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PESTICIDE RESIDUES IN FOOD

Report of the 1970 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues

Rome, 9–16 November 1970

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1970 JOINT MEETING OF THE FAO WORKING PARTY OF EXPERTS ON PESTICIDE RESIDUES AND THE WHO EXPERT COMMITTEE ON PESTICIDE RESIDUES

Rome, 9–16 November 1970

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PESTICIDE RESIDUES IN FOOD

Report of the 1970 Joint FAO/WHO Meeting

A Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues was held in Rome from 9 to 16 November 1970. The meeting was opened by Dr O. E. Fischnich, Assistant Director-General of the Food and Agriculture Organization of the United Nations, on behalf of the Directors-General of the Food and Agriculture Organization of the United Nations and the World Health Organization. Dr Fischnich also introduced Mr F. Albani, who had become Director of the Plant Production and Protection Division of FAO since the last Joint Meeting, and Mr Albani welcomed the participants. The FAO Working Party of Experts on Pesticide Residues had already met from 3 to 7 November 1970 in Rome in preparation for the Joint Meeting.

1. INTRODUCTION

This annual Joint Meeting was held in pursuance of the recommendation made in 1961, at a meeting of a WHO Expert Committee on Pesticide Residues held jointly with the FAO Panel of Experts on the Use of Pesticides in Agriculture (WHO/FAO, 1962), that studies be undertaken to evaluate possible hazards to man arising from the occurrence of residues of pesticides in foods. Following this recommendation, Joint Meetings of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues were held in 1963 and 1965. The reports of these meetings (FAO/WHO, 1964; FAO/WHO, 1965a), which were concerned primarily with establishing acceptable daily intakes (ADIs), and the supporting documents (FAO/WHO, 1965b, 1965c) were then considered by the FAO Working Party on Pesticide Residues with a view to recommending tolerances and appropriate methods of analysis for certain pesticides used on cereals (FAO, 1966).

Joint Meetings of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues (referred to hereafter as "Joint Meetings") were held in 1966, 1967, 1968, and 1969.

The reports of these meetings (FAO/WHO, 1967a, 1968a, 1969a, 1970a) contain information on ADIs established, the tolerances recommended, and methods of analysis suggested, for the various pesticides considered. The supporting documents (FAO/WHO, 1967b, 1968b, 1969b, and 1970b) contain detailed monographs on these pesticides and include comments on analytical methods.

The present Joint Meeting was convened to consider a further number of pesticides, together with requests of both a general and a specific nature contained in the report of the Fifth Session of the Codex Committee on Pesticide Residues held in October 1970 (FAO/WHO, 1970c).

During the present Joint Meeting the FAO Working Party was primarily responsible for:

(*a*) reviewing relevant data on certain pesticides and their residues;

(*b*) proposing, where appropriate, pesticide residue tolerances and/or practical residue limits;

(*c*) recommending, where appropriate, methods of analysis for pesticide residues.

The WHO Expert Committee was primarily responsible for:

(*a*) reviewing toxicological and other relevant data on certain pesticides and their residues;

(*b*) establishing, where possible, ADIs for man for those pesticides.

Furthermore, each of these groups made recommendations designed to initiate, stimulate, and co-ordinate necessary research.

2. GENERAL CONSIDERATIONS

2.1 Principles adopted

Like its predecessors, this meeting took account of the principles enumerated in the first and second reports of the Joint Meetings of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues (FAO/WHO, 1964; FAO/WHO, 1965a), in the second, fifth, eleventh and twelfth reports of the Joint FAO/WHO Expert Committee on Food Additives (FAO/WHO, 1958; FAO/WHO, 1961; FAO/WHO, 1968c; and FAO/WHO, 1969c), in the report of the WHO Scientific Group on Procedures for Investigating Intentional and Unintentional Food Additives (WHO, 1967), and in reports of previous Joint Meetings (FAO/WHO, 1967a; FAO/WHO, 1968a; FAO/WHO, 1969a; and FAO/WHO, 1970a).

2.2 Value of a multidisciplinary approach

The Meeting emphasized the need for a multidisciplinary approach to the evaluation of the safety of use of pesticides in relation to the occurrence of residues in food. In this connexion, it was noted with approval that the relevant disciplines were well represented among the members of the Joint Meetings. A multidisciplinary approach often facilitated the interpretation of the significance of observed effects by providing a range of criteria on which to base judgement of potential toxicity for man.

2.3 Need for undertaking further work

At the 1969 Joint Meeting (FAO/WHO, 1970a) it was noted that, for some compounds given temporary acceptable daily intakes (temporary ADIs) and/or temporary tolerances at previous Joint Meetings, the further information specified had not been supplied. Unfortunately, a similar situation again prevailed. For some compounds, however, it was noted that companies either individually or co-operatively had initiated research to provide information, even though the patents on such compounds had expired.

With certain other compounds it seemed unlikely that the necessary work would be done and that the information would become available. The Meeting therefore noted with satisfaction that FAO had prepared a request to the United Nations Development Programme Special Fund for a global project concerned with research on pesticides. It was hoped that this request would receive favourable consideration.

The Meeting also noted that the Joint FAO/IAEA Division of Atomic Energy in Agriculture had initiated a collaborative radioisotope research programme concerned partly with providing information on the fate of pesticide residues during storage, processing, cooking, etc. Such information should be taken into account when assessing potential intakes of pesticide residues (see section 3.1).

2.4 Nature and availability of data considered

The Meeting appreciated the large amount of information furnished for its consideration, particularly by industrial organizations. As at previous meetings, however, the special value of published results was particularly emphasized. Publication in the scientific literature ensures that work is subjected to scrutiny and criticism and affords the possibility of confirmation or refutation of results. Further, where residues in food result from the use of pesticides, publication of methods of residue analysis is essential if residues are to be detected and measured under practical conditions. Notwithstanding these reservations, the Meeting agreed to accept and to consider relevant information from all sources, whether published or not.

It was, however, regarded as highly desirable that the names and, if possible, qualifications and/or an indication of relevant experience of the person or persons responsible for experimental work be provided. The date on which experiments were carried out should also be stated.

The Meeting felt unable to accept and take confidential information into account because it was important that the data on which the assessments were based should be generally available for reference purposes. The Meeting was informed that it was, in fact, the policy of FAO and WHO to make available to *bona fide* scientists, on request, copies of the unpublished reports quoted in the monographs. The Meeting also agreed that it could not set ADIs or tolerances on the basis of abstracts or brief summaries of experimental data. For such purposes a full disclosure of relevant data is necessary.

2.5 Etiology and pathogenesis of liver tumours in mice

Recent reports concerning a number of pesticides have highlighted the need for further information on the factors involved in the etiology and pathogenesis of liver tumours in mice. In many strains of mice, such tumours develop spontaneously, some with a relatively high incidence, in the absence of deliberate exposure to any test compound. Non-specific factors, such as calorie intake and dietary protein level (Tannenbaum & Silverstone, 1949a, 1949b), and microbiological status (Roe & Grant, 1970), profoundly affect the incidence of these tumours. Under these circumstances, it is difficult to be sure whether exogenous compounds that increase the risk of development of these tumours do so by facilitating events of natural origin and peculiar to the mouse as a species, or by inducing tumours that would not otherwise have arisen.

When tumours arise in the livers of dieldrin-treated mice, the cells of which they are composed show the same cytoplasmic change as surrounding non-tumorous liver parenchyma cells, namely, proliferation of the smooth endoplasmic reticulum. The Meeting agreed that, apart from the latter manifestation, the liver tumours that arise in dieldrin-treated and DDT-treated mice are similar to the liver tumours that arise spontaneously in untreated mice.

The Meeting agreed that there is an urgent need for a better understanding of the nature, etiology, and pathogenesis of liver tumour development in mice.

