INDUSTRY'S CONTRIBUTION - THE RESPONSIBILITIES AND COMMITMENTS OF THE CHEMICAL MANUFACTURER

C.S. Major
British Agrochemicals Association, Alembic House, 93 Albert Embankment, London, SE1 7TU.

Summary

The chemical industry has made a significant contribution to the control of aquatic weeds. Industry's responsibilities are much broader than profit maximisation. The paper explains the responsibilities of manufacturers and the lengths to which companies go both individually and collectively to ensure the safety of their products.

Some people may question the title of my paper and suggest that it is not industry's contribution to the problems of aquatic weed control that is of prime interest to chemical manufacturers but the returns they gain from this contribution. It is true to say that unless the sales of aquatic herbicides contribute to the profitability of the company's operations their interest in aquatic herbicides is unlikely to remain. Companies are not in the lame duckweed business and cannot in this day and age, for any period of time, subsidise unprofitable operations. However, it is not this aspect of the pesticide industry which I wish to concentrate on in my paper but rather on the ways in which manufacturers contribute to the safe use of chemicals in aquatic situations.

In recent years the prime functions of waterways namely to supply essential water and to drain the land of excess have been faced with additional demands for recreational and environmental purposes. The need for aquatic weed control in many situations is undisputed. With the intensification of agricultural production, greater attention is given to efficient land drainage and it is recognised that improvements in soil structure can be achieved by efficient drainage.

The use of chemicals to control water weeds has only become common in this country during the past ten years. This is because of the increasing costs of manual labour and the efficiency associated with chemical methods. The present

concern over Government expenditure also weighs heavily in favour of chemical means. The development of chemical weed control in water has been accompanied by an increasing public awareness of our environment and consequently greater statutory control over industrial and agricultural operations which might lead to pollution. Herein lies the conflict; on the one hand there is an undisputed need for chemicals to control water weeds and on the other there is an equally undisputed need for the protection of the environment.

The chemical manufacturer has legal obligations to ensure that any chemical he supplies is safe to the user, the consumer of anything treated with that chemical and to the general public. These obligations arise under the Health and Safety at Work Act 1974. The Pesticides Safety Protection Scheme exists to safeguard human beings, livestock, domestic animals and wildlife against risks from pesticides. It is believed that if a product cleared under the Pesticide Safety Protection Scheme leaves the factory suitably packaged and labelled, in accordance with transport, Poisons Law and PSPS requirements then the manufacturer's obligations under the Health and Safety at Work Act would be met in these areas. However, this Act has implications for people other than manufacturers, e.g. workers. It is felt that if the user of a product cleared under the Pesticide Safety Precaution Scheme adheres to label recommendations and instructions accompanying a product then he too is complying with the Health and Safety at Work Act. Thus, clearance under the PSPS for aquatic uses is an important criterion for any product used for water weed control, both for the manufacturer and for the user. Information on all herbicides cleared for aquatic use under the PSPS has been circulated to all delegates to the Symposium. Further copies are available on request to BAA.

A Regional Water Authority wishing to defend the use of an aquatic herbicide in addition to citing the financial benefits reflected in the rates could also explain that the product in use was cleared under the terms of the PSPS. So what is the Pesticides Safety Precaution Scheme; it is an agreed scheme between Government departments and trade associations representing the pesticide industry set up in 1957 to ensure the safety of pesticides. Under the scheme manufacturers agree to notify a new chemical or a new use of an existing chemical to Government before putting the product into circulation. In practice this means that a Company will notify the PSPS at a very early stage in the development of a new product and the officials of the scheme will then lay down the data which must be provided by experimentation by the company concerned before clearance is granted. It can take up to 7/8 years between original discovery of a product and full clearance being obtained at a cost of some £3 million. During this period detailed experimental work is carried out by the company to determine not only the efficacy and mode of action of the product but also to determine any risks which might be present. The independent Advisory Committee on Pesticides and Other Toxic Chemicals together with its Scientific Sub-Committee exists to assist the scheme in its work. I am sure that Mr Bates, in his paper, will explain the type and extent of testing which is required for aquatic herbicides. Once the PSPS is satisfied with a product's safety it can then be marketed initially to a limited extent and if all goes well full scale commercial marketing can start. In products used in agriculture and if a food crop is involved, then it is necessary for the company to supply residue data on the levels expected to be present in crops treated with the chemical.

