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1. In the developed countries, particularly in North America, Western Europe and Japan, pesticides have come to play an extremely important if not irreplaceable role in the maintenance of high agricultural productivity levels.

2. Although availability is one factor which has led to the increased use of pesticides in the developed countries, possibly a more important factor has been the relatively high costs of other associated inputs such as labor, mechanisation and land values. Under these conditions, the cost of the pesticide input probably amounts to no more than 5 per cent of the costs of all inputs and the benefits resulting from the use of pesticides far outweigh their costs.

3. In developing countries on the other hand, virtually all pesticides have to be purchased from abroad at the expense of limited foreign exchange credits. Furthermore, the cost of other related inputs such as labor and land values are relatively low. Under these conditions the cost of the pesticide input, relative to other inputs, may reach as high as 40 per cent.

4. Thus, great care must be taken in developing countries to select those pesticides which will produce the most economic returns and this paper will attempt to outline the various factors which must be considered in deciding which pesticides and formulations can be used. For the purposes of the discussion the factors will be grouped under the following main headings:

Technical
Economic
Legislative

TECHNICAL FACTORS

Crops and associated pest complexes

5. Although many major crops are grown in a relatively large number of countries their associated pest complexes are highly variable. For example, in the case of 32 major cotton-producing countries, boll weevils are present and are major economic pests in only five (USA, Mexico, Colombia, Peru and Nicaragua) whereas bollworms of one species or another are major economic pests in all except the USSR where they are not reported to occur, and Greece, Argentina and Peru, where they are not of major economic importance. On the other hand, there is not a single cotton pest of major economic importance in Greece, the USSR, and Burma, whereas the USA and India share the dubious distinction of having seven, closely followed by Mexico, Brazil, Turkey, Burundi and Rhodesia which each have six (CIBA-GEIGY, 1972). Under these conditions, therefore, the types of pesticides required in one cotton-producing country will be quite different from the types of pesticides required in another cotton-producing country and the same can be said for virtually all crops. Accordingly, one of the first factors which must be defined is the pest complex attacking each major crop. In this context, it is doubtful that there would be any truly significant requirement for additional types of pesticides generated by the requirement to control the pest complexes attacking minor crops.

Spectrum of effectiveness

6. Certain pesticides have a very broad spectrum of effectiveness and can be used to control a wide variety of pests attacking many different crops whereas other pesticides are effective against

only a very [illegible] pests. [illegible] is registered to control more than 100 different [illegible] against a wide variety [illegible] pests including aphids, mites, [illegible] insects, [illegible], moths, leaf hoppers, leaf miners, etc., etc. [illegible] the other hand, schradan, a systemic insecticide, is used primarily for the control of aphids, mites and leaf hoppers on a limited number of crops such as apples, alfalfa, maize, citrus, sugar beets, etc. (Thomson, 1970). At first glance, therefore, it would appear that the pesticides with the broadest possible spectrum of effectiveness should be chosen, particularly for use in developing countries interested in reducing the total number of imported pesticides to a minimum and thereby simplifying regulatory actions and procedures. But other factors also must be taken into consideration, such as effects on non-target organisms as well as persistence, relative cost and acute toxicity, as will be discussed below.

__Persistence__

7. In considering this factor, pesticides can be classified into non-persistent, moderately persistent, persistent and permanent as indicated below: (Ling, Whittemore and Turtle, 1972):

	Duration of activity	[illegible]	[illegible]
Non-persistent	1-12 weeks	Organo-phosphorous compounds Carbamates	Malathion, methyl parathion, parathion, carbaryl
Moderately persistent	1-18 months		2,4-D, atrazine
Persistent	2-5 years	Organochlorine[1/] compounds	DDT, BHC, lindane, aldrin, dieldrin, endrin, chlordane, heptachlor, camphaclor
Permanent (residues)	Degraded to permanent residue	Compounds containing mercury, arsenic or lead	phenyl mercury acetate, arsenate of lead

The overlaps and gaps in the table simply illustrate the difficulties in classifying pesticides in this way.

6. This characteristic of pesticides must be considered in the light of the pests to be controlled. Ideally, a pesticide should persist only long enough to provide protection from pest or disease attack and then completely disappear. However, no such pesticide is available and a compromise must be reached, based upon the specific pest or disease problem to be controlled.