2.6 Use of biochemical parameters for establishment of "no-toxic-effect level"

The Meeting stressed the need for further discussion on the difficulties of distinguishing between significant toxic effects and adaptive responses. In particular, it is necessary to decide whether the changes associated

with the induction of microsomal enzymes by a wide variety of exogenous compounds are to be regarded as a manifestation of toxicity. Previous induction of such enzymes may either increase or decrease the manifestation of toxicity attributable to exposure to a second exogenous or endogenous agent. There is a special need to consider this problem in relation to the possible effect of pesticides on the efficacy and toxicity of drugs given for medicinal purposes. It was proposed that a meeting be convened to consider these and related problems concerning chemical interaction between additives, limited aspects of which were touched upon by the WHO Scientific Group that met in 1966 to discuss procedures for investigating intentional and unintentional food additives (WHO, 1967).

2.7 Possible interaction between pesticides

At the 1967 Joint Meeting (FAO/WHO, 1968a) concern was expressed about the policy of considering ADIs of pesticides individually in view of the possibility that, if more than one pesticide is present, the toxic effects may be additive or one pesticide may potentiate the effect of another. Certain conclusions were reached at the 1967 Meeting. At the present Meeting, the possibility of such interaction in relation to the organochlorine group of insecticides was a subject of particular concern.

It was accordingly recommended that the persistent organochlorine insecticides be considered together at a future meeting, and that ADIs for individual compounds be reviewed in the light of the possibility that their toxic effects might be additive or more than additive.

2.8 Accidental poisoning and human toxicological data

The Meeting noted that, in reports of suspected cases of pesticide poisoning in man, details of the identity, the purity, the precise formulation, and the dose of the pesticides concerned and of possible concomitant exposure to similar or unrelated chemicals were often lacking. The Meeting considered it desirable to have further information about persons employed in the manufacture or formulation of pesticides, or in their application in the field. Such data would not only provide information of importance for the protection of personnel but, by indicating toxic effects specific to man, would also be useful in assessing the safety of pesticide residues in food.

Although the Meeting was primarily concerned with pesticide residues in food, it was felt that the question of serious or fatal accidents due to exposure to certain pesticides could not be ignored and that it was particularly necessary to discuss the actual and potential problems associated with exposure to such pesticides as diquat, paraquat, and 2,4,5-T.

2.9 Possible contamination arising from the use of pesticides in the home, restaurants, and similar places

The Meeting considered its terms of reference with regard to pesticides that may contaminate food prepared in the home, restaurants, or similar places. This problem, which had been touched on at the 1968 Joint Meeting (FAO/WHO, 1969a), has to be taken into account in the evaluation of the safety in use of pesticides such as dichlorvos. Accordingly, in arriving at its decisions, the Meeting took into account data relevant to the possible occurrence of residues of these pesticides in food.

2.10 Classification of foods and definition of food groups

The report of the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c) indicated that there was confusion about the tolerances recommended by the Joint Meetings for broad classes of foods especially "fruit", "vegetables", "leafy vegetables", "berries", etc. In a number of instances it was not clear which specific food commodities were involved.

The Meeting discussed this matter and agreed to apply the following principles in making recommendations for tolerances:

(*a*) When residue data are available for only a small number of commodities in a class of food, tolerance recommendations should be made separately for each commodity on which the data are considered adequate.

(*b*) When data on a number of commodities in a class show that there is a great variation in residue levels in different commodities, separate recommendations should be made for each commodity.

(*c*) When data on a wide variety of commodities in a class indicate that the range of residue levels is relatively narrow, a single tolerance should be recommended for the class as a whole.

(*d*) Every effort should be made to use classifications that are generally recognized by those concerned with pesticide residue problems and that are suitable for adoption by the Joint FAO/WHO Codex Alimentarius Commission.

2.11 Recommendations for temporary tolerances

The Meeting noted with concern that a high proportion of the tolerances already recommended were classified as "temporary" and that this did not always appear to be justified. It was observed that, according to the definition of a temporary tolerance given in Appendix IV to the report of the 1969 Joint Meeting (FAO/WHO, 1970a) this designation is normally employed:

(*a*) when the tolerance is recommended for a pesticide having only a temporary ADI;

(*b*) when there is a theoretical possibility that the ADI might be exceeded if all food contaminated with the pesticide contained residues up to the tolerance limit.

In either event, the recommendation has to be reviewed and a date for review is usually set.

Extensive data show that most pesticides leave little or no residue in the majority of foods and most of the residues present are removed in storage, preparation, and processing.

It was therefore decided that recommendations of temporary tolerances not based upon temporary ADIs should be restricted, and this policy was followed by the Meeting.

Any such recommendations made at earlier meetings would therefore need to be brought into line with this change in practice, and it was proposed that this subject be placed on the agenda of the 1971 Joint Meeting.

2.12 Methods of analysis

In discussing analytical methods, the Meeting reaffirmed its policy of advising on those most suitable for use at the tolerance levels for regulatory purposes. Where possible, the sensitivity and specificity of the methods mentioned would be indicated in the appropriate monograph. It was noted that this procedure was acceptable to the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c). Liaison with the Commission on the Development, Improvement and Standardization of Methods of Pesticide Residue Analysis of the International Union of Pure and Applied Chemistry (IUPAC) was regarded as being very useful in this connexion.

The Meeting reviewed the minutes of the Fifth Meeting of the Commission[1] and agreed that multiresidue methods showed considerable promise for residues of organophosphorus compounds. It was also noted that two specific methods were mentioned and that further development and validation of these and other procedures were proposed.

2.13 Tolerances to be expressed to one significant digit

Because of the lack of precision of the sampling and analytical procedures used in the determination of pesticide residues, it would be unrealistic to express tolerances or practical residue limits to more than one significant figure. The Meeting therefore recommended that, whenever possible,

[1] The proceedings of this meeting are to be published in the IUPAC *Information Bulletin* and a summary in the *Journal of the Association of Official Analytical Chemists*.

tolerances should be expressed to only one significant digit when new tolerance figures are proposed or when established tolerances are reconsidered.

2.14 DDT

With regard to DDT, it was noted that the work initiated by WHO and IARC (the International Agency for Research on Cancer) was still in progress, but that there were no definite conclusions as yet.

It was also noted that, in accordance with the recommendations made in 1969 (FAO/WHO, 1970a), several countries have stopped using DDT except in situations where no satisfactory substitute is available. As a consequence of the changing patterns of DDT use in these countries, the levels of DDT residues in many food crops will be lower.

The Meeting therefore endorsed the views expressed in 1969 and recommended that the compound should be kept under constant review.

2.15 Expression of tolerances for fat-soluble pesticides in meat, milk, and fish

The Joint Meeting considered the report of the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c) dealing with the method of expressing the tolerance for residues in animal products, especially meat, milk, and fish. It noted that, at its Fifth Meeting, the IUPAC Commission on Pesticide Residue Analysis had also stated that the expression of analytical results on a "fat basis" was not advisable, in view of the difficulties experienced in analysing certain samples.

The Meeting noted that, for most products, pesticide tolerances are expressed on the basis of the whole product as it moves in commerce, and it was agreed that this principle should be adhered to wherever possible. Because residues from certain pesticides that are highly soluble in fat have been shown to be partitioned in such a way that they pass almost completely into the fatty tissue, being distributed evenly throughout the body fat, it is sometimes more convenient and justifiable to express them in terms of the fatty tissue content. This applies to DDT, lindane, dieldrin, and some organophosphorus compounds. In the light of these considerations, the following conclusions were reached.

Meat

It has long been an accepted practice to remove samples of fat from carcasses and to determine and express residue levels in the fat. The measurement of these levels is also a satisfactory means of determining whether approved agricultural and animal husbandry practices have been

violated. Tolerances for residues of highly fat-soluble compounds in cattle, sheep, hogs, poultry, etc., should therefore be expressed in the form "in the fat of meat from ..."

The tolerances and practical residue limits recommended at this and previous meetings for residues in meat were established on the basis of the residue levels in fat in the case of the following pesticides : chlordane, coumaphos, crufomate, DDT, diazinon, dieldrin, dioxathion, ethion, fenchlorfos, fenitrothion, heptachlor, hexachlorobenzene, and lindane. Tolerances for residues of dichlorvos have been established on a whole-meat basis in the absence of any indication of concentration of the residues in the fat.