Similarly, for aquatic uses residues of herbicides used in aquatic situations will be required. The implication of these residues is assessed

toxicologically by the PSPS, and by the Advisory Committee on Pesticides and other Toxic Chemicals and its Scientific Sub-Committee. Only when the scheme is satisfied that the levels of residues in water and hydrosoil, arising from normal use, are safe is the product cleared. For products used in water there are additional criteria and assessments of effects on fish, environment and irrigation are made.

I do not hold that the use of agricultural chemicals in accordance with the label recommendations or, the approved use of herbicides in aquatic situations can be described as pollution. These products are being used deliberately within certain confined rates of application and are not pollutants. This is recognised in the Code of Practice on the Use of Herbicides in Water Courses issued by the Ministry of Agriculture. This code was produced following full consultation and agreement with industry.

The misuse or misapplication of pesticides which result in contamination of water ways is of much concern to us all. This is pollution. It is not confined to those products used in aquatic situations although, in fact, this does happen, sometimes deliberately.

It is the agricultural spray tank being filled by the water's edge which overflows and pollutes a water course which is one source of the problem. The use of pesticides in water which are not cleared for aquatic use is another. But let us not lay the entire blame for this pollution at the door of the chemical manufacturers. In as much as the car manufacturer is not responsible for the human error which causes accidents so the chemical manufacturer is not necessarily responsible for the human error which causes accidents involving chemicals but, nevertheless, we believe that we have a duty to assist in the education of users in the proper use of the pesticides we supply. I believe that the Water Authorities can provide much assistance in this area as well. It is no use industry taking great care to ensure the safety of its products in use if the recommendations for safe use are to be ignored or wrongful use condoned by the people using them, e.g. the use of uncleared and non-approved copper sulphate to control algae.

Container disposal is another difficult area where farmers need guidance. Fortunately, this guidance is now available in the Code of Practice On The Disposal of Containers And Unwanted Pesticides, prepared by the British Crop Protection Council and recognised by the Ministry of Agriculture and the Department of the Environment. Publication of the existence of this code of practice will, it is hoped, go a long way towards minimising the occurrence of empty and partly empty pesticide drums in water courses. Let us make farmers aware of this Code of Practice and their responsibilities under it.

I know many people, in particular Regional Water Authorities, are concerned that the Pesticides Safety Precaution Scheme does not cater effectively for aquatic uses of chemicals and does not satisfy their statutory obligations and have, therefore, introduced their own schemes which manufacturers have to satisfy on a regional basis thus involving time consuming and expensive administrative operations. I ask the RWA's who are so concerned to direct their efforts towards the PSPS. It is open to bodies such as the Regional Water Authorities to make representations to the Government departments concerned to

ensure that the experimental hurdles which an aquatic herbicide is asked to jump are such that if the product completes the course then they are willing to accept the use of that product in their regions. The scheme exists, it works well, let us make it work well in this area. Let us support one already recognised scheme and not a dozen variants.

This Symposium, Mr Chairman, has recognised difficulties which exist in the use of aquatic herbicides. I would suggest that the root of the problem is the all too common breakdown of communications. I hope that we have all helped to remedy the situation. The development of mutual trust and co-operation between Water Authorities and manufacturers can, I believe, resolve these problems. Support and recognition of the Pesticides Safety Precaution Scheme will serve to ensure the safety of aquatic herbicides, the demand for which will increase in years to come as their competitiveness with hand labour and machines grows increasingly more favourable.

PESTICIDES SAFETY PRECAUTIONS SCHEME - THE REGISTRATION OF AQUATIC HERBICIDES

J A R Bates

Plant Pathology Laboratory, Ministry of Agriculture, Fisheries and Food, Hatching Green, Harpenden, Hertfordshire, AL5 2BD

Summary This paper is in two parts. The first part summarises the general arrangements in the United Kingdom for the registration of pesticides through the Pesticides Safety Precautions Scheme. The second part itemises the kind of data required by the Scheme for the registration of aquatic herbicides.

PART I THE PESTICIDES SAFETY PRECAUTIONS SCHEME

Because of the possible adverse effects they may have on non-target organisms, the introduction and use of pesticides must be controlled in some way to reduce risks associated with their use to a minimum.