1/ A number of organochlorine compounds are in the "non-persistent" or "moderately persistent" classifications, e.g. methoxychlor, dicofol, chlorobenzilate.

9. For example, in the case of [illegible] sub-t[illegible] [illegible] poison which persisted for [illegible] of years should be [illegible] (e.g. dieldrin), whereas in the case of codling moth, where only 1 generation per year and a partial second generation occur, a short-life pesticide having a persistence of a matter of 4 to 12 weeks (e.g. malathion), would provide the necessary protection which could be obtained by 2 judiciously applied applications.

__Previous use patterns__

10. In deciding upon current and projected requirements for particular pesticides, previous use patterns play a very important role because such information provides the basis for estimating how long a particular pesticide might be used in the future. Indeed, it has become almost axiomatic that the speed of development of resistance of pests to a pesticide is directly related _inter alia_ to the extent and intensity of use of the pesticide. Thus, a pesticide which is widely and extensively used can probably not be depended upon to provide satisfactory protection in all instances for more than 3 to 5 years and indeed, control failures may be encountered in much shorter periods of time (NAS/NRC, 1951). A pesticide which is used in limited amounts against a few pests, on the other hand, might be useful for an appreciably longer period.

[illegible]

11. A [illegible] patterns [illegible] resistance. Pest resistance to pesticides has now become wide spread, particularly in the developed countries and in some of the developing countries where pesticides have been heavily used for some years on cash crops, e.g., cotton in Central America. And the resistance problem is further complicated by what has come to be called "cross" and "multiple" resistance. The following statement is extracted from the Report of the First Session of the FAO Working Party of Experts on Pest Resistance to Pesticides (FAO, 1967):

> " Cross-resistance is the phenomenon whereby an insect population becomes resistant to two or more chemically distinct insecticides as a result of selection by one insecticide only. It must not be confused with multiple resistance which is readily induced in some species by simultaneous or successive exposure to two or more insecticides. The fundamental and practical implications of cross-resistance have been critically discussed by Winteringham and Hewlett (1964). It is possible to recognise certain patterns of cross-resistance which have important implications for pest control programmes. For this purpose insecticides can be grouped as follows:
>
> I. DDT and its 1,2-hydrochloro-analogues
> II. Non-dehydrohalogenatable DDT analogues (e.g. Prolan, Bulan)
> III. -BHC, dieldrin, chlordane, etc.
> IV. O-Methyl organophosphates.

V. [illegible]

VI. [illegible]

VII. Miscellaneous individual carbamates.

VIII. Pyrethroids.

IX. Groups I, and IV to VIII + suitable synergists.

X. Miscellaneous organic compounds.

XI. Miscellaneous inorganic compounds, inert dusts.

Generally speaking, but by no means invariably, the development of resistance to one member of the group involves significant cross-resistance to other members of that group thus vitiating their value as alternatives. The value of members of other groups is usually unimpaired but the development of resistance to any compound often involves a low level of cross-resistance (sometimes misleadingly called "vigour tolerance") to members of other groups, and this may predispose the population to the rapid development of resistance on their introduction for control. Fortunately, in the organo-phosphate and carbamate groups, high resistance to one compound does not usually extend to more than a few chemically related analogues. Thus, resistance of the rice-stem borer to parathion (Group V) did not extend to its methyl analogue (Group IV). There is some evidence that resistance to certain members of groups VI, VII and VIII may involve high cross-resistance to groups I and/or III."

Under these conditions, therefore, it is essential that data on the current susceptibility of major agricultural pests to pesticides is available if informed estimates relating to future pesticide requirements are to be made. As the result of the activities of the FAO Working Party mentioned above, the general principles [illegible] for the laboratory [illegible] been published in the [illegible] [illegible] a,b,c). Other methods are [illegible]

12. A point which is frequently overlooked however, is the fact that non-target species must of necessity also develop resistance to pesticides. The mere fact that man has chosen to designate one insect as a "pest" and another as a "non-pest" does not in turn mean that only the <u>pest</u> species will develop resistance. Such a line of reasoning is just as fallacious as the line of reasoning, often heard some years ago, that we should seek a pesticide to which pests would not become resistant. Although entirely too little is known concerning the development of resistance in non-target species, some positive evidence is already available particularly in respect to honey bees (FAO, 1969 4).

