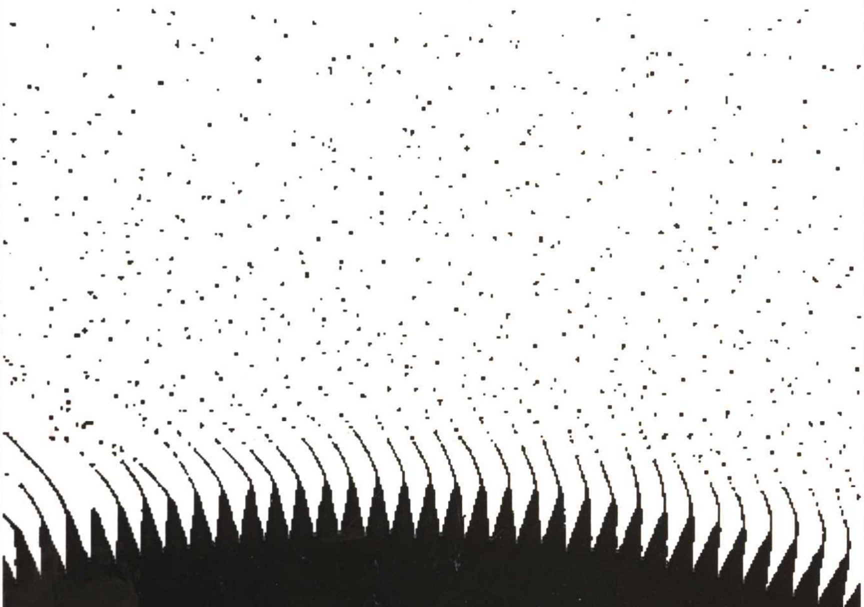
Equipment for Vector Control

Third Edition



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Preface

The effective, economic and safe use of pesticides for vector control is dependent on many factors including knowledge of the susceptibility of the vector to the various pesticides available, selection of an appropriate formulation, judicious timing of applications, adequate precautions against toxic hazards to man and animals, and the availability of properly designed equipment for the application and dispersal of the formulation selected. The WHO Expert Committee on Vector Biology and Control (and previously, the WHO Expert Committee on Insecticides) keeps all these aspects of vector control under constant review. As the need arises and sufficient information is accumulated, it recommends specifications for pesticides and for the equipment used in applying them.

In 1956, WHO published the first edition of *Specifications for pesticides* which contained all the specifications established by the WHO Expert Committee up to that date. A second, enlarged edition was published in 1961.[1] Only a small section of that publication was devoted to specifications for equipment, all of which had been established prior to 1956. Since that time, considerable attention has been paid to improving the efficiency and safety of the spraying and dusting equipment used in mass campaigns, such as malaria control programmes. The experience gained in these campaigns showed up the weak points in design, and a number of innovations were introduced and evaluated in the field. It therefore became necessary to re-examine the equipment available for the application and dispersal of pesticides.

The 1963 meeting of the WHO Expert Committee on Insecticides[2] resulted in the publication in 1964 of the first edition of *Equipment for vector control* which provided information on a wide variety of equipment that could be used for the dispersal of pesticides and gave detailed specifications for the sprayers and dusters considered most important for vector control operations.

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[1] Four further editions have since appeared, the third in 1967, the fourth in 1973, the fifth in 1979 and the sixth in 1984. These no longer contain specifications for equipment used in public health, and have an amended title, *Specifications for pesticides used in public health*.

[2] WHO Technical Report Series, No. 284, 1964 (*Application and dispersal of pesticides*: fourteenth report of the WHO Expert Committee on Insecticides).

A meeting of the WHO Expert Committee on Insecticides, convened in November 1970,[1] strongly recommended the revision of *Equipment for vector control* to reflect the new knowledge available. Consequently the second edition was expanded to include a discussion of the principles of vector control by chemicals and to provide information on the use of aircraft.

In September 1976, a meeting of the WHO Expert Committee on Vector Biology and Control was held to discuss engineering aspects of vector control operations. The Committee revised the specifications for hand-operated compression sprayers, and recommended that WHO should produce interim specifications for motorized knapsack mistblowers and vehicle-mounted motorized aerosol generators. At its meeting in April 1989, the Expert Committee produced revised specifications for hand-operated compression sprayers, motorized knapsack mistblowers, vehicle-mounted motorized aerosol generators, thermal fogging equipment, and vehicle-mounted mistblowers.

In view of the considerable advances that have been made in this field over the past ten years—including: development of several new and promising types of ground insecticide application equipment; improvement in aerial spraying equipment and techniques; development of new types of nozzles; and improvement in other components of existing types of application equipment—revision and updating of the second edition was considered desirable. In October 1984, an informal consultation (see Annex 7) was held to prepare a first draft of this revision.

In the preparation of this third edition, an attempt has been made to reflect the new knowledge available and to include more practical points of interest to those involved in vector control as well as to manufacturers.

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[1] WHO Technical Report Series, No. 465, 1971 (*Application and dispersal of pesticides*: eighteenth report of the WHO Expert Committee on Insecticides).

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Principal methods of applying pesticides in integrated vector control

Introduction

The control of public health pests and vectors of human disease requires a number of different strategies. The use of pesticides has produced spectacular control of certain vectors, but the development and spread of resistance to pesticides, concern about environmental contamination and increased costs of chemicals have re-emphasized the need to use several control techniques simultaneously or sequentially in integrated vector control programmes. The essential requirement for integrated control is the availability of more than one method of control which can be utilized in a cost-effective manner. The methods used must, of course, be compatible with one another, for example use of a selective pesticide that does not have detrimental effects on naturally occurring biological control agents.