In the United Kingdom control is achieved through the Pesticides Safety Precautions Scheme which has been operating since 1954, although it formally began in 1957. The Scheme was the result of close co-operation between government departments and the pesticides industry and this co-operation has been, and still is, a major factor in its continuing success.

The Scheme is designed to safeguard human beings (whether they be users, consumers of treated crops or other members of the public) livestock, domestic animals, wildlife and the environment against risks from pesticides. Manufacturers, distributors and importers who propose to introduce new pesticides or new uses for pesticides undertake to notify the government of their intention, before they are introduced. The Scheme applies to all chemicals formulated as pesticides; that is insecticides, fungicides, herbicides (including aquatic herbicides), growth regulators, rodenticides and similar products used in agriculture, forestry, horticulture, home gardens and food storage in the UK. It covers:

1. Products based on a new active ingredient, that is a chemical not previously used as a pesticide in the UK.

2. Any extension of the use of an existing pesticide, for example, from non-edible to edible crops, or to additional crops; to home garden use; from outdoor to indoor use or vice-versa or even a new distributor of an existing product.

   Aquatic herbicides so far have been chemicals designed originally for agricultural or horticultural use and the extension of use to the control of aquatic weeds is covered by the Pesticides Safety Precautions Scheme.

3. Other changes in the way of using an existing pesticide that could produce a new or increased risk, for example, changes in formulation or rates and methods of application.

Notification is not normally expected while the product is at the stage of laboratory or small-scale trials carried out by the firm's staff but if the product is to be used by agricultural, horticultural or public service workers, or if treated crops, including water, are to be available for human or animal consumption, then the product must first be notified. Each notification is, in fact, a request from a firm for official agreement to its proposals and the firm must justify its request by submitting relevant supporting information.

The firm is required to provide all the information needed to enable the government to advise on the precautions which should be taken when the pesticide is used and the firm agrees not to introduce new products until agreement has been reached on appropriate precautions and safeguards. These, together with the name of the active ingredient, are then included on the label of every container of the product offered for sale. Although the Pesticides Safety Precautions Scheme is non-mandatory, regulations under the Farm and Garden Chemicals Act, 1967, require, by law, the name of the active ingredient to be on the label.

Notifications concerned with agriculture, forestry, horticulture, aquatic uses and home gardens are made to the technical secretary of the Scheme at the Ministry of Agriculture, Fisheries and Food at the Plant Pathology Laboratory, Harpenden, those concerned with food storage, domestic and animal husbandry uses to the Pest Infestation Control Laboratory, Slough, and notifications on "non-agricultural" uses such as wood preservatives, mothproofing, etc, to the Health and Safety Executive at Cricklewood.

Guidance to firms on the amount and type of data required is given by the Scheme's many appendices and working documents and thorough discussion with the technical secretariat. For example, advice is given on the scope of toxicological studies required, presentation of data on pesticide residues in crops and standard tests for the toxicity of pesticides to fish and bees and effects on wildlife. The information required includes full details of the composition of the product, its proposed method of use, mode of action, toxicity, persistence and other data relevant to its safe use.

Procedures

The technical secretariat of the Pesticides Safety Precautions Scheme can process notifications in one of two basic ways, those involving trials with new chemicals or minor changes in use and labels of chemicals already on the market being cleared quickly by using a panel of advisers. In other cases notifications go through the committee procedure. The government's and the Scheme's main source of advice on risks arising from pesticides is the Advisory Committee on Pesticides and other Toxic Chemicals. This committee has an independent chairman and other independent members from outside government circles, together with representatives, both administrative and technical, of interested departments and research councils. There are no trade representatives on the committee. Notifications go first to the Scientific Subcommittee of the Advisory Committee which carefully assesses the supporting technical information.

The Subcommittee, composed of scientists with relevant expert knowledge, includes biologists, chemists, toxicologists, as well as members with a special interest in livestock, the environment and wildlife. This membership allows the Committee to take into account all problems likely to arise from the use of a pesticide and to agree to recommendations. Not infrequently a notification is rejected, usually

on the grounds of inadequate data, in which case it may be resubmitted when the data are available.

Whichever course is taken, final clearance depends on decisions by government departments. Any recommendations by advisers or the Subcommittee are based on an assessment of the scientific data supporting the notification and in its advice to its parent Advisory Committee the Scientific Subcommittee is concerned only with the scientific aspects of the safe use of pesticides. The Advisory Committee then may take into account factors other than those of a scientific nature.