<u>Cropping patterns</u>

13. In many of the developing countries certain cash crops are grown on a "plantation" basis, e.g., rubber, tea, coffee, cotton, whereas other crops are now grown essentially as monocultures of one or a small number of improved high yielding varieties, e.g. rice, maize and wheat. Under these latter conditions, an integrated package of inputs has been developed and is used under adequate technical supervision. Hence more costly and sometimes more acutely toxic plant protection chemicals can be safely and effectively used e.g. parathion.

14. In other areas, where major crops are grown on scattered individual land holdings, adequate technical supervision becomes difficult, if not impossible, and only the less costly and less acutely toxic compounds can be safely made available for use by individual farmers e.g. DDT.

15. Still another aspect of the cropping pattern is that of crop rotation. Certain of the more persistent pesticides which are widely used on cotton e.g. dieldrin, will tend to build up soil residues which in turn will produce unacceptable contamination in root crops, such as carrots. Accordingly, consideration must also be given to current and projected crop rotation programmes to ensure that pesticide residues resulting from the protection of one crop do not produce unacceptable residues in other crops grown in the same crop rotation patterns.

16. Finally, particularly where a variety of crops are grown on small individual holdings, the factor of spray "drift" cannot be overlooked, which can sometimes cause inadvertent and unacceptable contamination of crops grown in neighbouring fields.

Side effects on pest parasites and predators and upon beneficial insects

17. When the synthetic organic pesticides were first introduced, little attention was paid to their possible effects on pest parasites and predators and although greatly increased yields were obtained in the first years following their introduction, in some instances the yields soon began to decrease and revert to their

previous levels. Further, in some other instances, because of the development of a high degree of resistance and repeated applications of broad-spectrum insecticides, control became impossible and certain areas went out of production of a particular crop.

1[illegible]. The situation with respect to cotton has been succinctly described by Doutt and Smith (Huffaker, 1971), in which the pattern of cotton production may go through a series of five phases, as follows:

a. <u>Subsistance phase</u> - yields of less than 200 kg/hectare, minimal use of chemical pesticides. Crop protection, such as it is, results from natural control, inherent plant resistance, hand picking, cultural practices, rare pest treatments and luck!

b. <u>Exploitation phase</u> - Cotton is often one of the first crops planted in newly irrigated areas and crop protection measures are introduced to protect these larger and more valuable crops. In most instances these measures depend solely upon application of chemical pesticides on fixed schedules which result at first, in higher yields of seed and lint.

c. <u>Crisis phase</u> - After a variable number of years, pest resistance starts to develop and is accompanied by more frequent and heavier applications of pesticides followed by rapid pest resurgence. Resistance becomes so high that alternative pesticides are used and resistance again develops, but even more rapidly. Secondary pests are unleashed because their parasites and predators have been killed off. This situation leads to still more use of chemical pesticides and increased production costs.

d. Disaster phase - Cost of chemical pesticides and their application rise so high that the crop becomes unprofitable, with marginal land and marginal farmers being the first to be forced out of production.

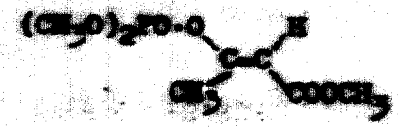
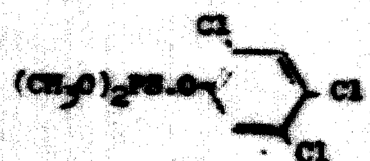
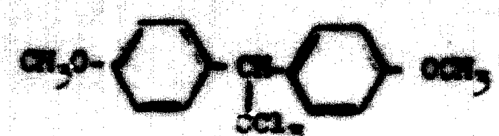
e. Recovery phase - A crop protection system is employed comprising a variety of control procedures. Attempts are made to modify environmental factors and fullest use is made of biological control and natural mortality.