Milk and milk products

The fat content of milk from different breeds of dairy cattle varies widely, and differences in processing are reflected in the fat contents of cheeses, ice-cream, yoghurt and other milk products as well as of butter, ghee, butter oil, etc. The large number of these products would make it very difficult to specify separate tolerances for each of them. It was therefore agreed that it would be more practicable to recommend tolerances as applied to the fatty portion of milk and milk products. Separate tolerances should therefore not be made for "whole milk"; instead, tolerances should be expressed both for milk and for milk products "on a fat basis" —i.e., the fat content of the sample should be determined and the residue levels expressed as if wholly contained in the extracted fat.

Fish

Pesticide residues in fish result from the inadvertent and adventitious contamination of the environment. Since it is usual and convenient to carry out analyses on the flesh of fish without measuring the fat content, it would be appropriate to express any practical residue limit in terms of levels in the edible portion of the fish.

3. COMPARISON OF ESTIMATED INTAKES OF PESTICIDE RESIDUES AND ACCEPTABLE DAILY INTAKES

3.1 Potential intakes of pesticide residues

For the protection of the health of the consumer, the amount of a pesticide consumed by an individual over a prolonged period of time should not, except under special conditions, exceed the acceptable daily intake, which is established on the basis of relevant toxicological and related data. To assess the possibility that a particular consumer is at risk, it is necessary to

know precisely the exposure to which he is subject from the food he actually consumes. To ascertain this would be a formidable task because of the laborious nature of the analytical studies required and the great number of pesticides involved. The 1968 Joint Meeting (FAO/WHO, 1969a) recommended that a study be initiated to provide estimates of potential daily intakes of pesticides based on the appropriate food consumption data and tolerance figures. In view of the large number of pesticides and food commodities involved and of the wide variation in dietary habits in different parts of the world, it was agreed that this task could best be performed with the help of modern techniques of storing, retrieving and processing data. A study of the type proposed was undertaken by WHO, and the results were presented to the 1969 Joint Meeting (FAO/WHO, 1970a), which noted that the ADIs for certain pesticides were not being exceeded at that time and considered that further work on the reduction of residue levels during storage, processing, or cooking was not essential. It further recommended that, in the case of pesticides for which the ADIs might theoretically be exceeded, information on the disappearance of residues prior to consumption should also be used in future studies to provide more realistic estimates of the intakes. The present Meeting recommended that studies of potential intakes should be continued.

3.2 Consideration of results of total diet studies

The Meeting endorsed the recommendation made to Member Governments at the 1968 Joint Meeting (FAO/WHO, 1969a) that further total diet studies should be carried out, particularly in those countries where such work has not been undertaken so far. It also stressed the need for continued surveillance of pesticide residues by further total diet studies in countries in which such studies have already been carried out.

The Meeting noted with satisfaction that, where measurements have been made, the intakes calculated from total diet studies indicate that the amounts of pesticide residues that actually reach consumers are generally much below the corresponding ADIs. It was apparent, however, that information from total diet studies is at present available for only a small proportion of the pesticides in current use, and only from a very few countries. Furthermore, the results of such studies would lose their validity if there were significant changes in the pattern of pesticide use.

4. EVALUATION OF DATA FOR ACCEPTABLE DAILY INTAKES

4.1 Organochlorine insecticides

Four cyclodiene compounds—dieldrin, endrin, chlordane, and heptachlor—were reconsidered in the light of new data that had recently become available. Although the Meeting noted that the incidence of liver tumours was higher in mice exposed to dieldrin than in controls, it was agreed that this could not be regarded as sufficient evidence to categorize dieldrin as a carcinogen and that there was no need at present to alter the ADI established for dieldrin in 1967. The Meeting noted that there had been an inconclusive report on tumour formation in mice following exposure to endrin, and that the results of similar tests on rats had been negative. Moreover, there was little evidence of storage of endrin in the body tissue. An ADI for endrin was therefore established. Due regard was given to studies of workers engaged in the manufacture of dieldrin and endrin. The Meeting considered new information on the mammalian metabolism of heptachlor and retained the ADI established in 1966. In the case of chlordane, information on the comparative toxicity of the technical compound, the *cis*- and *trans*- isomers, and oxychlordane was reviewed and the ADI established in 1967 was reconfirmed.

The Meeting drew attention to reports of blood dyscrasias resulting from exposure of man to lindane, but, pending the results of further studies, the ADI established for lindane in 1966 was retained.

As the work on DDT initiated by WHO and IARC was still in progress and there was no new information on the subject, the conditional ADI established for DDT in 1969 was not changed (see section 2.14).

4.2 Herbicides and plant growth regulators

The Meeting considered a number of herbicides for the first time. In the absence of any long-term oral studies on 2,4-D, it was not possible to establish an ADI for this compound. In this connexion, the Meeting stressed that a decision not to establish an ADI or temporary ADI for a particular pesticide does not necessarily mean that its safety is in serious doubt. For the establishment of an ADI, certain data, including data from long-term studies in at least one animal species, are normally required. The lack of such data usually precludes the establishment of an ADI for a compound, even though long experience of its use suggests that it presents no hazard for man. The compound 2,4-D is a case in point. This compound has been used for many years without any apparent ill effects in man, and there are also acceptable data indicating that levels of 2,4-D residues in

foodstuffs are minimal, being generally at or below the level of detection (i.e., of the order of 0.01 to 0.1 ppm). There was concern regarding the reported teratogenic and other toxic effects of 2,4,5-T; these may or may not be related to impurities in the technical product. For these reasons and because there had been no long-term oral studies, an ADI for 2,4,5-T was not established.

Two bipyridyl herbicides—diquat and paraquat—were considered. The Meeting was concerned about reports of cataracts in animals exposed to diquat and of the high sensitivity of man to the serious effects of paraquat on the lungs. Information was, however, available on studies in several species and temporary ADIs were therefore established for both compounds. Nevertheless, it was hoped that the serious toxic effects of these compounds would be brought to the attention of appropriate bodies of experts.

Because many of the data on chlormequat, a growth regulator, were not made available to the Meeting, it was not possible to consider the toxicology of this compound.

4.3 Organotin pesticides

A number of organotin pesticides were also considered. Three fentin compounds—two of which had been considered in 1965 under the heading "triphenyltin compounds"—were grouped together because, in plants and animals, they all react in the same way. Although the effect of these compounds on the reticuloendothelial system gave rise to some concern, the Meeting considered that adequate information was available to establish an ADI. A difficulty with the toxicological evaluation of tricyclohexyltin hydroxide, an acaricide, was that laboratory diets containing the compound were apparently unpalatable to the animals fed on them, thus making it difficult to ascertain whether the compound has a primary effect on body growth. A carefully controlled paired feeding study is therefore needed. In addition, there have been reports of liver and pituitary cysts as well as disturbances of the copper balance in experimental animals, following the administration of tricyclohexyltin hydroxide. It was therefore decided to establish only a temporary ADI for this compound.

4.4 Organophosphorus and carbamate insecticides

Two organophosphorus insecticides—dichlorvos and diazinon—were reconsidered. The Meeting noted that extensive work has been carried out on the elucidation of the metabolic pathways of dichlorvos in mammals and on human exposure to this compound, but that a comparison of the metabolic routes followed by dichlorvos after inhalation and after oral intake by man is still needed. The ADI established in 1966 on the basis of the oral no-effect level in man was therefore retained. It was also decided to retain the ADI established for diazinon in 1966.

The Meeting considered that the additional data on carbaryl were insufficient to justify changing the temporary ADI established in 1969.

4.5 Miscellaneous pesticides

Recent data indicate that exposure to the dithiocarbamate mancozeb leads to the formation of the same metabolites in plants as in animals. It was considered that, in the light of the data now available on the metabolism of mancozeb, the proviso attached to the temporary ADI established in 1967, namely, that it was applicable to the parent compound only, could be removed ; but because more data are needed the ADI was still designated as temporary. No information was available on the comparative metabolism of the other dithiocarbamate fungicides previously considered, namely ferbam, maneb, nabam, thiram, zineb, and ziram, and it was therefore agreed that the temporary ADIs for these compounds should continue to be taken as applying to the parent compounds only and to their sum if more than one is used.