Government departments also decide, after advice from the Advisory Committee, whether or not a chemical is toxic enough to be included in the Health and Safety (Agriculture) (Poisonous Substances) Regulations. The Regulations are to protect employees from poisoning by the more dangerous compounds, by ensuring that they are supplied with and use suitable protective equipment. Provisions of the Regulations previously applied to employees of farmers, growers and contractors, and obligations are imposed on the employer, who must provide the prescribed clothing and make sure his workers wear it. Regulations were recently extended to cover self-employed persons.

The Regulations take into account the fact that one method of using a chemical may be more hazardous than another and the Ministry issues a leaflet APS/1 entitled "The Safe Use of Pesticides on the Farm" which gives a summary in non-legal terms of the main provisions of the Regulations as well as much other general advice.

Of the 300 or so pesticides registered in this country, about 60 have been considered sufficiently toxic to need regulating. Chemicals included in the Regulations are usually also subject to the provisions of the Pharmacy and Poisons Act and Regulations made under it, which restrict sales and impose certain labelling requirements and conditions under which listed poisons may be bought, packed, and stored on shop premises.

If a chemical is not sufficiently toxic to require regulating, advice on such user precautions as are necessary will be given by Departments, using the wording the manufacturer will be required to put on his label. Consultation with industry has produced a labelling guide which is part of the Scheme and this ensures that the advice going to the user in official recommendations and from industry through the label is the same.

In this country it is believed that the most effective and practical way of protecting the consumer is to lay down users' "Codes of Practice" so that the user, in following advice, will know that the harvested crop, or water, resulting from a treatment will not contain harmful pesticide residues. Official recommendations on the safe use of a pesticide may contain limiting conditions such as:

1. Specifying the crop or situation in which the pesticide may be used.

2. The maximum rate and frequency of application and the minimum interval which must elapse between last application of the pesticide and harvesting the crop.

3. In the case of aquatic herbicides a maximum application rate and an interval controlling use of the treated water for irrigation or human or animal consumption.

The official advice is so designed that, provided the chemical is used properly, there will be either no residue or any residue present will be at a level acceptable to expert medical opinion. The proportion of our nationally grown foodstuffs treated with pesticides is modest and even if a crop has been treated, it does not follow that there will be a residue at harvest. In many instances the normal commercial use of a pesticide is such that no trace is left at harvest. Official studies of the problem of pesticide residues in foodstuffs in the UK are conducted under the direction of the Scientific Subcommittee's Panel on Residues of Pesticides in Foodstuffs. Selective surveys of home produced and imported foods have been carried out since 1961 and the results published. Studies on total diet have also been made and, in general, as expected, residues if detectable are very low and the results justify to a large extent the Panel's practice of selecting for analysis specific foods for special consideration. The work is continuing. Residues in water for human consumption have also been shown to be very low.

Also at risk from the use of pesticides is a very wide group which includes livestock, game, birds, fish, bees, other wildlife and the general environment. The Scheme normally requires information on the acute toxicity of a chemical to birds, bees and fish as well as the data on various laboratory animals. Not all pesticides are potentially harmful to wildlife but even so, each use of a chemical is carefully assessed, and specific advice on the protection of wildlife is given when necessary.

In the case of aquatic herbicides the chemical is added directly to the aquatic environment and although the dose levels are very low the Pesticides Safety Precautions Scheme needs assurance that these offer no risk to fish and aquatic organisms, as well as humans or animals consuming the water. In recent years there has been growing appreciation of the significance of the contamination of the environment with persistent pesticides and information on the persistence of new chemicals is asked for.

Draft recommendations on safe use, after consideration by the Advisory Committee and government departments are then sent to the notifier as the official reply to his notification. When government departments and firms concerned agree on recommendations for safe use they are published in a loose-leaf dossier entitled "Chemical Compounds Used in Agriculture and Food Storage - Recommendations for Safe Use in the United Kingdom", freely available to anyone in this country or abroad. It is supplied to government departments, local authorities, medical officers of health, public libraries, hospitals and universities, industry, the farming and medical press and many other organisations and persons interested in the safe use of pesticides.

