

GUIDELINES

**FOR PERSONAL
PROTECTION
WHEN WORKING WITH
PESTICIDES IN
TROPICAL CLIMATES**



**FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS**

**GUIDELINES FOR
PERSONAL PROTECTION WHEN WORKING
WITH PESTICIDES IN TROPICAL CLIMATES**

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, March 1990

These guidelines are based on a comprehensive survey, including field and laboratory studies, undertaken by the international agrochemical industry association, GIFAP, in cooperation with FAO. The guidelines were subsequently reviewed and agreed by the FAO Group of Experts on Pesticide Registration Requirements in December 1989.

CONTENTS

	<u>PAGE</u>
1. INTRODUCTION	1
2. UNDERSTANDING PESTICIDE HAZARD.....	2
3. PRINCIPLES OF PERSONAL PROTECTION	3
3.1 Reading and Understanding Labels.....	3
3.2 Avoiding Contamination	4
3.3 Personal Hygiene	4
4. PERSONAL PROTECTION WHEN WORKING	5
IN HOT CLIMATES	
4.1 Work Clothing	5
4.1.1 Maintenance of Work Clothing.....	6
4.1.2 Protection Against Leakage from Application Equipment.....	6
4.2 Additional Protective Equipment	9
4.2.1 Protective Gloves.....	9
4.2.1.1 Care and Maintenance of Gloves	10
4.2.2 Eye and Face Protection	10
4.2.3 Protective Garments.....	12
4.2.4 Footwear.....	15
4.2.5 Aprons.....	15
4.2.6 Respiratory Equipment	15
5. REFERENCES	17

1. INTRODUCTION

Wherever and whenever pesticides are applied in agriculture there is the need to make sure that the applicator is able to protect himself adequately against contamination. However, he may have difficulties in hot and humid conditions because of discomfort caused by wearing protective apparel with low heat dissipation.

The problem of wearing additional protective equipment in tropical countries is well recognized and has been commented upon over the years. In 1984 the FAO Group of Experts on Pesticide Registration Requirements recommended the preparation of a FAO Guideline on protective clothing suitable for use in the tropics. The Group commented: "... that while of benefit to all countries, such a Guideline would be particularly useful for developing countries" (1). In identifying this need it was recognized that the information on this subject was scarce and fragmentary. There is little reference in the literature specifically addressing the needs of the pesticide operator working in tropical countries (2).

In the period following the 1984 FAO Group of Experts' meeting, GIFAP, in collaboration with FAO, set up a Working Group to review and assess the available resources for pesticide operators working in hot and humid conditions and to come up with recommendations for appropriate advice on protective measures to use in these situations. The Working Group spent two years assembling and reviewing information from the technical literature, agrochemical companies, national and international organizations and protective clothing manufacturers. It surveyed materials for potential use in hot and humid conditions using criteria such as protectiveness against pesticide products, comfort, durability, cost and availability. The Working Group also undertook a field study on selected items of protective equipment in Thailand in order to assess their protectiveness and acceptability to pesticide operators working in tropical conditions (3). The outcome of the Working Group's activities are included in the advice and recommendations given in these Guidelines.

These Guidelines are aimed principally at government registration officials and agricultural officers and consultants and others in the field who may be asked by farmers for information about the safe use of pesticides in tropical conditions. They are intended to offer practical and realistic advice by taking into account sufficient protection to the pesticide user while ensuring that he is able to work comfortably and efficiently. It is not intended that they should replace or contravene existing national regulations but it is hoped that when such regulations come up for review or new regulations are introduced, that the recommendations given in these guidelines will be taken into account. The Guidelines are to be used in support of the FAO International Code of Conduct on the Distribution and Use of Pesticides.

These Guidelines complement those produced in a simpler format by GIFAP for guidance to farmers and other agricultural workers in tropical developing countries (4).

2. UNDERSTANDING PESTICIDE HAZARD

Knowledge of the possible hazards arising from pesticide use and how pesticides might enter the body is a key to understanding how to take sensible precautions against such hazards. Every opportunity should be taken to educate farmers on the basic relationship between pesticide toxicity, exposure and hazard.