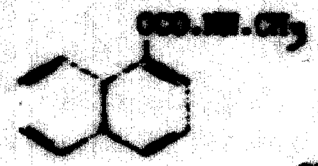
Accordingly, in planning future pesticide requirements, consideration must be given to those pesticides which are most suitable for use in integrated pest control programmes if the five phases described above are to be avoided.

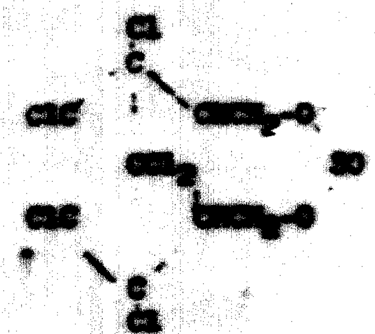
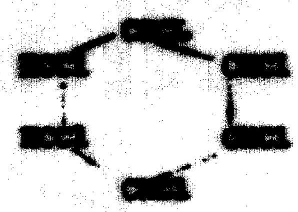
19. In this context, Metcalf in a lecture at the 14th International Congress of Entomology in Canberra in 1972 (referred to by Gasser, 1972) divides the most important pesticides on the market into three categories from the viewpoint of pest management:

Category I:	Desirable because very well suited for integrated control, and also readily degradable.
Category II	Somewhat less favourable, but still to be recommended.
Category III:	Recommended only under special circumstances.

All categories are, of course, subject to the restriction that allowance must be made for any resistance. Besides DDT, the following are not recommended: Heptachlor, Dieldrin, Aldrin, Endrin. However, as yet there is no classification for the products not listed.

Cat.	Common Names (Brands)	Chem. Formula	Toxs mg/kg rats	Special properties (Inventing Company)
I	Mevinphos (Phosdrin)		3,7 - 12	Short-term insecticide (Shell)
I	Phorate (Thimet)	$(C_2H_5O)_2PS \cdot SCH_2SC_2H_5$	2,5 - 6,2	Systemic, against sucking insects, granulate or treatment of seed (American Cyanamid Comp.)
I	Disulfoton (Disyston)	$(C_2H_5O)_2PS.SCH_2CH_2SC_2H_5$	2,6 - 12,5	Systemic, against sucking insects, for treatment of seed (BAYER)
I	Phoxim (Baythion)		>2000	Leaf- and soil insecticide, hygiene and stock protection. Not systemic (BAYER)
I	Fenchlorphos (Nankor, Trolene, Korlane, Ronnel)		1740	Systemic insecticide, residual spray and bait against flies and ectoparasites.
I	Methoxychlor		5000	Contact- and stomach action, inferior to DDT (GEIGY, DUPONT)
I	Cryolite	Na_3AlF_6	13500	Stomach and contact insecticide

Cat.	Common Name (Brands)	Chem. Formula	Tox. mg/kg rats	Special properties (Inventing Company)
II	Diazinon (Basudin)		600	Contact and stomach poison (GEIGY)
II	Carbaryl (Sevin)		850	Contact insecticide (Union Carbide Corp.)
II	Tetrachlorvinphos (Gardona)		4-5000	Selective preparation against Lepidoptera (Shell)
II	Trichlorphon (Dipterex, Negovon)	$(CH_3O)_2PO.CH(OH)CCl_3$	560 - 630	Contact and stomach poison (BAYER)
II	Dimethoate (Cygon, Rogor)	$(CH_3O)_2PS.SCH_2CO.NH.CH_3$	300 - 600	Systemic and contact insecticide and acaricide (American Cyanamid Co., Montecatini)
II	Ethion	$(C_2H_5O)_2PS.SCH_2SPS.(OC_2H_5)_2$	96 - 208	Contact insecticide and acaricide (Niagara)
II	Naled (Dibrom)	$(CH_3O)_2PO.OCHBr.CBrCl_2$	430	Contact and stomach insecticide and acaricide with gas effect (Chevron Chem. Co.)