Official interest in a chemical does not cease with the publication of recommendations for safe use. Chemicals are constantly under review and recommendations can be, and often are, revised in the light of new information. Research in all aspects of pesticides is in progress in many government departments, the Medical and Agricultural Research Councils and in universities and agricultural institutes. As knowledge increases, official requirements become more sophisticated and the examination of the data submitted by industry more critical. Industry recognises this continued stiffening of the official attitude towards pesticides - an attitude which also applies to other classes of chemicals, for example drugs, medicines and industrial chemicals - and accepts it as inevitable in our progress towards safer pesticides.

Safety Record in the UK

Since 1950, there have been very few accidents to operators in agriculture and horticulture due to pesticides. An analysis of accidents in agriculture since 1967, a period over which pesticide use has steadily increased, is given in Table I and the evidence would seem to indicate that occupational hazards from applying pesticides are well-controlled by existing methods. There have been no known cases of illness in any country resulting from pesticides residues in food when pesticides have been used according to directions.

TABLE I TABLE SUMMARISING NUMBERS OF FATAL AND NON-FATAL ACCIDENTS IN AGRICULTURE 1967-73. Source: HMSO Annual Reports - Report on Safety , Health, Welfare and Wages in Agriculture

	Fatal accidents		Non-fatal accidents in agriculture	
	Total	Due to pesticides	Total	Due to pesticides and other chemicals
1967	114	-	8 572	26
1968	114	-	7 387	22
1969	115	-	7 387	15
1970	105	-	6 291	30
1971	118	-	5 711	23
1972	95	-	5 755	29
1973	91	-	5 259	43

The Safety Scheme also tries to collect data on other incidents resulting from the use of pesticides and depends in part on an assessment of such incidents to review, and possibly modify, clearances. Reported incidents involving bee casualties and aerial spraying incidents are summarised annually and reviews of chemicals are carried out. So far however no similar collation exists for incidents involving fish casualties. If Regional Water Authorities have authenticated cases of fish poisoned by pesticides (ie cases supported by data) then the Safety Scheme is, of course, willing to review any clearance situation.

PART II DATA REQUIRED FOR THE REGISTRATION OF AQUATIC HERBICIDES

As stated, the major task of the Safety Scheme is to evaluate the hazards involved in the use of pesticides. To assess hazards the Scheme needs to know not only the toxicity of the pesticide to the various species but also needs to know the exposure of these species to the pesticide. Thus there are two basic inputs of data into the Scheme and the Scheme offers guidance to firms on the type of data to provide. The guidance does not deal with the questions exhaustively, nor are the various proposals to be taken as final. Firms realise that they can always be asked to supply additional information on a product. Each application is considered on its merits and it is impossible to lay down a general scheme which is applicable to all situations. The precise pattern of tests required in a particular

case is a matter for discussion between the firm and the technical secretariat of the Scheme. No guidelines can replace this essential dialogue.

Toxicity Testing

Since every pesticide used is likely on some occasion to come into contact with the skin or be ingested, acute toxicity data are required on oral ingestion and skin application. Similarly, inhalation data must be provided when there is danger of uptake by the respiratory tract. Repeated use may create a further risk from cumulative action and this also must be adequately covered in toxicological studies.

For the initial assessment of the toxicity of a pesticide there is a need for certain "primary toxicological studies". When the pesticide is to be used in situations where items for human or animal consumption are not involved then the basic data may be sufficient.

Basic studies may be short-listed as follows:

1. Acute toxicity on at least two laboratory animal species.

2. Percutaneous toxicity on both active ingredient and formulated product. In some cases repeated applications are desirable.

3. Skin and eye irritancy.

4. Inhalation toxicity when relevant.

5. Allergic sensitization when relevant.

6. Short-term toxicity - a study of the effects of repeated doses is essential.

In most cases it is necessary to supplement this basic information and when the basic studies needed will have to be planned. Some of these may include:

1. Degradation products, metabolites and possible investigations on these.

2. Metabolic studies in animals.

3. Long-term toxicity studies especially when the use leads to residues in food or water.

4. Delayed effects.

5. Neurotoxicity.

6. Reproduction studies.

7. Carcinogenicity
   Teratogenicity
   Mutagenicity

8. Potentiation

9. Observation in Man.

Experience has shown that birds, fish and insects may differ widely from mammals in response to certain pesticides. Therefore appropriate toxicity tests are required on at least one fish, one avian and one relevant insect species. In some cases additional information on wild mammals may be needed.