Pesticide use falls into two major categories, namely:

- a) handling the concentrated pesticide formulation and
- b) applying the diluted formulation.

The concentrated formulation, potentially, presents the greater hazard because the pesticide is present at its highest concentration in this form. All pesticide formulations must be handled carefully but some will have to be used with greater care because of their high toxicity. Pesticide formulations not requiring the use of additional protective clothing should be used where practical. The toxicity of pesticide formulations is classified in many countries and also internationally by the Recommended Classification of Pesticides by Hazard (5). As explained later, information on the toxicity class should be present on labels to give guidance to the user.

The diluted formulations which are sprayed onto crops have a lower, often much lower, toxicity because the initial formulation will have been diluted many times. Even so there is the need to avoid contamination or to minimise it to the lowest practical level.

Not all pesticide products and uses fall neatly into the above categories, e.g. ULV application or granular application, and safety precautions may have to be modified accordingly. However, the basic precautions described in the next Section apply to all situations.

Of equal importance is the knowledge of how pesticides might enter the human body during use. It is universally recognised that the most likely route of exposure for pesticide operators is via the skin. This is because pesticide products can splash or spill onto exposed skin during pouring and mixing concentrated pesticide formulations and during application when spray or dust can contaminate exposed skin or clothing. Therefore the most important safety measures aim to avoid or minimise skin contamination as far as possible and, if this occurs, to ensure efficient decontamination.

Apart from specific instances an inhalation hazard, i.e. intake into the lungs via nose or mouth, is not usually a significant feature of pesticide exposure. Exposure studies have shown that during conventional application of pesticides, the amount of contamination from inhalation is a tiny fraction of that from skin exposure (6,7,8). This is because most pesticides are not sufficiently volatile, or because the particle sizes generated during conventional application of sprays or dusts are too large to be inhaled into the lungs. Where the method of application does produce a significant number of particles capable of being inhaled into the lungs, e.g. mist blowing, or where the pesticide formulation is volatile, then respiratory protection would be required.

Oral contamination is not a significant factor during normal pesticide uses. If there is a problem, then this usually occurs outside normal agricultural practice and is due to accidental or intentional ingestion of products or contaminated foodstuff. In the field, the pesticide operator can take simple precautions to avoid ingestion of the products he is using.

Although these Guidelines outline measures for the personal protection of pesticide operators against all forms of exposure, the main emphasis has been placed upon avoidance of skin contamination since this is the most likely route of exposure.

3. PRINCIPLES OF PERSONAL PROTECTION

There are certain measures which should always be undertaken by pesticide operators to help protect against contamination during the handling and application of pesticides. These measures are as applicable in tropical conditions as elsewhere and should always be followed.

3.1 Reading and Understanding Labels

The first principle is to always read and follow the label recommendations on the pesticide container. Containers come in various sizes, shapes and materials (9). The small-scale farmer in tropical countries will most often handle smaller containers of 1 litre capacity or less. Label sizes are consequently smaller and the print may be more difficult to read. In many cases however additional leaflets may be attached to the container which has more detailed label information. If the label information cannot be read or understood for any reason, then the operator should find someone who can explain the instructions to him.

Apart from the written instructions, the operator should also look for pictorial information on the label which will indicate the degree of hazard presented by the pesticide formulation. Many countries follow international recommendations to use a colour band coding system to indicate the toxicity class of the formulation.

Similarly warning symbols, such as skull and crossbones, St Andrew's Cross, give information on the type of chemical hazard.

Pictograms on labels are a pictorial form of explaining safety precautions and are of use for emphasising these to semi-literate or illiterate people.

More detail on the content and layout of label recommendations is contained in the FAO Guidelines on Good Labelling Practice for Pesticides (10) and the addendum, Pictograms for Pesticide Labels.

3.2 Avoiding Contamination

If direct exposure of the skin, nose, mouth or eyes can be avoided or minimised when working with pesticide products, then this greatly reduces the chances of personal contamination.

When pouring and mixing the concentrated product, every effort should be made to avoid splashing or spilling onto skin or clothing. If any product falls on the skin, or into the eyes, then this should be washed off as soon as possible. Heavily contaminated clothing must be removed and washed with detergent and water.

