EQUIPMENT
FOR
VECTOR CONTROL

WORLD HEALTH ORGANIZATION GENEVA 1974

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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. WHO Expert Committees on Insecticides keep all these aspects of vector control under constant review. As the need arises and sufficient information accumulates, they recommend 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 WHO Expert Committees up to that date. A second, enlarged edition was published in 1961.*[1]

Only a small section of this publication was devoted to specifications for equipment, all of which has 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 the 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.*

Considerable advances have been made in this field over the past 9 years. Many new and highly effective insecticides are being utilized, necessitating refinements in methodology as well as new concepts in control. New types of nozzle have been developed and improvements have been made in other components of dispersal equipment.

A meeting of the WHO Expert Committee on Insecticides convened in November 1970,[3] *strongly recommended the revision of* Equipment for Vector Control *to reflect the new knowledge available. This second edition has been expanded to include a discussion of the principles of vector control by chemicals and to provide detailed information concerning the use of aircraft. It consists of 4 principal parts.*

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

[2] *Wld Hlth Org. techn. Rep. Ser.*, 1964, No. 284.

[3] *Wld Hlth Org. techn. Rep. Ser.*, 1971, No. 465.

Part I discusses the importance of permanent, semipermanent, and temporary control measures. A table is provided to facilitate the selection of the proper control measures and the appropriate equipment. Droplet size characteristics and the effect of meteorological, physical, and biological factors on the success of field applications are considered, and the section concludes with a description of the various components of dispersal equipment, their use, and any limitations they may have.

Part II provides a guide to the most important items of equipment for use on the ground in routine or emergency control operations.

Part III provides guidance on the aerial application of pesticides. It covers criteria for the selection of aircraft and dispersal equipment and considers the various factors governing the effective application of pesticides from the air.

Part IV contains detailed specifications for the spraying and dusting equipment most frequently used in organized vector control operations. The specifications for the hand-operated compression sprayer and the stirrup-pump sprayer have been revised in this edition.

Annexes provide information on : (1) methods of sampling pesticide emissions in order to determine droplet size spectra, biological effectiveness, and swath widths ; (2) procedures for sampling and testing equipment ; (3) useful formulae and conversion factors, and (4) the testing of aerosol dispensers.

Part I

PRINCIPLES OF PESTICIDE APPLICATION FOR VECTOR CONTROL

INTRODUCTION

A variety of permanent, semipermanent and temporary measures are available for the control of public health pests and vectors of human disease. Some public health problems lend themselves to permanent or semipermanent solution. For example, house construction can be improved to eliminate habitats suitable for bedbugs and reduviid bugs and to reduce the entry of flies and mosquitos; mosquito sources can be eliminated by means of drainage, filling, diking, flushing, and other manipulations of the aquatic habitat.

However, 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, the cost of permanent vector control work becomes prohibitively expensive in relation to the 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 drastic 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 chemicals. Temporary control measures are also used in emergency situations arising from earthquakes, hurricanes, floods, or sudden epidemic outbreaks.

Much emphasis is currently being given to the investigation of possible biological control agents that it is hoped will affect the environment to a lesser extent than other control measures. However, these agents, for example the viruses, must be carefully studied for potentially harmful effects and must be subject to requirements as stringent as those for insecticides. Agents that have been investigated so far for the biological control of pests and vectors [1, 2] can be considered only as temporary measures. In order to be fully effective most of them have to be applied periodically in relatively large quantities and are most successful when used together with insecticides and/or other measures in an integrated control programme.

Integrated control can be defined as the rational utilization of a combination of physical, biological, and chemical measures in such a way that each supplements the effects achieved by the others and enhances the final result. For example the area of a mosquito-breeding swamp might be reduced by means of drainage, the remaining water being clarified to facilitate the activity of predator fish. The measures would be completed by the use of limited amounts of insecticide, where required, to achieve satisfactory control.

Although integrated control is the goal of many agencies engaged in combating pest and vector problems it requires favourable conditions, adequate

[1] Brown, A.W.A. (1972) *Alternative methods of vector control.* In: *Vector control and the recrudescence of vector-borne diseases,* Washington, Pan American Health Organization, p. 59.
[2] *WHO Chronicle,* 1971, **25**, pp. 230–235.

financing and considerable time. Chemical control measures alone, therefore, continue to be widely used.

Research and development efforts during recent years have resulted in the discovery of many new pesticidal chemicals, of improved formulations, and of more effective application techniques.

Successful use of these depends on the selection of the optimum formulation for the application and of the proper dosage to ensure satisfactory control of the target organism with the least possible effect on the environment.

Recent WHO publications concerned with chemical control contain recommendations on the pesticides to be used and methods of application,[1] physicochemical specifications for pesticides,[2] precautions considered desirable when handling or applying commonly used pesticides,[3] and a review of current legislation on the use of pesticides in different countries throughout the world.[4]

Selection of suitable equipment

Table 1 has been designed to assist in the selection of the most suitable item of equipment for applying the recommended chemical for vector control. The first step in using the table is to identify the vector problem. For each problem, recommendations for control measures and equipment are listed. The item of equipment to be used should be selected with the help of the information given in Parts II and III, bearing in mind (1) the frequency and duration of control measures, (2) the extent and accessibility of the target area, (3) the ease of use and operator efficiency, (4) the amount and ease of maintenance required, and (5) the maintenance facilities available.

The choice of equipment must be consistent with the recommended method of control. It will also depend on the physical nature of the formulation of the recommended pesticide. For optimum chemical effect it is necessary to secure an even and continuous dispersal of the recommended dosage over the target area.

The majority of pesticides used in vector control are applied in liquid form. There are many types of dispersal equipment available but, since the material must be delivered not only at the desired rate of application but also in a distribution of suitably sized droplets, it is essential to understand the operating characteristics and various adjustments of the equipment in order to use it effectively.

Solid formulations vary widely in size and size range of particles, particle and bulk density, and rate of release of the active ingredient. Applicators are now available for dispersing dusts, granules, and pellets.

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[1] *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 443.

[2] World Health Organization (1973) *Specifications for pesticides used in public health*, 4th ed., Geneva.

[3] *Wld Hlth Org. techn. Rep. Ser.*, 1967, No. 356.

[4] *Int. Dig. Hlth Legis.*, 1969, **20**, 579.