Assessing Hazards

the operator

Workers who mix or apply pesticides in the field are often exposed to relatively high levels of such compounds but experience has shown that if the various routes of entry of pesticides into the body are protected even the more toxic compounds can be used safely. The results of the animal experiments must finally be extrapolated to man and any information which will give some indication of worker exposure is of value. It is essential to assess as accurately as possible the amounts of pesticide to which people will be exposed. This will usually require careful analytical work, for example to determine the amount of pesticide in the work environment. The more toxic pesticides are scheduled under the Health and Safety (Agriculture) (Poisonous Substances) Regulations 1975 but none of the chemicals cleared as aquatic herbicides is scheduled. Nevertheless, in certain cases protective clothing and precautions are recommended for their use and these are to be found in the published official recommendations for safe use.

the consumer

A principle on which a new pesticide is accepted rests upon evidence that the crop (or water) treated according to the methods that will be recommended to users of the pesticide will not contain a residue that is harmful to the consumer. Nationally and internationally there is great activity aimed at introducing legislation to control pesticide residues in food but there is no evidence to suggest that there is an unsatisfactory situation anywhere from the proper use of pesticides. On the contrary, the evidence suggests that when pesticides are used correctly there is no residue problem. In the case of chemicals cleared as aquatic herbicides an examination of the maximum cleared rates in water makes it clear that for man and other mammals there is a large margin of safety even at the herbicidally active concentrations. For example, based on an average daily water intake of 2 litres in the United Kingdom, the relevant data for paraquat, the most acutely toxic herbicide cleared for aquatic use, are as follows:

paraquat	Recommended concentration in water	2 mg per litre
	Theoretical maximum daily intake	4 mg
	LD_{50} dose for a 70 kg man (based on rat data)	10,500 mg
	No toxicological effect following daily intake for life for 70 kg man (based on rat data)	10.5 mg

One can see from these figures that temporary intake of water at treatment concentration will not produce an effect in man. This situation of course is extremely unlikely in practice.

wildlife and the environment

The environment offers much more of a challenge in interpreting the word "exposure". Some pesticide effects may be too complex, subtle or delayed to be detected by ordinary routine testing in the Laboratory or in the field and in any case it is impossible to cover in such trials all the infinite variety of conditions under which the pesticide may be used in practice. Nevertheless, experience has shown that in most cases predictions can be made of probable effects of a compound from the results of residue studies, toxicity tests, field trials and field surveys.

The introduction of a pesticide into water by leaching from land surfaces, spray drift or use as an aquatic herbicide may create hazards not encountered when the same chemical is used in agriculture in situations away from water sources. There may be some potential risk to people using the water for domestic, recreational, agricultural or horticultural purposes or, to fish and other forms of life living in the water. The risk of harmful side-effects is governed by:

the properties of the pesticide ie

1. its toxicity to man, animals and plants at the concentration reached in the water;

2. its persistence or that of its breakdown products, in a toxic form in water, weeds and mud;

3. its other properties such as taste, colour, smell and corrosiveness.

the condition and situation of the lake or water course affected ie

1. the use made of the water;

2. whether the water is flowing or stationary;

3. the importance of wildlife, fishing, land drainage and other interests in relation to each other;

4. the adjacent crops and their susceptibility to spray drift, seepage, etc.

Situations may therefore arise to justify an evaluation of residues in water or small aquatic organisms at relevant intervals, in addition to the criteria mentioned in the paragraph below on the toxicity to fish.

If the use-pattern of a pesticide involves direct application to water (for example aquatic herbicides) or may lead to inadvertent contamination, then toxicity tests should be carried out on representative species of fish.

The test should be carried out according to a recognised method and the results should give LC_{50} data for the formulated product after 24, 48 and 96 hours' exposure. If the chemical degrades in water within a few hours then shorter observation times may also be necessary.

When a pesticide is relatively stable in water, tests should be made with lower doses of the toxicant during a longer exposure period and tissue residue levels associated with death should be measured. In addition, in special cases, a possible cumulative effect should be studied and residues in suitable organs should be determined at intervals during the prolonged exposure, as well as the rate of loss of accumulated residues from fish subsequently kept in clean water.

Indirect effects on fish from pesticides applied directly to water

In addition to the possible direct effects on fish, several indirect effects may occur due to changes in the fish food and environment. For example, when herbicides are used to control the growth of aquatic weeds, the decay of plants that are killed may deplete the dissolved oxygen concentration of the water.