The likelihood of contamination can be greatly reduced by using suitable equipment for measuring out and transferring the product. In particular the hands must never be used as scoops nor should the hands or arms be used to stir liquids.

The most appropriate application technique should be selected to control the pest problem. It is very important that the application equipment is in a good state of repair and that it is properly maintained and calibrated. Leaking knapsack sprayers, for example, are a source of contamination of clothing and skin (11). If spray nozzles become clogged then they should be cleaned out with water or a soft probe such as a grass stem. They should not be cleared by blowing through with the mouth.

When spraying the diluted product the applicator should always work upwind of the spray to avoid coming into contact with it. He should also avoid contact with freshly sprayed foliage as far as possible.

3.3 Personal Hygiene

Another basic principle of personal protection is good hygiene when working with pesticides. This is to ensure that if any contamination occurs then it is removed in good time. In addition personal habits will help avoid direct contamination in itself.

Operators should not eat, drink or smoke during work and should not touch their face or other bare skin with soiled hands or gloves. They should always wash their hands and face after handling pesticides and before eating, drinking, smoking or going to the toilet. When they have finished work for the day they should then wash themselves thoroughly.

Their work clothes should also be washed after work, separately from other clothing, and then dried. More detailed advice on care and maintenance of work clothing and protective equipment is given in Section 4.

4. PERSONAL PROTECTION WHEN WORKING IN HOT CLIMATES

The previous Section dealt with the fundamentals of personal protection of pesticide operators under all field conditions and climates. This Section is devoted to additional advice and information for those operators working under hot and humid conditions in tropical countries.

In particular this Section deals with the selection, care and maintenance of work clothing and protective equipment as well as general advice when working in these conditions. This is because the wearing of additional protective clothing and other equipment may cause severe discomfort and even physical distress due to heat stress if they are made of inappropriate materials. Alternatively, because of the discomfort, operators may dispense with protective apparel and become subject to greater exposure and possible contamination.

There are certain measures which can help reduce this problem, namely:

- a) where possible using a pesticide formulation which does not require the wearing of additional items of protective clothing;
- b) applying the pesticide in the cooler hours of the day when it is more comfortable to wear protective equipment.

However these measures serve to mitigate the problem and not to overcome it. With better advice on the selection and use of protective equipment it is possible for pesticide operators to work in comparative comfort while ensuring sufficient protection for themselves.

It must be stressed that the use of protective equipment does not obviate any of the measures outlined so far in this Guideline. All the basic principles of personal protection must be applied whether or not additional items of protective equipment are worn.

4.1 Work Clothing

In terms of additional protection for the body, work clothing must be considered as the first line of defence. Some thought should therefore be given to the amount and type of clothing worn for pesticide use. In this context work clothing is defined as clothing which can be normally obtained and worn by the operator in his place of domicile. It does not include the additional items of protective equipment that he may be required to wear due to label recommendations. Advice and information on these additional items are covered in Section 4.2.

Work clothing must be comfortable but also give sufficient protection to do the job safely. The minimum requirement for all types of pesticide operations is lightweight clothing covering most of the body. In practice this includes a long-sleeve upper garment, a garment covering the lower body including the legs, footwear (boots or shoes) and, if spraying high crops, a hat (Figure 1).

Most work clothing is made of cotton or cotton in combination with another material. It is recommended that the material should be as thick or as heavy as can be worn with comfort during work. It is known that the thicker or heavier the material the better it protects against

pesticide penetration. This is important advice to give to farmers since the more the skin is protected the smaller the amount of pesticide that can get to the body.

It will be evident from the foregoing that shorts and shortsleeved shirts favoured by agricultural workers in many tropical countries are not considered to provide adequate protection during pesticide use. In contrast, national dress worn by workers in some countries affords adequate protection since it covers most parts of the body and is composed of voluminous or relatively heavy material (Figure 2).

4.1.1 Maintenance of Work Clothing

The above advice assumes that work clothing will be adequately maintained and cleaned. If clothing is allowed to become badly worn or torn then this allows pesticides to penetrate more easily and counters any benefit of wearing the clothes. Work clothing should therefore be kept in a good state of repair with any significant tears or worn patches being mended. As clothing becomes worn and thin it should be replaced by new garments. Footwear must be inspected regularly and be repaired or replaced accordingly.

