic manifestations, abscesses and sinuses develop.

In the obstructive stage, swelling of the tissues due to fluid tension occurs, this swelling pits on pressure. Hydrocele, lymphatic varices and chyluria are signs of obstruction.

In the hyperplastic stage, new tissues grow and hence true elephantiasis develops. Warty growths of the skin are seen.

Ultimately, fibrotic elephantiasis is the result.

Other signs of filariasis may be present and may mimic other diseases. Occult filariasis is a host reaction causing hypereosinophilia and lesions in the lung, liver and spleen without circulating microfilariae. Dead microfilariae may be found in lymph nodules.

ANNEX 5

VECTORS OF FILARIASIS IN THE SOUTH PACIFIC

American Samoa:	Aedes polynesiensis, Ae. samoanus, Ae. upolensis
Cook Islands:	Ae. polynesiensis
Ellice Islands:	Ae. polynesiensis
Fiji:	Ae. polynesiensis, Ae. pseudoscutellaris, Ae. fijiensis
French Polynesia:	Ae. polynesiensis
Futuna:	Ae. futunae, Ae. polynesiensis
Gilbert Islands:	Culex pipiens fatigans
Loyalty Islands:	Ae. vigilax
Nauru:	C.p. fatigans
New Caledonia:	Ae. vigilax
New Hebrides:	Anopheles farauti
Niue:	Ae. cooki
Papua New Guinea:	"Anopheles punctulatus" group
Rotuma:	Ae. rotumae
Solomon Islands:	"A. punctulatus" group
Tonga:	Ae. tabu, Ae. tongae, Ae. oceanicus, Ae. sp.*
TTPI:	C.p. fatigans
Wallis Islands:	Ae. polynesiensis
Western Samoa:	Ae. polynesiensis, Ae. samoanus, Ae. upolensis

*An undescribed species of the Ae. scutellaris group.

ANNEX 6

CURRENT INFORMATION ON DENGUE FEVER/DENGUE HAEMORRHAGIC FEVER AND THE DISTRIBUTION OF AEDES AEGYPTI IN THE SOUTH PACIFIC

American Samoa

A low level epidemic occurred in 1972. There have been no confirmed cases since. Ae. aegypti is prevalent.

A new dengue fever control section has been established to co-ordinate vector surveillance and control, sanitation measures and health education.

British Solomon Islands Protectorate

There has been no recognized epidemic of dengue since World War II. No Ae. aegypti was found recently.

Cook Islands

There has been no recognized epidemic of dengue since 1946. Surveys in Rarotonga and Aitutaki in March 1974 revealed no Ae. aegypti.

Gilbert and Ellice Islands

A small outbreak of dengue type 2 occurred in 1972. The Breteau index of Ae. aegypti in Funafuti and Vaitupu in the Ellice Islands was 54 and 78 respectively, when surveyed in 1972.

Fiji

A wide-spread epidemic of dengue type 2 began in 1971 and a small number of cases continue to be reported. Ae. aegypti has been found in several localities. The Breteau index was 51 in Suva when it was surveyed in 1972. There is an active dengue control programme including vector surveillance and control, a diagnostic virus laboratory and an active public health education and sanitation programme.

ANNEX 6

French Polynesia

A dengue type 2 epidemic began in 1971 and a small number of cases continue to be reported. Ae. aegypti is widely distributed in Tahiti and other Islands. There is a very active dengue control programme including vector surveillance, public health education and sanitation. A research laboratory is available for serological and virological studies.

Guam

There has been no recognized outbreak of dengue since 1947. No Ae. aegypti has been found recently. There is a very active general vector control programme.

New Caledonia

The last epidemic occurred in 1972 and was confirmed as dengue type 2. The presence of Ae. aegypti was reported. There is currently an active vector control programme. A virus laboratory will be established soon.

New Hebrides

There was a confirmed outbreak of dengue type 2 in 1972. The Breteau index of Ae. aegypti in Ekipe was 163 when it was surveyed in early 1973. Abate is being used in some areas for the control of Ae. aegypti larvae.

Niue

An explosive epidemic of dengue type 2 occurred in 1972. Ae. aegypti was found for the first time in August 1972 by the entomologist of the WHO inter-country filariasis advisory team.

Papua New Guinea

An epidemic of dengue type 2 occurred in Rabaul in 1972, and some other coastal areas may have been involved. Ae. aegypti is present in several coastal areas.

Tonga

An epidemic of dengue type 2 is currently occurring. Ae. aegypti is prevalent. The control activities include public health education and sanitation.