Cat.	Common Name (Brands)	Chem. Formula	Tox. mg/kg rats	Special properties (Inventing Company)
III	Parathion	$(C_2H_5O)_2PS.O-C_6H_4-NO_2$	3,6 - 13	Contact and stomach insecticide (BAYER)
III	Aldicarb (Temik)	$CH_3S-C(CH_3)_2-CH=NOCO.NHCH_3$		Systemic insecticide and nematicide. Can only be applied to the soil in granular form (Union Carbide Corporation).
III	Endosulfan (Thiodan)		110	Contact and stomach insecticide (Farbwerke Hoechst)
III	Lindane (Gamma-BHC)		90	Persistent stomach and contact poison (ICI Ltd).
II	Toxaphene	$\sim C_{10}H_{10}Cl_8$	30 - 90	Persistent stomach and contact poison

Hazards to the environment

20. Unfortunately data of this type is only now being developed and it is particularly scanty for some of the older pesticides which were developed and registered long before present concerns about environmental effects of pesticides came into being. Furthermore, toxicities to fish, birds, wild mammals and other non-target organisms have not been as precisely categorized as they have to man and laboratory and domestic animals. Nevertheless, general guidelines have been developed (von Rümker, R. and Horay, F., 1972) as outlined below:

- "Relatively non-toxic" means that no losses or injury to non-target species are likely to occur, allowing for a considerable margin of overuse, misapplication and/or miscalibration.

- "Slightly toxic" means that slight losses or injury to non-target animals or organisms may occur.

- "Moderately toxic" means that moderate losses of the animals or organisms may occur under the operating conditions outlined in the preceding subparagraph.

- "Highly toxic" means that severe losses may occur if the pesticide is used in or over a habitat containing the animals or organisms specified. "Use" of the pesticide in this context means use at recommended dosage levels, including such overuse as may be expected in normal operations from overlapping swaths, inadvertent double treatment and/or miscalibration.

Using these guidelines, von Rümker categorises 35 of the most commonly used pesticides as follows:

[illegible]

Pesticide	Fish	Lower Aquatic Organism	Birds	Wild Animals	Soil Organisms
alachlor	x	?	?	?	?
propanil	x	?	xx	?	?
trifluralin	xxxx	xxx	?	x	?
dalapon-Na	x	xxx	xx	xx	xx
MCPA	xxx	?	xx	xx	x
2,4-D	xxx	xx	xx	xx	x
2,4,5-T	xxx	xx	xx	xx	x
carbaryl	xx	xxx	x	x	x
malathion	xxxx	xxx	xxx	x	(1)
naled	xxxx	xxx	xxx	xx	x
dimethoate	xxx	x	xxx	xxx	(2)
fenthion	xxxx	xxxx	xxxx	?	?
diazinon	xxxx	xxxx	xxxx	xx	(1)
ethion	xxxx	xxxx	xxx	?	(1)
oxydemeton-methyl	xxx	xxx	xxx	?	?
azinphos-methyl	xxxx	xxxx	xxx	?	?
phosphamidon	xxx	xxxx	xxxx	xxx	?
mevinphos	xxxx	xxxx	xxxx	xxxx	(1)
methyl parathion	xxx	xxxx	xxxx	xxxx	(1)
parathion	xxxx	xxxx	xxxx	xxxx	xxxx
DDT	xxxx	xxx	xxx	xxx	x
BHC	xxxx	xxxx	xx	xxx	x
chlordane	xxxx	?	xx	xxx	xxx
heptachlor	xxxx	xxx	xx	xxx	xxx
toxaphene	xxxx	xxx	xxx	xxx	?

Pesticide	Relative Toxicities: Fish	Lower Aquatic Organisms	Birds	Wild Mammals	Soil Organisms
aldrin	xxxx	xxxx	xxxx	xxxx	(1)
dieldrin	xxxx	xxxx	xxxx	xxxx	(1)
endrin	xxxx	xxxx	xxxx	xxxx	xx
captan	xxx	?	x	x	(3)
benomyl	?	?	?	?	?
zineb	xxx	?	x	x	?
maneb	xxx	?	x	x	?
mancozeb	xxx	?	x	?	xxx
methyl bromide	n.a.	n.a.	xxxx(4)	xxxx(4)	xxx
zinc phosphide	?	?	xxxx	xxxx	?

(1) Toxic to insects; relatively non-toxic to other soil organisms.

(2) Toxic to insects; toxicity to other soil organisms not known.