Work clothing, including footwear, must be washed after each day's use with soap or other detergent if available. It must be washed separately from other clothing and kept in a separate place.

4.1.2 Protection Against Leakage From Application Equipment

One source of contamination for which some additional protection may be required is from leaks from defective application equipment, such as hand sprayers. Although the first priority is to keep this equipment in good order it is known that this is not always attainable in tropical developing countries.

If leaks do occur, that cannot be repaired immediately, then there are simple measures which can be taken to prevent the spray liquid contaminating work clothing and skin. These include placing plastic sheeting or bags over the upper and/or lower body areas where leakage may occur (Figure 3).



FIGURE 1



FIGURE 2

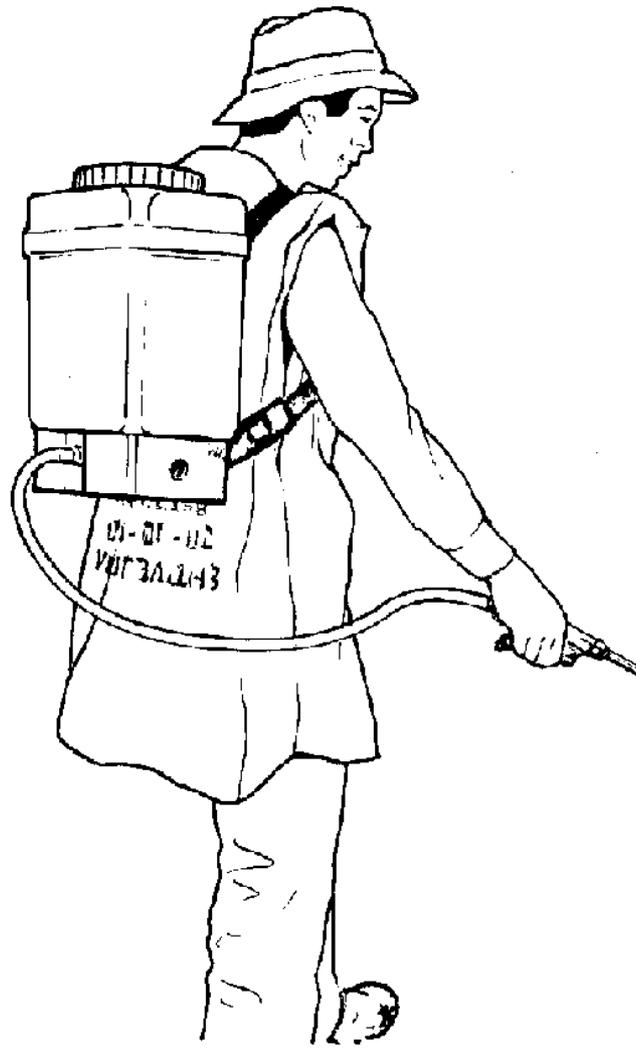


FIGURE 3

Preferably, a properly designed garment made of suitable protective material should be worn over the areas of the body likely to be exposed. The materials and designs for such protective garments are described under the next Section on additional protective equipment.

4.2 Additional Protective Equipment

Work clothing, as described above, will help protect the operator when he is working with pesticides. Choice of appropriate material such as cotton will enable him to work comfortably and efficiently which also helps to assure safe working practices.

There will be times when additional protective equipment is required. The most common requirement is for gloves and eye protection when pouring, mixing and loading pesticide formulations.

In other circumstances other protective equipment may be required for protection from inhalation of vapour, fine dust or spray, protection against especially hazardous products, specialised application methods or applications in tall dense crops. Protective equipment for these purposes may include aprons, boots, face masks, protective garments or hats.

It should be emphasised that this protective clothing must only be used during handling and application of pesticides and should not be worn on other occasions or for other purposes.

The following Sections contain advice and information on these protective items in the context of their use in hot and humid climates.