Source reduction of a vector and improved sanitation through health education are fundamental means of environmental management to control several vectors; other control methods serve as a supplement. In recent years, control measures have involved several types of environmental management, such as drainage of mosquito breeding sites or promoting personal protection through the use of screened windows and bednets. Environmental management for vector control was reviewed at a meeting of the WHO Expert Committee on Vector Biology and Control in November 1979.[1] Detailed descriptions of certain environmental management measures are given in a 1982 WHO publication, *Manual on environmental management for mosquito control, with special emphasis on malaria vectors* (WHO Offset Publication, No. 66).

Biological control of vectors, through the use of bacterial agents and the introduction of fish and other predators and pathogens, is now a component of some programmes for the control of vector-borne diseases. The greatest potential of these agents lies in their ability to augment the effect of natural enemies and in their use in combination with limited amounts of chemical pesticides.

[1] WHO Technical Report Series, No. 649, 1980.

The role of chemical control in the integrated approach

In many parts of the world, particularly in developing countries with few resources, where relatively small numbers of people may be scattered over a large area, permanent environmental management for vector control becomes prohibitively expensive in relation to the short-term benefits that may be derived from it. Moreover, permanent control measures may not be practical because of the wish to preserve agricultural practices or to avoid changes to the natural environment. As a result, the control of pest and vector species has generally been dependent on the use of temporary measures, particularly the application of pesticides.

Chemical control methods should be considered as a supplement to basic sanitation, even when they must be employed as the principal means for obtaining rapid and maximum control of a vector. Where the vector is exophilic, exophagic and peridomestic, space spraying of insecticides has been found useful, especially during epidemics of dengue haemorrhagic fever and Japanese encephalitis.

The aim is to use integrated control. However, the success of many environmental management programmes requires favourable conditions, adequate financing and considerable time, so that chemical control measures will remain an essential component of most vector control programmes for the foreseeable future. More efficient and economic use presents a challenge—fixed schedules and dosage of treatments are now replaced wherever possible by flexible programmes of chemical treatment aimed at specific targets for disease control or prevention.

Principal methods of pesticide application

Most pesticides used in vector control are applied in liquid form. Determination of the optimum droplet size of sprays and use of equipment producing droplets within narrow size-ranges for a specific target will increase the biological effectiveness of pesticides, reduce the doses required, and thereby minimize environmental contamination. The appropriate droplet size-range depends on whether the pesticides are aimed at controlling larvae or adult vectors and, if the latter, on whether they are to be delivered by a space application (mist or aerosol) or by residual treatment of preferred resting sites. Thus the choice of application method will depend largely on the behavioural characteristics of the target vector.

When applying larvicides, granules, pellets and dusts may be used, as well as sprays. The particles in these formulations vary widely in their size range. Particle and bulk density and rate of release of the active ingredient will also differ, so that the rate of application has to be checked carefully for each product.

The need for more economical use of pesticides has led to modifications in methods of application and formulations. In this connection, recent WHO publications concerned with chemical control contain recommendations on the pesticides to be used and methods of application, a guide to specifications for pesticides, precautions considered desirable when handling or applying commonly used pesticides, and a review of current legislation on the use of pesticides in different countries throughout the world (see Bibliography, page 219).

Factors to be considered for effective application of pesticides

Target areas

Pesticides may be applied in breeding areas where immature stages are found and at the resting and feeding sites of the adult vector. Different techniques and pesticides will be needed for application of larvicides, treatment of interior surfaces of buildings, and exterior and/or interior space treatments where the vector is found.

The extent and accessibility of the target area, the presence of vegetation or forest, and the layout of buildings have a bearing on the effectiveness of applications, whether ground or aerial dispersing equipment is used.

Selection of pesticides

In selecting a pesticide, consideration should be given to its biological effectiveness against the pest concerned, its likely effect on target and non-target organisms, its hazard to humans, the threat to the environment posed by its proposed use, its cost, transportation requirements, and the availability of suitable application equipment. Determination of costs should be based on the expense of the material as applied and not on the purchase price of the chemical only.

Pesticide formulations

Where alternative pesticide formulations are available, the least toxic to humans and the least hazardous to the environment should be given preference.

Liquids may be applied in dilute or concentrated form. Dilute spray mixtures are most frequently used for high-volume applications using large droplets to achieve a complete wetting of the treated surface. On the other hand, extremely low volumes of more concentrated chemicals may be used in the form of fine sprays, mists or aerosols—a technique known as ultra-low-volume (ULV) application.

The aim of ULV techniques is to apply the minimum amount of liquid, usually less than 5 litres per hectare, to achieve control of a specific organism. When such small volumes are applied the liquid has to be finely atomized in order to maintain a sufficient number of droplets per unit area or per unit volume; such small droplets are very susceptible to air disturbances. Where applicable, ULV application has resulted in substantial savings to vector control programmes through speed of operation, reduced labour requirements and lower handling costs. ULV cold aerosols and thermal fogs[1] may be equally effective against a vector, but the latter use a higher volume of diluted spray per hectare. A further advantage of cold aerosol application is that it does not produce a dense fog, which may constitute a traffic hazard.

[1] The term "fog" may be used to describe an aerosol spray having a distribution of droplets with a volume median diameter (VMD) in the range 5–15 μm, and where the number of droplets per unit volume is such that visibility is reduced.