(3) Toxic to some soil fungi, relatively non-toxic to other soil organisms.

(4) Birds and wild mammals will not ordinarily come in contact with compound.

n.a.: not applicable.

Current or potential non-agricultural uses

21. In industrial research and development programmes leading to the marketing of new pesticides, priority is given to compounds which will be useful in the control of major pests of major agricultural crops. Indeed, the rapidly increasing costs associated with the development of a new compound (now estimated by various authorities to be between $5,000,000 and $6,000,000) mitigates against the development of compounds with a lesser market potential e.g. compounds effective only against insects of medical importance such as Anopheline mosquitoes.

22. Furthermore, compounds generally come into rather wide-scale agricultural use before they have been thoroughly evaluated for malaria control purposes both from the stand-point of ability of interrupt malaria transmission and toxicity hazard to inhabitants of treated houses. And it is this latter factor which greatly circumscribes the list of compounds which can be used for malaria control purposes because of the implications of continuous round-the-clock exposure of babies, invalids and the aged in treated houses.

23. Accordingly, in developing countries where insect-borne diseases such as malaria are still a problem, serious consideration should be given to restricting or prohibiting the agricultural use of compounds which are being used or being considered for use in public health programmes. At the present time, the following compounds are under consideration by WHO for use in vector control programmes and certain of them are already being used for agricultural pest control as indicated below:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Dicapthon	yes
Landrin	yes (soil insecticide)
Nobam	yes
Phenoycloca[illegible]	no
Phenthoate	yes
Phoxim	yes
Chlorphoxim	no
Jodfenphos	no

Hazards to applicators and third parties

24. The scope of this paper does not permit an adequate discussion of this factor which is of particular importance in developing countries where technical knowledge of responsible authorities is limited and the educational level of users is low. Accordingly, only general guidelines can be given and the reader should refer to other publications for additional information e.g. FAO, 1969 c; FAO, 1970 d; WHO, 1973; von Rümker and Horay, 1972.

25. It should be recognized, at the outset that all pesticides are toxic to some form of life and in fact if they did not have this property, the compounds would not be classified as pesticides. Unfortunately, however, this essential quality of pesticides frequently extends to man and higher animals, but the relative toxicities of pesticides to insects, for example, may be entirely different to

[illegible] to do not necessarily reflect their inherent toxicity [illegible]. There have been numerous attempts to categorize pesticides according to their toxicity to man for purposes of regulation and control, but no system is completely satisfactory, and no general agreement on this problem has yet been reached. However, the problem is under review by WHO (1973) which is developing a classification of pesticides according to the hazard they present.

26. In the interim, it might be useful to follow the guidelines developed by von Rümker and Horay (1972) who have allocated 35 of the most commonly used pesticides to one of four of the categories defined in the chart on page 24.

<u>Toxicity of pesticide to man</u>

Group A Highly toxic		Group B Moderately toxic		Group C Slightly toxic		Group D Relatively non-toxic	
oxydemeton-methyl	I	2,4-D	H	alachlor	H	captan	F
azinphos-methyl	I	naled	I	propanil	H	benomyl	F
phosphamidon	I	dimethoate	I	trifluralin	H	zineb	F
mevinphos	I	fenthion	I	dalapon-Na	H	maneb	F
methyl parathion	I	diazinon	I	MCPA	H	mancozeb	F
parathion	I	ethion	I	2,4,5-T	H		
aldrin	I	DDT	I	carbaryl	I		
dieldrin	I	B H C	I	malathion	I		
endrin	I	chlordane	I				
methyl bromide	I	heptachlor	I				
zinc phosphide	I	toxaphene	I				

F = fungicide

H = herbicide

I = insecticide

27. Note that all of the fungicides listed are relatively non-toxic to man, that only two of the insecticides but all of the herbicides except 2,4-D fall in the slightly toxic category, and that virtually all of the insecticides (except 2) fall in the "Moderately toxic" or "Highly toxic" categories.

Economic factors

Export crops

28. Countries with limited foreign exchange available for the purchase of pesticides from abroad frequently must give first priority to the protection of their export crops, particularly if these crops constitute a significant proportion of their foreign exchange earnings. On the other hand, neglect of the plant protection problems, including post-harvest storage problems, of the subsistence farmer frequently perpetuates his situation and has been identified in some countries as the factor limiting agricultural development.