4.2.1 Protective Gloves

When pouring, mixing or loading pesticide formulations the wearing of protective gloves is advised (Figure 4). Since this operation usually occurs over short periods of time this precaution can be taken in hot and humid conditions as easily as in other conditions. Studies have shown that although wearing protective gloves may be uncomfortable for operators this did not prevent them wearing them nor were there any adverse consequences from doing so.

Protective gloves are available in a variety of materials and designs. Gloves made of materials such as nitrile rubber, neoprene, PVC and butyl rubber offer good protection to a range of pesticide products and are particularly appropriate for those containing organic solvents. However, neoprene and butyl rubber gloves are likely to be more expensive than those made of nitrile rubber or PVC.

Gloves made of natural rubber offer protection against liquid products which are dissolved or suspended in water, for example, suspension concentrates. They also protect against solid products such as granules or dusts. Rubber gloves do not provide sufficient protection against liquid products containing other solvents, for example, emulsifiable concentrates.

Gloves should be selected that fit the hands comfortably and that are flexible enough to grip pesticide containers and other equipment firmly. They must be long enough to at least cover the wrists and preferably the forearm. Gloves with lining inside are generally not recommended for handling pesticides.

For temporary protection against aqueous based or solid products, disposable gloves made of polyethylene, or, if nothing else is available, plastic bags covering the hands, can provide sufficient protection. These must be worn for one mix and load operation only and then disposed of safely.

4.2.1.1 Care and maintenance of gloves

As with all protective equipment, gloves do not necessarily reduce pesticide contamination unless they are used and maintained properly. Gloves should be examined carefully before use for any signs of wear or tear, particularly in the areas between the fingers. If there is any doubt about their protectiveness, they should be replaced.

It must be emphasised that the face or any other exposed parts of the body should not be touched when wearing the gloves.

When pesticide use is finished the gloves must be rinsed with water before they are removed from the hands. At the end of each day's use, gloves must be washed inside as well as outside and dried before they are used again.

4.2.2 Eye and Face Protection

A simple face shield made from clear transparent material is a comfortable form of eye and face protection when mixing and loading pesticide formulations in tropical field conditions (Figure 4). It can be constructed from a visor mounted with an elasticated band so that the transparent vertical section is approximately one inch from the face. Face shields offer protection against splashes and are less likely to mist over than other forms of eye protection such as goggles.

Goggles, which are an alternative for eye protection, are more uncomfortable than face shields and may not be acceptable pesticide operators in hot and humid conditions. If eye protection is needed, and a face shield is not available, then a pair of safety glasses is an acceptable alternative.

Before use, eye protection equipment should be examined carefully for any signs of damage. If there is any doubt about its adequacy it should be replaced. During use, the equipment should be cleaned when necessary to ensure clear vision. After use, it should be washed to remove any contamination.

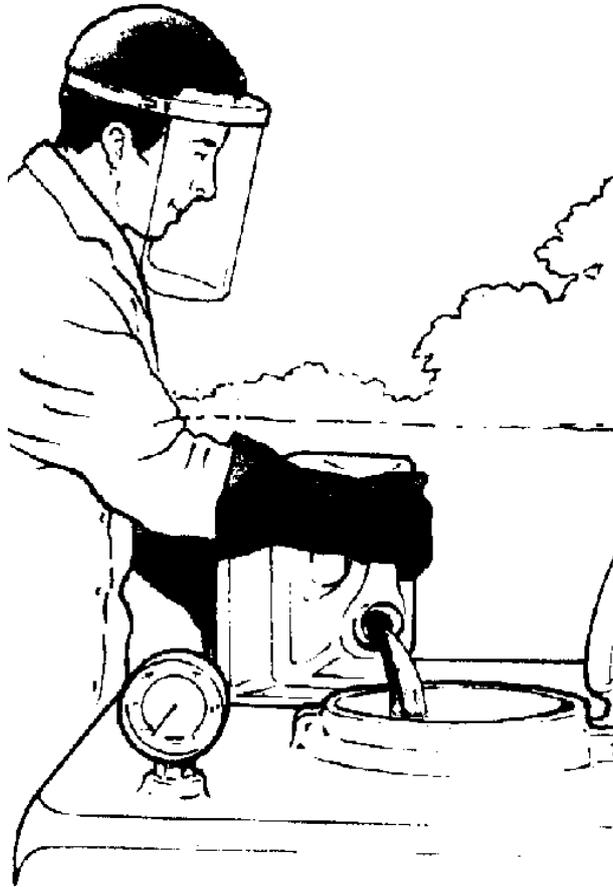


FIGURE 4

A lightweight face mask covering the mouth and nose may be required when handling dust formulations (Figure 5). This will protect against oral or airway contamination caused by the deposition of dust particles in this region of the face. It has to be emphasised that such masks should be used for protection against dusts only and must be regarded as disposable items and discarded after each use.