The data available on the metabolism of thiabendazole, and the short-term and long-term studies carried out on this fungicide, were considered adequate for the establishment of an ADI.

As regards the pyrethrins, the Meeting noted with concern that the short-term oral studies on a non-rodent mammalian species called for at the 1966 Joint Meeting had not yet been carried out. It decided, however, to retain the temporary ADI established at that Meeting.

5. EVALUATION OF DATA FOR TOLERANCES AND PRACTICAL RESIDUE LIMITS

The Meeting reviewed and, in certain cases, amended recommendations previously made on some pesticides. Some pesticides that had not been previously considered were also reviewed.

5.1 Matters referred to the Joint Meeting by the Codex Committee on Pesticide Residues

The report of the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c) deals with a number of questions concerning the following substances : aldrin and dieldrin, bromide, carbaryl, chlordane, DDT, diazinon, dichlorvos, dicofol, ethion, heptachlor, hydrogen phosphide, lindane, malathion, parathion. The amendments, additions, or clarifications made at this meeting are given in Annex 1 of the present report and in the relevant monographs (FAO/WHO, 1971).

In the absence of any new data, it was not possible to propose a practical residue limit for chlordane in carrots or for DDT in fish, or to propose a tolerance for bromide residues in fruit. The Meeting reviewed available data on the uptake and fate of dichlorvos arising from the use of impregnated strips. To safeguard against excessive exposure, however, recommendations on tolerances were made for meat and meat products. The Meeting reviewed data concerning the use of chlordane in sugar beet, and it was agreed that the residue levels would not be in excess of the practical residue limits previously recommended. The tolerance figures for dicofol and ethion relating to the residues occurring in bulk tea were retained, but the tolerances recommended for "blended only" tea were deleted. The Meeting noted that doubts had been expressed concerning the possible intake of residues resulting from the consumption of uncooked breakfast cereals fumigated with hydrogen phosphide and agreed that the proposed tolerance of 0.01 ppm be retained pending further consideration.

5.2 Pesticides reviewed in the light of new information

The following pesticides were reconsidered in the light of information received since the previous meeting : carbaryl, chlordane, diazinon, dichlorvos, dieldrin, dimethoate, dithiocarbamates, heptachlor, lindane, malathion, mancozeb, and parathion. Certain amendments, additions, or clarifications were made ; these appear in Annex 1 of this report and in the relevant monographs (FAO/WHO, 1971).

In considering the organochlorine compounds, attention was drawn to the problem of residues in plant products resulting in residues in animal products. An indication was given of the level of residues in plant products that, in farm animals consuming these products, would not produce residues in excess of the practical residue limits recommended for organochlorine compounds in animal products.

Wherever it is possible to indicate the probable "half-life" of the pesticide residues occurring in various crops both before and after harvest, such information is given in the monographs (e.g., for dichlorvos and for malathion). This provides a useful additional guide to the residue levels that may be expected when commodities move in international trade and when sampling may be carried out long after harvest.

5.3 Pesticides not previously considered for tolerances or practical residue limits

Tolerances for residues arising from the use of the herbicide diquat as a desiccant before harvest were recommended. For paraquat, the only recommendations were concerned with its use as a desiccant for potatoes

and cotton. With neither compound do pre-emergent uses lead to residues in excess of 0.1 ppm.

Residues from the fentin compounds appear as triphenyltin hydroxide. For many crops these residues fall below the limits of detection, but for others it was possible and necessary to recommend tolerances.

Tricyclohexyltin hydroxide, a non-systemic acaricide, may leave residues on apples and pears, and tolerances were recommended for these fruits. Thiabendazole was considered only as a post-harvest fungicide on citrus fruit and bananas, for which tolerances were recommended.

As no ADIs were established for chlormequat, 2,4-D, or 2,4,5-T, no tolerances were proposed. However, as these compounds have been used as pesticides for many years and are already covered by national tolerances in many countries, it was decided to include in the monographs information on the levels at which residues may be expected to occur after approved use. It was recognized that the current registered uses of both 2,4-D and 2,4,5-T on cereal crops did not give rise to significant residues.

Full details of the recommendations for all the compounds considered are given in the monographs, and Annex 2 contains a summary of the additional information needed.

6. FUTURE WORK

It was suggested that the following items should be considered at future meetings:

1. The compounds in Priority List VI in Appendix IX of the report of the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c) — namely: chlorfenvinphos, chlorphenamidine, fenthion, omethoate, trichloronate, and trichlorphon.

2. Matters referred to the Meeting by the Fifth Session of the Codex Committee on Pesticide Residues (FAO/WHO, 1970c) but not yet dealt with.

3. Endosulfan, for which the temporary tolerances recommended are due to expire in 1971, and the following fumigants: carbon disulfide, carbon tetrachloride, chloropicrin, ethylene dibromide, ethylene dichloride, ethylene oxide, hydrogen phosphide, and methyl bromide.

4. The results of the further studies on the calculation of the potential intakes of pesticides in diets and their relationships with ADIs in accordance with recommendation 2 below, as well as the intake figures derived from total diet studies.

5. "Temporary tolerances" not based on temporary ADIs (see section 2.11), which should be reviewed in 1971 with a view to considering the

removal of the "temporary" classification in cases where this step can be justified.

6. Possible revision of the definitions given in Appendix IV to the report of the 1969 Joint Meeting (FAO/WHO, 1970a).

7. A review of all the organochlorine insecticides (see section 2.7).

7. RECOMMENDATIONS

7.1 Recommendations to FAO and WHO

1. In the interests of public health and agriculture and in accordance with the recommendations of previous Joint Meetings on pesticide residues, it is desirable that further Joint Meetings should be convened annually.

2. The study of the relationship between intake, tolerance, and ADI should continue in the case of pesticides for which—according to the pilot study presented to the 1969 Joint Meeting—the ADIs might theoretically be exceeded (see section 3.1). This study should be extended to additional countries and should also cover the pesticides reviewed in 1969 and 1970. It should take into consideration information now available on the disappearance of residues during storage and processing prior to consumption, as outlined in the monographs. Any information on the percentage of food commodities containing residues should also be taken into account.

3. WHO should consider investigating the significance of hepatoma development in mice for predicting the carcinogenic potential of certain pesticides for man, with special reference to dose-response relationships in hepatoma induction in mice and the possibility of threshold levels of exposure in tumorigenesis.

4. WHO should examine the interpretation to be given to the effects of pesticides on microsomal enzymes and should also study certain related subjects (see sections 2.6 and 2.7).

5. The meeting reiterated the request made at the 1968 and 1969 Joint Meetings that consideration should be given to publishing a single volume containing monographs of all pesticides evaluated up to and including the most recent Joint Meeting.

7.2 General Recommendation

Adequate data, based on observations of the effects of pesticides in man, should be provided whenever feasible. Such data are of primary importance in establishing ADIs and should permit the use of a considerably smaller safety factor than is the case with data obtained from experimental animals.

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Annex 1

INDEX TO DOCUMENTATION AND SUMMARY OF RECOMMENDATIONS CONCERNING ACCEPTABLE DAILY INTAKES, TOLERANCES, AND PRACTICAL RESIDUE LIMITS, AS OF DECEMBER 1970 *

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
acrylonitrile	1965c				
aldrin	1967b, 1968b	0.0001			See also dieldrin.
allethrin	1965b				
arsenic (as calcium or lead arsenate)	1969b				
azinphos-methyl	1969b	0.0025	Apricots, grapes . . . . . 4 [b] Other fruit. . . . . 1 [b] Vegetables . . . . . 0.5 [c]		
BHC (mixture of isomers)	1969b				
binapacryl	1970b	0.0025	Peaches, cherries . . . . . 1 Apples, pears, grapes . . . 0.5 Plums. . . . . 0.3 Nectarines 0.2		

* Further details concerning the recommendations will be found in the original documents referred to in the second column. Explanatory notes are given at the end of this table.