29. Therefore, where appropriate, pesticides must be evaluated in terms of their usefulness in protecting export crops and in protecting crops of subsistence farmers, giving due attention where possible to other crops which do not fall into either of these two categories.

Costs of pesticides

30. The actual cost of a pesticide formulation to the end-user is highly variable and dependent upon a large number of factors, including not only supply and demand but also *inter alia*, transport, type of formulation, basic cost of the compound and preferential trade agreements. However, types of formulations will be of particular interest to developing countries especially in arriving at decisions relating to local formulation. Many pesticide formulations for agricultural use are available in concentrated form, particularly wettable powders and emulsifiable concentrates. Consequently, where appropriate, such formulations should be chosen, in preference to formulations containing a relatively small amount of active ingredients e.g. 0.5 to 10 per cent, thereby reducing transport costs attributable to inert diluents such as water, organic solvents, talcs and pyrophyllite. On the other hand, where crop protection problems require the use of factory-prepared formulations having a low percentage of active ingredients, serious attention should be given to the possibilities of local formulation, a subject which is dealt with more extremely in one of the related papers.

TOXICITY AND PRECAUTION CATEGORIES

(after von Rümker and Horay, 1972)

Group	A	B	C	D
Description	Highly toxic	Moderately toxic	Slightly toxic	Relatively non-toxic
Acute oral LD-50, mg/kg	Less than 50	Over 50 - 500	Over 500 - 5,000	Over 5,000
Acute dermal LD-50, mg/kg	Less than 200	Over 200 - 2,000	Over 2000 - 20,000	Over 20,000
Acute inhalation LC-50, ug/1	Less than 2,000	Over 2000 - 20,000		
Dose probably lethal to a 150 lb. man	A few drops to 4 cc	4 cc to 30 cc	Over 30 cc to 470 cc	Over 470 cc
Signal word required on label*	Danger-Poison Skull and Crossbones	Warning	Caution	None required

* By USA Pesticide laws and regulations

Legislative factors

Pesticide residue levels

31. Lastly, one of the most important factors entering into a decision regarding the selection of a particular pesticide, especially if the pesticide is to be used on an export crop, is the expected level of residue which would result from following good agricultural practice in the use of the pesticide and the pesticide residue tolerance levels allowed on the crop by the importing country or countries.

32. To facilitate such decisions and in the interests of working toward international agreement on pesticide residue tolerance levels in food, FAO and WHO initiated a programme to study the problem of pesticide residue levels in food in 1961 and close co-operation has continued ever since by means of annual Joint Meetings of the FAO Working Party of Experts and the WHO Expert Committees on Pesticide Residues. The most recent report of these annual meetings (FAO/WHO, 1972) lists more than 250 recommended pesticide residue levels for over 50 compounds on a wide variety of crops. These recommendations are referred to all member governments of FAO and WHO and in addition to the Codex Committee on Pesticide Residues of the Codex Alimentarious Commission. The latter Committee, which is composed of official government delegates, meets annually to discuss the recommendations of the joint FAO/WHO meeting for the purpose of recommending the adoption of specific pesticide residue tolerance levels by all Codex Member Governments.

34. Accordingly, before taking a decision at the national level regarding the use of a pesticide on an export crops, the appropriate officials of the exporting country should contact their counterparts in importing countries to ensure that the exported commodities will comply with the requirements of the importing countries.

Summary

35. Government officials of developing countries are now being confronted with serious problems related to the selection and use of agricultural pesticides. These problems have become increasingly complicated as more information on the deleterious side effects of these compounds has become available. In efforts to deal with these latter problems, the more persistent, broad-spectrum pesticides are being gradually replaced by the less-persistent narrow-spectrum pesticides. However, many of the latter compounds are more acutely toxic to man and more expensive than the compounds they are replacing. FAO through its Regular Programme and in co-operation with WHO, UNDP and bilaterial sources of funds, has been furnishing advice, expert services and equipment to assist a number of developing countries to deal with these problems and is planning to expand this programme in the future, as funds become available.

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