4.2.3 Protective Garments

For many pesticide operations work clothing made of cotton or cotton/polyester material, covering most of the body, provides sufficient basic protection (Section 4.1). When more protection is required this can be provided by additional garments, for example, in the form of overalls.

In tropical conditions, cotton is one of the most comfortable materials for making up protective garments and is usually readily available in most countries. It is a durable material over long periods when worn for work.

The protection given by cotton depends upon its weight and thickness, therefore it is advisable to choose garments with the material as thick and as heavy as can be worn with reasonable comfort in the prevailing climate.

Suitable alternative materials for wearing in hot and humid conditions include those based upon non-woven polypropylene, example, 'Kleenguard' ®. This material is as comfortable as cotton in these conditions but is less durable and therefore will have to be replaced more often according to the type of work involved. For example, knapsack sprayers rubbing at the shoulders and lower back can cause chafing of this material within a few days.

Other materials available at the time of publication are not suitable for use in hot and humid climates, either because they are unacceptable to the user because of heat discomfort or because they are too expensive.

The simplest and universally available design for protective garments is provided by overalls. They should button, or be elasticated, at the wrists and neck and not have pockets or other features to cause a build up of contamination.

An alternative design is a two-piece garment with separate top and trousers (Figure 6). The top can be of a double apron design with the sides open or sewn together, and coming down to the knees. This two-piece design gives greater flexibility to the wearer because the top or the trousers can be worn separately or together over normal work clothing according to the type of pesticide operation.

Protective garments must be maintained and cleaned in the same way as work clothing as described in Section 4.1.1.



FIGURE 5

FIGURE 6

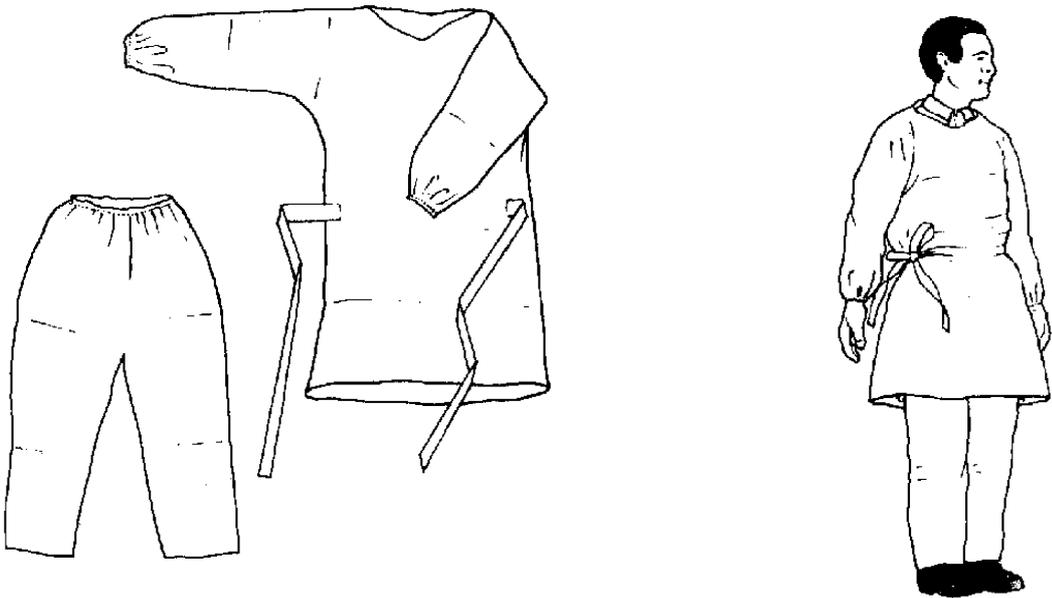


FIGURE 7

4.2.4 Footwear

It is recommended that footwear should be worn during pesticide operations and should be made of a material which can be easily washed and decontaminated. Leather footwear is unsuitable because it absorbs some pesticide products and cannot be decontaminated.