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
bromide (inorganic form, derived from bromine-containing fumigants and other sources)	1969b, 1970b Previously considered under ethylene dibromide or methyl bromide	1	Spices, herbs . . . . . 400 [a] Raw cereals, wholemeal flour . . . . . 50 Dried figs . . . . . 250 [a] Dried raisins, dried dates . 100 [a] Dried peaches . . . . . 50 [a] Dried prunes . . . . . 20 [a] Other dried fruit . . . . . 30 [a] Avocados . . . . . 75 [a] Citrus fruit, strawberries . . 30 [a] Other fresh fruit . . . . . 20 [a]		Tolerance for dried eggs suspended at 1969 Meeting pending review and clarification in 1971. Recommendations relate exclusively to inorganic bromide. Tolerances not recommended for unchanged fumigant. Current work on status of residues in various products to be reviewed in 1971.
calcium arsenate	1969b				
captafol	1970b	0.05 [c]	Peaches . . . . . 15 [c] Cherries (sour) . . . . . 10 [c] Cherries (sweet) . . . . . 2 [c] Tomatoes . . . . . 5 [c] Melons (whole) . . . . . 2 [c] Cucumbers (whole) . . . . 1 [c] Apricots . . . . . 0.5 [c] Plums . . . . . 0.2 [c]		Recommendations relate only to parent substance. Referred to as "difolatan" on p. 18 of FAO/WHO 1969a.
captan	1970b	0.125 [c]	Apples, cherries . . . . . 40 [c] Pears . . . . . 30 [c] Apricots . . . . . 20 [c] Citrus fruit, peaches, plums, rhubarb, tomatoes . . . . . 15 [c] Strawberries, raspberries, cranberries, cucumbers, lettuce, green beans, peppers . . . . . 10 [c] Raisins . . . . . 5 [c]		Monograph in 1965b is obsolete.

carbaryl	1967b, 1968b, 1969b, 1970b, 1971	0.01 [c]	Raspberries, blackberries, boysenberries, peaches, nectarines, asparagus, okra, leafy vegetables (except brassica), nuts (whole), olives (fresh) . . . 10 [c] Citrus fruit, strawberries, blueberries . . . . . 7 [c] Apples, bananas (pulp), grapes, beans, peas (including pod), brassica, tomatoes, peppers, egg-plant, poultry (skin) . . . . 5 [c] ● Poultry (total) (edible portions) . . . . . 0.5 [c] Cucurbits (including melons) . . . . . 3 [c] Rice . . . . . 2.5 [c] Cottonseed (whole), sweet corn (kernels), nuts (shelled), olives (processed), meat of cattle, goats, and sheep . . . . . 1 [c] Potatoes . . . . . 0.2 [c]		Earlier tolerances reviewed at 1969 Meeting in light of Codex comments. Tolerance on whole milk temporarily withdrawn (see monograph).
carbon disulfide	1965c, 1968b, 1970a				
carbon tetrachloride	1965c, 1968b, 1970a				
chlorbenside	1965b	0.01			
chlordane	1968b, 1970b, 1971	0.001	● Potatoes, sweet potatoes, rutabagas, turnips, parsnips, sugar beet, radishes . . . . . 0.3 ● Asparagus, broccoli, Brussels sprouts, cabbage, celery, cauliflower, mustard greens, spinach, Swiss chard, lettuce . . . . 0.2 ● Beans, peas, egg plant, tomatoes, collards (= cole-worts) 0.02	● Milk and milk products (fat basis) . 0.05 ● Fat of meat and poultry . 0.05 ● Eggs (shell free) 0.02	Expressed as the sum of the *cis*- and *trans*- isomers in plant products and as the sum of *cis*- and *trans*-isomers and oxychlordane in animal products. Tolerances apply to residues resulting from soil or seed treatments apart from that for cottonseed oil.

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
chlordane *(continued)*			● Wheat, rye, oats, rice (polished), maize, popcorn, sorghum . . . . . 0.05 ● Cantaloupes, cucumbers, pumpkins, squash, watermelons. . . . . 0.1 ● Almonds, bananas, figs, filberts, guavas, mangoes, olives, passion fruit, papayas, pecans, pomegranates, pineapples, strawberries, walnuts . . . . . 0.1 ● Citrus, pome, and stone fruits . . . . . 0.02 ● Crude soya bean and linseed oils . . . . . 0.5 ● Crude cottonseed oil. . . . 0.1 ● Edible cottonseed oil. . . . 0.02 ● Edible soya bean oil 0.02		
chlorfenson	1965b	0.01			Erroneously omitted from Annex 2 of Ref. 1969a.
chlormequat	1971				
chlorobenzilate	1969b	0.02	Apples, pears (whole fruit). 5 [b] Citrus fruit (whole) . . . . 1 [b] Almonds, walnuts (without shells) . . . . . 0.2 [b] Melons, cantaloupes. . . . 1 [b]		
chloropicrin	1965c				

chloropropylate	1969b	0.01 [b] (see remarks)	Apples, pears, citrus fruit (whole) . . . . . 3 [b] Tomatoes, cantaloupes . . 1 [b]		ADI is temporary; this fact was erroneously omitted from Annex 2 of Ref. 1969a and from Appendix I of Ref. 1970a. See monograph, Ref. 1969b, p. 62.
chlorpropham	1965b				
chlorthion	1965b				
coumaphos	1969b	0.0005 [b]	Eggs (shell-free). . . . . 0.05 [b] Meat (including poultry (on fat basis)) . . . . . 0.5 [b]		To be determined as coumaphos and oxygen analogue and expressed as coumaphos.
crufomate	1969b	0.1	Whole milk . . . . . 0.05 [b] Meat (fat basis) . . . . . 1 [b]		
2, 4—D	1971				
DDT	1967b, 1968b, 1969b, 1970b	0.005 (see remarks)	Apples, pears, peaches, apricots, small fruit (except strawberries), vegetables (except root), meat or poultry (on fat basis) . . . . . 7 Nuts (shelled), strawberries, root vegetables . . . . . 1 Cherries, plums, citrus and tropical fruit. 3.5	Whole milk. 0.05 Milk products (fat basis) . 1.25 Eggs (shell-free) 0.5	ADI is "conditional". Tolerance on fish withdrawn at 1969 Meeting. Limits apply to DDT, DDD and DDE singly or in combination. Tolerances subject to regular review.
demeton	1965b, 1968b	0.0025			
diazinon	1965b, 1967b, 1968b, 1969b, 1971	0.002	Peaches, citrus fruit, cherries. . . . . 0.7 Other fruits . . . . . 0.5 Leafy vegetables. . . . . 0.7 Other vegetables . . . . . 0.5 ● Wheat, barley, rice (polished). . . . . 0.1 ● Almonds, walnuts, filberts, pecans, peanuts (shelled) . 0.5 ● Cottonseed, safflower seed, sunflower seed . . . . . 0.5 ● Sweet corn (kernels and cob with husks removed). . . . 0.7 ● Olives and olive oil . . . . 2 ● Fat of meat of cattle, sheep and hogs 0.7		Residues to be determined and expressed as the parent compound. Residues decline rapidly in level during storage and shipment; the tolerances are based on residues likely to be found at harvest or slaughter (see monograph).