ANNEX 6

Trust Territory of the Pacific Islands

There has been no recognized outbreak since World War II, except for a small number of cases of dengue type 1 which were reported in the Marshall Islands in April 1974. Ae. aegypti is present in all districts of the Territory.

Western Samoa

An outbreak of dengue type 2 occurred in 1972. A recent survey indicated the presence of Ae. aegypti in some parts of the main island. The Breteau index in Apia was 25, when it was surveyed in April 1973.

TABLE 1 - SUMMARY OF FILARIASIS CONTROL PROGRAMMES AND CHANGES IN ENDEMICITY IN THE SOUTH PACIFIC

		American Samoa	Solomon Islands	Cook Islands	Fiji	French Polynesia	Gilbert & Ellice Is.	New Hebrides	Niue	Papua New Guinea	Tonga	Western Samoa
Changes in distribution of filariasis	5 yrs	-	0	-	+	-	-	-	+	-	0	+
	10 yrs	+	+	-	+	-	-	-	+	-	0	0
Changes in degree of endemicity	5 yrs	+	+	+	+	+	-	0	+	+	0	+
	10 yrs	+	+	+	0	+	-	+	0	+	0	0
Rural area	Decline	+	(?+)	+	+	+	+	+	**	0	0	+
	Increase		+									
	Neither		+									
Urban area	Decline	+	0	+	+			+	**	0	0	+
	Increase											
	Neither					+	+					
Special filariasis service		+	-	+	+	+	+	+	+	-	+	+
National programme		+	+	+	+	+	+	+	+	-	***	+
Type of programme		N	N	N	N	N	S	S	N	-	N	N
Mass drug administration		+	-	+	+	+	+	-	+	0	-	+
Vector control		-	anti-malarial spraying	+	-	-	+	anti-malarial spraying	-	anti-malarial spraying	-	-

Remarks:

+ = Yes
- = No
0 = No information supplied
N = Nationwide
S = Selective
** = No distinction between rural and urban areas in Niue
*** = Starting in 1975

TABLE 2 - LC-50 VALUES (%) OF INSECTICIDES OF *AEDES* FEMALE MOSQUITOES IN THE SOUTH PACIFIC

Insecticide	Country	Year	*Ae. polynesiensis*	*Ae. pseudoscutellaris*	*Ae. fijiensis*	*Ae. aegypti*	References
DDT	Fiji	1959	0.70	0.72	0.24	1.28	Burnett and Ash (1961)
	Fiji	1974	1.5	-	-	-	Suzuki (unpublished)
	W. Samoa	1971	0.35	-	-	-	Suzuki and Sone (unpublished)
dieldrin	Fiji	1959	-	0.124	0.054	-	Burnett and Ash (1961)

TABLE 3 - LC-50 VALUES (PPM) OF INSECTICIDES OF *AEDES* LARVAE IN THE SOUTH PACIFIC

Insecticide	Country	Year	*Ae. polynesiensis*	*Ae. pseudoscutellaris*	*Ae. fijiensis*	*Ae. samoanus*	*Ae. oceanicus*	*Ae. aegypti*	References
DDT	Fiji	1957-58	0.005	0.006	0.36	-	-	0.012	Burnett and Ash (1961)
	W. Samoa	1970-71	0.0031	-	-	0.0040	0.0080	-	Suzuki and Sone
			0.011	-	-	0.0064	-	-	(unpublished)
			-	-	-	0.0076	-	-	
dieldrin	Fiji	1957-58	0.006	0.006	0.005	-	-	0.008	Burnett and Ash (1961)
	W. Samoa	1970-71	0.0043	-	-	0.0015	0.0038	0.0083	Suzuki and Sone
			0.015	-	-	0.0023	-	-	(unpublished)
γ-BHC	Fiji	1957-58	0.009	0.020	0.007	-	-	0.010	Burnett and Ash (1961)
malathion	W. Samoa	1970-71	0.051	-	-	0.010	0.023	-	Suzuki and Sone (unpublished)
fenthion	W. Samoa	1970-71	0.0025	-	-	0.0017	0.0028	-	Suzuki and Sone (unpublished)
fenitrothion	W. Samoa	1970-71	0.0062	-	-	0.0042	0.0071	-	Suzuki and Sone (unpublished)
diazinon	W. Samoa	1970-71	0.042	-	-	0.027	0.041	-	Suzuki and Sone (unpublished)
Abate	W. Samoa	1970-71	-	-	-	0.00072	0.00082	-	Suzuki and Sone (unpublished)

Note: Two or three figures in one column for the same country mean the results obtained in different localities.