If boots are worn, those made of rubber give protection to a wide range of pesticide products. They should be at least calf height, unlined, with trousers worn outside so that any splashes or spills do not fall inside the boots (Figure 7). Footwear must be washed inside as well as outside at the end of each day's work and then allowed to dry. It must be inspected regularly for any sign of damage or leakage and replaced when necessary.

It is often impractical to wear boots or shoes when applying pesticides in flooded rice paddies. In this situation however, contamination from pesticides is very low due to high dilution by the paddy water. Regular washing of the exposed feet and legs with clean water is recommended to further reduce possible contamination.

4.2.5 Aprons

Aprons are useful additional protective items for mixing and loading operations with concentrated pesticide formulations and for cleaning out empty pesticide containers (Figure 8). Aprons made of PVC or rubber, or disposable ones made of polyethylene materials, provide adequate additional protection for operations of this kind. To be effective, an apron should cover the front of the body up to the neck and down to the knees. As with other protective equipment it must be washed after use and inspected regularly for signs of damage.

If nothing else is available, clean plastic sheets or sacks cut to form an apron can be worn as a temporary measure and destroyed after use.

4.2.6 Respiratory Equipment

Protection against the inhalation of fumes or fine droplets and particles into the lungs is provided by full or half-face respirators. This protective equipment is required only for certain specialised operations which give rise to this type of exposure, for example, fumigation indoors. Because of the physical discomfort involved, this type of equipment can be worn for only very short periods of time in tropical conditions. However, if they are recommended for an operation then they must be worn, and they should be cleaned and maintained as directed by the manufacturer.

Further detailed information on the selection, use and maintenance of respiratory protective equipment can be obtained from the manufacturers of such equipment or from the technical literature (12).



FIGURE 8

5. REFERENCES

1. FAO (1984). FAO Panel of experts on pesticide specifications, registration requirements and application standards. Group on Pesticide Registration Requirements. Report of fifth meeting, Rome, 10-14 December 1984.
2. Litchfield M.H. (1988). A Review of the requirements for protective clothing for agricultural workers in hot climates. Performance of Protective Clothing: Second Symposium, ASTM STP 989. (Mansdorf, Sager & Nielsen, Eds) pages 796-801.
3. GIFAP-FAO (1989). Field evaluation of protective clothing materials in a tropical climate. GIFAP-FAO Working Group on Protective Clothing for Hot Climates.
4. GIFAP (1989). Guidelines for personal protection when using Pesticides in hot climates. GIFAP, Brussels.
5. WHO (1988). The WHO recommended Classification of Pesticides by Hazard and Guidelines to Classification 1988/1989. WHO/VBC/88.953. WHO, Geneva.
6. Abbott I.M., Bonsall J.L., Chester G., Hart B. and Turnbull G.J. (1987). Worker exposure to a herbicide applied with ground sprayers in the United Kingdom. Am. Ind. Hyg. Assocn. Vol. 48 Pages 167-175.
7. Davies J.E., Enos H.F., Barquet A., Morgade C., Peters L.J. and Danauskas J.X. (1982). Protective clothing studies pages 169-182.
8. Moraski R.V. and Nielsen A.P. (1985). Protective clothing and its significance to the pesticide user. ACS Symposium series No. 273. (Honeycutt, Zweig and Ragsdale, Eds) pages 395-402.
9. FAO (1985). Guidelines for the packaging and storage of pesticides. FAO, Rome.
10. FAO (1985) Guidelines on good labelling practice for pesticides. FAO, Rome.
11. FAO (1988). Guidelines on good practice for ground and aerial application of pesticides. FAO, Rome.
12. Oudejans J.H. (1982). Agro-pesticides: their management and application. United Nations and Social Commission for Asia and the Pacific. Bangkok, Thailand.