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
dichlofluanid	1970b				
dichlorvos	1967b, 1968b, 1970b, 1971	0.004	● Cocoa beans . . . . . 5 ● Raw grain (wheat, rice, rye, oats, barley, maize, sorghum, etc.) . . . . . 2 ● Milled products from raw grain . . . . . 0.5 ● Coffee beans, soya beans, lentils, peanuts . . . . . 2 Mushrooms . . . . . 0.5 Fresh vegetables (except lettuce) . . . . . 0.5 ● Lettuce . . . . . 1 ● Tomatoes . . . . . 0.5 Fresh fruit (apples, pears, peaches, strawberries, etc.) 0.1 ● Meat of cattle, sheep, goats, pigs, and poultry . . 0.05 ● Eggs (shell-free) . . . . . 0.05 ● Milk (whole) . . . . . 0.02 ● Miscellaneous food items not otherwise specified . . 0.1		Content of dichloroacetaldehyde (DCA) to be reported where possible. The tolerances are based on residues likely to be found at harvest or slaughter. Residues decline rapidly during storage or shipment (see monograph). The tolerance for "miscellaneous food items, not otherwise specified", for example bread, cakes, cheese, cooked meats, etc., is intended to cover residues resulting from usage of dichlorvos for pest control purposes in storage in warehouses, shops, etc. Tolerance recommendations no longer listed as temporary.
dicofol	1969b 1971	0.025	Fruit, hops, vegetables, tea. 5		● Previous distinction between blended and straight tea deleted.
dieldrin	1967b, 1968b, 1969b, 1970b, 1971	0.0001	● Asparagus, broccoli, Brussels sprouts, cabbage, cauliflower, cucumber, eggplant, horseradish, onions, parsnips, peppers, pimentoes, radishes, radish tops 0.1	● Carrots, lettuce, fat of meat . 0.2 ● Milk and milk products (fat basis) . 0.15	Practical residue limit for shell-free eggs is equivalent to 0.25 ppm in egg yolk. Limits apply to aldrin and dieldrin singly or together and expressed as dieldrin. Not now listed as temporary.

dieldrin *(continued)*			Fruit (other than citrus) . . 0.1 Citrus fruit . . . . . 0.05 ● Rice (rough) . . . . . 0.02 ● Potatoes 0.2	Raw cereals (other than rice) . . . . 0.02 Eggs (shell-free) 0.1	
difolatan (see captafol)					
dimethoate	1968b 1971	0.02	Tree fruit (including citrus). 2 Tomatoes and peppers . . 1 Other vegetables 2		Residues to be determined as dimethoate and its oxygen analogue and expressed as dimethoate. Tolerances no longer temporary.
dimethrin	1965b				
dinocap	1970b				
dioxathion	1969b	0.0015	Pome fruit . . . . . 5 [b] Grapes . . . . . 2 [b] Citrus fruit . . . . . 3 [b] Meat, excluding poultry (fat basis) . . . . . 1 [b]		Residues of *cis*- and *trans*-isomers of principal active ingredient to be determined and expressed as sum of both.
diphenyl	1967b, 1968b	0.125	Citrus fruit 110		
diphenylamine	1970b	0.025	Apples 10		
diquat (cation)	1971	0.002 [d]	Rice (in husk) . . . . . 5 [d] Rape seed, sorghum. . . . 2 [d] Peas, beans, sunflower seed . . . . . 0.1 [d] Onions, potatoes, maize, rice (polished). . . . . 0.1 [d] Edible oils (sesame seed, sunflower seed, rape seed, cottonseed) . . . . . 0.1 [d]		
dithiocarbamates, dimethyl (ferbam, thiram, and ziram)	1965b, 1968b, 1971	0.025 [b]			ADI applies to parent compound or to sum of residues of all compounds present.
dithiocarbamates, ethylene bis (mancozeb, maneb, and zineb, including zineb derived from nabam plus zinc sulfate)	1965b, 1968b, 1971	0.025 [b]			ADI applies to parent compound or to sum of residues of all compounds present (see mancozeb).

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
DNOC	1965b				
endosulfan	1968b, 1969b	0.0075	Fruit, vegetables . . . . . 2 [a]		To be measured and reported as total endosulfan A and B and endosulfan sulfate.
endrin	1965b, 1971	0.0002	Cottonseed, cottonseed oil (crude) . . . . . 0.1 Edible cottonseed and maize oil . . . . . 0.02 Apples, wheat, barley, sorghum, rice (husked and/or polished) 0.02	Milk and milk products (fat basis) . 0.02 Fat of poultry . . . 1 Eggs (shell-free) 0.2	All recommendations are total figures for endrin plus delta-keto-endrin.
ethion	1969b, 1970b	0.00125	Grapes . . . . . 2 [b] Other fruit. . . . . 1 [b] Vegetables . . . . . 0.5 [b] Tea . . . . . 7 [b] Meat (fat basis) . . . . . 2.5 [b]		The proviso "at slaughter" made for meat at 1968 Meeting withdrawn. Distinction between blended and straight tea withdrawn.
ethoxyquin	1970	0.06	Apples, pears 3		ADI and tolerances erroneously designated as temporary in Appendix I of Ref. 1970a.
ethylene dibromide	1967b, 1968b, 1970a				Analytical method should differentiate between original compound and inorganic bromine. New data on residues in foods to be included in 1971 review (see entry for bromide).

ethylene dichloride	1965c, 1968b, 1970a				
ethylene oxide	1965c, 1969b 1970a				
fenchlorfos	1969b	0.01	Whole milk . . . . . 0.04 [b] Egg yolk. . . . . 0.05 [b] Meat (fat basis) . . . . . 7.5 [b]		Residues of fenchlorfos and oxygen analogues to be determined and expressed as fenchlorfos.
fentin compounds	1971	0.0005	Celery. . . . see remarks 1 Sugarbeet, carrots . . . see remarks 0.2 Potatoes, celeriac . . . see remarks 0.1 Peanuts (shelled) 0.05		Triphenyl tin considered in FAO/WHO 1965b. Tolerances on root crops expressed on "soil free" basis. Tolerances to refer to the total amount of fentin compounds present, expressed as fentin hydroxide. (Inorganic tin is not included in these tolerances.)
ferbam	1965b, 1968b	0.025 [a]			See dithiocarbamates.
fenitrothion	1970b	0.001 [c]	Apples, cherries, grapes, lettuce . . . . . 0.5 [c] Red cabbage, tea (green at harvest) . . . . . 0.3 [c] Tomatoes . . . . . 0.2 [c] Cocoa. . . . . 0.1 [c]	Milk products (fat basis) . 0.05 [c] Meat or fat of meat . . 0.03 [c] Milk (whole) 0.002 [c]	
folpet	1970b	0.16 [c]	Currants (fresh) . . . . . 30 [c] Grapes, blueberries . . . . 25 [c] Cherries, raspberries . . . 15 [c] Apples, citrus fruit . . . . 10 [c] Tomatoes, strawberries . . 5 [c] Cucumber, cantaloupe (whole), water melon (whole), onions . . . . . 2 [c]		Recommendations apply only to parent compound.
formothion	1970b		Strawberries. . . . . 0.3 Black currants. 2		Residues present as dimethoate to be covered by recommendations for dimethoate.

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
heptachlor	1967b, 1968b, 1969b, 1970b, 1971	0.0005	● Pineapple (edible portions). 0.01	● Milk and milk products (fat basis) . 0.15 ● Fat of meat and poultry. 0.2 ● Raw cereals, tomatoes, cottonseed, soya beans, edible soya bean oil . . . . . 0.02 ● Vegetables (except where otherwise specified), eggs (shell-free) . 0.05 ● Carrots . . 0.2 ● Crude soya bean oil . . 0.5 ● Citrus fruit . 0.01	Residues of heptachlor and its epoxide to be determined separately and the sum to be expressed as heptachlor. Practical residue limits apply to residues resulting from applications to soil or seed only. Recommendations no longer listed as temporary.
hexachlorobenzene	1970b	(see remarks)		Fat of cattle, sheep, goats, and poultry. 1 [c] Eggs (shell-free) . . . . 1 [c]	Tentative negligible daily intake of 0.0006 mg/kg established. (To be reviewed in 1973. See monograph.)

hexachlorobenzene *(continued)*				Milk products . . 0.3 [c] Raw wheat . 0.05 [c] Cereal products (from wheat), milk (whole) . . 0.01 [c]		
hydrogen cyanide	1965c, 1969b	0.05	Raw cereals . . . . . 75 Flour 6			
hydrogen phosphide	1967b, 1968b, 1970b	Not necessary (see remarks)	Flour and other milled cereal products, breakfast cereals, dried vegetables, spices . . 0.01 Raw cereals 0.1			"Only items to be cooked" deleted at 1969 meeting. Subject to restrictions in use (FAO/WHO, 1968, p. 17), residues not detectable at time of consumption.
lead (as lead arsenate)	1969b					
lindane	1967b, 1968b, 1969b, 1971	0.0125	Raw cereals . . . . . 0.5 Vegetables . . . . . 3 Cranberries, cherries, grapes, plums, and strawberries . . . . . 3 Fat of meat (cattle, pigs, sheep) . . . . . 2 Beans (dried) 1	Eggs (yolk) . 0.2 Milk and milk products (fat basis) . . . 0.1 Poultry (fat basis) . . . 0.7		Referred to as "gamma" BHC prior to 1967.
malathion	1967b, 1968b, 1969b, 1971	0.02	Raw cereals, nuts, dried fruits . . . . . 8 Whole meal and flour from rye and wheat . . . . . 2 Citrus fruit . . . . . 4 Blackberries, raspberries, lettuce, endive, cabbage, spinach . . . . . 8 Cherries, peaches, plums . 6 Broccoli . . . . . 5 Tomatoes, kale, turnips . . 3 Beans (green), apples . . . 2 Strawberries, celery . . . . 1 Pears, blueberries, peas (in pod), cauliflower, peppers, eggplant, kohlrabi, roots (except turnips), Swiss chard, collards 0.5			The tolerances are based on residues likely to be found at harvest. Residues decline rapidly during storage or shipment (see monograph).

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	Practical residue limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
mancozeb	1968b, 1971	0.025 [b]	● Potatoes . . . . . 1 [b]		Temporary tolerance applies to parent compound or to sum of all dithiocarbamates present.
maneb	1965b, 1968b	0.025 [a]			See dithiocarbamates.
methoxychlor	1965b	0.1			
methyl bromide	1967b, 1968b				See entry under "bromide (inorganic)" for recommendations pertaining to inorganic bromide residues from methyl bromide.
mevinphos	1965b				
MGK 264	1968b				
nabam	1965b, 1968b	0.025 [a]			See entries for "dithiocarbamates" and "zineb".
organomercurial compounds	1967b, 1968b			1968b page 208 suggests possible figures	FAO/WHO, 1967b monograph is entitled "phenylmercury acetate".
orthophenylphenol (see 2-phenylphenol)					
oxydemeton-methyl	1968b, 1969b	Withdrawn at Joint Meeting in 1968 (Ref. 1969b)			Previous to 1968b referred to as demeton-S-methylsulfoxide.
oxythioquinox	1969b				(Renamed quinomethionate.)
paraquat (cation)	1971	0.0007 [a]	Cottonseed . . . . . 0.2 [a] Potatoes . . . . . 0.1 [a] Cottonseed meal, cottonseed oil (edible), sugar cane juice . . . . . 0.05 [a]		

parathion	1965b, 1968b, 1970b, 1971	0.005	Vegetables (except carrots) 0.7 Peaches, apricots, citrus fruit 1 Other fresh fruit 0.5	Reexamination of data at 1969 Meeting showed that tolerance recommendations for two groups of fruit had been recorded wrongly in previous reports. ● Recommendations no longer temporary.
parathion-methyl	1969b	0.001 [b]	Fruit, cole crops, cucurbits . . . . . 0.2 [b] Other vegetables . . . . . 1 [b] Cottonseed oil . . . . . 0.05 [b]	
phenyl mercury acetate				(See organomercurial compounds.)
2-phenylphenol (and sodium salt)		1	Cantaloupes (whole). . . . 120 Pears . . . . . 25 Carrots, peaches . . . . . 20 Sweet potatoes, apples, plums (including fresh prunes) . . . . . 15 Citrus fruit, cucumbers, peppers, cantaloupes (edible portions), pineapple, tomatoes . . . . . 10 Cherries, nectarines 3	Residues expressed as 2-phenylphenol. Referred to as orthophenylphenol on p. 18 of FAO/WHO 1969a.
phosphamidon	1965b, 1967b, 1969b	0.001	Raw cereals . . . . . 0.1 [b] Apples, pears . . . . . 0.5 [b] Citrus fruit . . . . . 0.4 [b] Other fruit, cole crops . . . 0.2 [b] Tomatoes, lettuce, cucumbers, water-melons . 0.1 [b] Other vegetables (except root vegetables, for which a tolerance is not required) . 0.2 [b]	Residues to be determined by cholinesterase inhibition and results expressed as phosphamidon. Entry for "other vegetables" erroneously omitted from tables in reports on 1968 and 1969 meetings.
phosphine				(See hydrogen phosphide.)
piperonyl butoxide	1967b, 1968b, 1970b	0.03 [b]	Raw cereals . . . . . 20 [b] Fresh fruit and vegetables, dried fruit and vegetables, oil-seeds, tree nuts . . . . 8 [b] Dried codfish . . . . . 1 [b]	Only data for codfish examined at 1969 Meeting.

Annex 1 *(continued)*

Pesticide	FAO/WHO publication dates (see list of references on page 21) [1]	Maximum acceptable daily intake (mg/kg body weight)	Tolerances (ppm) [2]	limits (ppm) [2]	Remarks
		Blank spaces indicate no recommendations made			
propham	1965b				
pyrethrins	1967b, 1968b, 1970b	0.04 [b]	Raw cereals . . . . . 3 [b] Fresh fruit and vegetables, dried fruit and vegetables, oil-seeds, tree nuts . . . . 1 [b] Dried codfish . . . . . 0.1 [b]		Only data for codfish examined at 1969 Meeting.
quinomethionate	1969b				Listed in 1969b as oxythioquinox, subsequently renamed.
quintozene	1970b	0.001 [c]	Mushrooms . . . . . 10 [c] Peanuts (whole) . . . . . 5 [c] Bananas (whole) . . . . . 1 [c] Lettuce, peanuts (kernels) . 0.3 [c] Beans (navy), potatoes. . . 0.2 [c] Tomatoes . . . . . 0.1 [c] Cottonseed . . . . . 0.03 [c] Broccoli, cabbage . . . . . 0.02 [c] Bananas (pulp), beans (other than navy), peppers (bell) . . . . . 0.01 [c]		
2,4,5—T	1971				
thiabendazole	1971	0.05	Citrus fruit . . . . . 6 Bananas . . . . . 3 Bananas (pulp) 0.4		
thiometon	1970b				

thiram	1965b, 1968b	0.025[a]			See dithiocarbamates.
toxaphene	1969b				
trichloroethylene	1969b				1969 Meeting decided not necessary to continue to study this compound.
tricyclohexyltin hydroxide	1971	0.0075[d]	Apples, pears . . . . . 2[d]		Expressed as the parent compound.
triphenyltin	1965b				Also see fentin compounds.
zineb	1965b, 1968b				(Including zineb derived from nabam plus zinc sulfate.) See dithiocarbamates.
ziram	1965b, 1968b	0.025[a]			See dithiocarbamates.

[1] The dates of publication refer to the first complete or completely revised monograph. Where more than one date is given, later dates refer to addenda to the monograph in the first reference. Where a monograph has been completely revised no mention is made of any earlier obsolete ones. Where the only date given is 1971, the compound was considered at the 1970 Joint Meeting for the first time.

[2] Unless otherwise indicated, the tolerances and practical residue limits should apply as soon as practicable after harvest to the raw agricultural products moving in commerce and prior to processing. For commodities entering international trade the tolerances are applicable at the point of entry into a country or as soon as practicable thereafter.

● Indicates additions or modifications made by the 1970 Joint Meeting concerning compounds considered at previous meetings.

[a] Temporary: results of work to be made available not later than 30 June 1971.
[b] Temporary: results of work to be made available not later than 30 June 1972.
[c] Temporary: results of work to be made available not later than 30 June 1973.
[d] Temporary: results of work to be made available not later than 30 June 1974.

Annex 2

FURTHER WORK OR INFORMATION REQUIRED (OR DESIRABLE)

If a compound has been considered at earlier meetings the requirements listed below replace those stated in earlier reports except where the name of the compound is marked with an asterisk, in which case the requirements previously stated are still valid.

CARBARYL *

Desirable

Further data on the nature and level of residues in whole milk and milk products.

CHLORDANE

Required before 30 June 1972

Further information on chlordane residues in carrots following soil and seed treatments or resulting from crop rotation on soils treated with chlordane in previous years.

Desirable

1. An adequate carcinogenicity study in a second species of animal.
2. Results of the investigation of the hydrolytic plant metabolites of chlordane.

CHLORMEQUAT

Required (before an acceptable daily intake for man can be established)

Full reports on the biochemical and toxicological studies conducted on chlormequat.

Desirable

1. Information on other registered uses for chlormequat.
2. Further information on residues in new agricultural commodities from a number of additional countries.
3. Information on the effect of milling and preparation on the level of residues in grain products.
4. Information on chlormequat residues in commodities moving in international trade.

5. Analytical methods capable of recovering and determining chlormequat residues in plant and animal products at levels down to at least 0.1 ppm, to be established for regulatory purposes.

2,4-D

Required (before an acceptable daily intake for man can be established)

1. An adequate long-term oral study in a rodent species and a study lasting at least two years in a non-rodent mammalian species.

2. A three-generation reproduction study in at least one mammalian species.

3. Information on the nature of the impurities occurring in commercial preparations of 2,4-D.

Desirable

1. Further information on the metabolism of 2,4-D in plants, laboratory animals, and man.

2. Elucidation of the problem of increased nitrate formation in plants treated with 2,4-D to determine if this phenomenon could create a toxic hazard to man.

3. Information on the occurrence of 2,4-D residues in crops other than cereals.

DIAZINON *

Desirable

1. Reproduction studies in one rodent and one non-rodent species.

2. Toxicological information on residual anticholinesterase metabolites of diazinon in plants.

DICHLORVOS *

Desirable

1. Continued observation of the effects of repeated exposure of man to dichlorvos in order to determine whether there are any qualitative or quantitative differences between the metabolic routes after oral intake and after inhalation.

2. Data from additional countries on residues in commodities moving in international trade.

3. Establishment, for regulatory purposes, of analytical methods capable of recovering and determining dichlorvos residues in foods.

DIELDRIN *

Desirable

1. Further information relevant to the assessment of the significance of the changes that occur in the livers of mice exposed to dieldrin. A comparison of the response to dieldrin of high and low spontaneous liver-tumour mouse strains in respect of liver tumour incidence and the metabolism of dieldrin might be helpful in this respect.

2. The continued collection of follow-up information on persons exposed occupationally during the manufacture of dieldrin.

3. Completion of the studies being conducted on the comparative metabolism of dieldrin in man, monkey, rat, and mouse.

4. Experimental studies to determine whether dieldrin might have teratogenic potential.

5. A continuing study of the possible occurrence of residues of photodieldrin in food surveys and total diet studies.

DIQUAT

Required before June 1973

1. Further studies on the mechanism of cataractogenesis in animals.

2. A three-generation reproduction study involving exposure to diquat during the entire duration of the experiment.

Desirable

Clinical studies on factory workers and users of diquat in order to determine the risk of cataract from contact with these compounds.

DITHIOCARBAMATES
(apart from mancozeb)

Required by June 1973

1. Elucidation of the effect on the reticulo-endothelial and haematopoietic systems.

2. Further clarification of the possible carcinogenic effect of these compounds.

3. Elucidation of the effect on reproductive physiology.

4. Elucidation of the effect on thyroid function.

Required (before tolerances can be recommended)

Studies on the biotransformation of the compound in plants to determine the chemical nature of residues, and appropriate toxicological studies on these residues.

ENDRIN

Desirable

1. An adequate long-term study in a strain of mice of known tumour susceptibility.

FENTIN COMPOUNDS

Required by 30 June 1972

1. Reliable analytical methods capable of distinguishing qualitatively between fentin compounds and tricyclohexyltin hydroxide or other organotin compounds and, where possible, of quantitative measurement of the separate compounds.
2. Data on the occurrence of monophenyltin and diphenyltin compounds in the residues in celery.

Desirable

1. More information on the effect of fentin compounds on the reticuloendothelial system, especially with respect to the reversibility of this effect.
2. Reports of toxicological observations in plant workers involved in the manufacture of these compounds.
3. Further studies on the effect on spermatogenesis.

HEPTACHLOR *

Desirable

An adequate carcinogenicity study in a second species of animal.

LINDANE

Desirable

1. Results of the two-year dog study and three-generation rat reproduction study currently in progress.
2. An adequate carcinogenicity study in a mammalian species.
3. Observations on the incidence of blood dyscrasias in man that can be related to quantitative exposure data and to verifiable effects.

4. Further data on the required rates and frequencies of application, pre-harvest intervals, and the resultant residues.

5. Further information on the nature of the residues occurring in plants, animals, and their products.

6. Further information on the necessity of applying lindane direct to animals, together with further data on the residues resulting from such applications.

7. Further data, from supervised trials, on residues in food resulting from treatments of storage bins and ships' holds, and other types of storage or conveyance space treatment.

MANCOZEB

Required by June 1973 [1]

1. Elucidation of the effect on the reticuloendothelial and haematopoietic systems.

2. Further clarification of the possible carcinogenic effect of these compounds.

3. Elucidation of the effect on thyroid function.

Required (before further tolerances can be recommended) [1]

Further studies on the biotransformation of the compound in plants to determine the chemical nature of the residues, followed by appropriate toxicological studies. The extensive residue data already submitted need to be validated by the diethylamine method and by measuring the level of ethylene thiourea.

PARAQUAT

Required before June 1973

1. Detailed comparative toxicity and metabolism studies in order to elucidate the reason for the comparatively high sensitivity of man to this compound.

2. Additional reproduction studies on at least one species.

3. Examination in several species of the toxic effects of metabolites formed by the action of the gut flora.

Desirable

Long-term oral studies on additional species.

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[1] Some of the data required or considered desirable are known to be already available, although they were not submitted in time for detailed scrutiny by the Meeting.

PARATHION *

Required (before tolerance recommendations can be made for the products concerned)

1. Data on residues resulting from the pre-harvest treatment of cereals and on the fate of parathion during the storage and processing of such cereals.

2. Data on residues in cottonseed oil and cottonseed cake.

PYRETHRINS *

Required before June 1972

1. Short-term toxicity studies in several species, including a non-rodent mammalian species, with special emphasis on the effects on the liver and a detailed study of the mammalian metabolism of pyrethrins.

Desirable

Further studies to determine if toxicity of pyrethrins in mammals is increased when they are used along with synergists, especially with the methylenedioxy compounds such as piperonyl butoxide.

2,4,5-T

Required (before an acceptable daily intake for man can be established)

1. An adequate long-term oral study in order to establish a no-effect level using (i) a commercially available material, (ii) the purest available 2,4,5-T, and (iii) 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.

2. Studies on reproduction and teratogenicity with 2,4,5-T using (i) a commercially available material, (ii) the purest available 2,4,5-T and (iii) 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.

Desirable

Information on the availability of acceptable methods for the detection and determination of chlorinated dibenzodioxin impurities in technical 2,4,5-T and its formulations at the 0.01-0.05 ppm level. Current attempts to standardize the specifications of 2,4,5-T products with regard to their content of chlorinated dibenzodioxin compounds should be continued and encouraged.

THIABENDAZOLE

Desirable

Studies to determine the effect of thiabendazole on the thyroid gland.

TRICYCLOHEXYLTIN HYDROXIDE

Required by June 1973

1. Further studies on the effects of exposure to tricyclohexyltin hydroxide on copper balance and, in particular, on the copper content of the liver.

2. Further information on the occurrence of liver and pituitary gland cysts in female rats fed the compound.

3. Further information on the effect of the compound on the rate of body-weight gain after allowing for the unpalatability of test diets.

4. Further information on the significance of the brown discoloration of the serosal surface of the intestine of treated animals.

5. Establishment of analytical procedures capable of distinguishing qualititatively between tricyclohexyltin compounds and other organotin compounds, particularly the fentin compounds, and, where possible, of quantitative measurement of the separate compounds.

Desirable

Data residues of tricyclohexyltin hydroxide on apples and pears moving in international commerce.