To assess the potential indirect hazards of pesticides to fish, the following information should, when possible, be provided:

1. toxicity data on some main types of fish food. Suitable test animals are Daphnia species, Asellus, Tubifex larvae and chironomid larvae;

2. pesticide disappearance curves in a few types of water (eg with differing temperature, hardness, pH and suspended solids);

3. data on absorption of the chemical by organic plant material and bottom sludge;

4. effects on the oxygen availability and the duration of this effect, by determining 24-hour dissolved oxygen cycles or biological oxygen demand (BOD) at intervals after the application.

Field Trials

When the data and measurements have been made and assessed it is very often necessary to carry out field trials to confirm the predictions based on toxicity tests and to determine effects which cannot be predicted from laboratory experiments. These field trials must be carried out on a sufficiently large scale to enable adequate observations to be made. Population assessments must be carried out to determine both the species and the numbers of animals present in the experimental area and their behaviour must be studied so that those species at greatest risk can be identified. Such procedures focus attention on a few "indicator" species which can then be studied in greater detail to maximise the information obtained from investigations which may necessarily be limited. Observations should extend over as long a period as possible and this is especially important in the case of materials applied to aquatic habitats.

Even after clearance has been granted a systematic watch by biologists should be kept for wildlife casualties during the first few years of use of a new chemical and the reporting of significant observations or data encouraged.

RECOMMENDATION SHEETS AND CODE OF PRACTICE

It is against the above background that clearance has been granted so far to 9 herbicides for use in aquatic situations and these are summarised in the Appendix. Recommendation Sheets have been published by Government Departments for each of these herbicidal uses and although each recommendation specifies the maximum rate of application and the so-called waiting periods or safety intervals, there is an overall recognition that in the use of aquatic herbicides there is no substitute for local knowledge and users should consult the appropriate Water Authority or Drainage Board before applications may be made. In 1967 a Code of Practice for the use of herbicides on weeds in water courses and lakes was produced by the Ministry of Agriculture, Fisheries and Food and this code has been recently revised. It is the belief of Government Departments that if aquatic herbicides are used according to the Code of Practice and under the conditions laid down in official Recommendation Sheets, no harm should come to users, consumers, wildlife or the environment.

HERBICIDES CLEARED FOR AQUATIC USES

Common name of a.i.	Proprietary products cleared under Pesticides Safety Precautions Scheme (and manufacturers) with relevant label recommendations	Official Recommendations		
		Number and date of issue	Permitted concentration	Safety interval before use for irrigation
chlorthiamid	'Prefix' (Shell Chemicals UK Ltd)	920 1.6.72	3 mg/L	5 weeks
dalapon	'Basfapon' (BASF) 'Campbells' Dalapon' 'Chipman Dalapon' (Chipman Ltd) 'Cleanacres Dalapon' (Cleanacres Ltd) 'Dalacide' (Borax) 'Farmon Dalapon' (Farm Protection Ltd) 'Longmates Reed Killer' (Longmates) 'Dalapon S.D.C.' (S.D.C. Pesticides) 'Dalapon 85 sp' (Ciba-Geigy) 'B & H Dalapon' (Burts & Harvey) 'S.B. Dalapon' (Stokes and Bomford) 'Dowpon' (Farm Protection) 'Dowpon' (Duphar-Midox) 'Dowpon Systemic Grass Killer' (Dow Agrochemicals) 'Dowpon Systemic Grass Killer' (Plant Protection Ltd) 'Chafer Dalapon' 'Bugges Dalapon Herbicide' 'Dalapon Weedkiller' (Boots)	272 1.6.67	30 mg/L	5 weeks
dichlobenil	'Casoron GSR' (Duphar Midox Ltd) 'Casoran G' (Duphar-Midox Ltd) 'Prefix D' (Shell)	770 1.3.71	3 mg/L	4 weeks
2,4-D amine salt	'Chipman 2,4-D' (Chipman Ltd) 'Stancide' (S.D.C. Pesticides) 'Dormone' (Burts & Harvey)	270 1.6.67	5 mg/L	3 weeks
maleic hydrazide	'Chipman Grass Growth Retarder' (Chipman Ltd) 'Regulox 50 W (Burts & Harvey) 'Regulox 36' (Burts & Harvey) 'Regulox W (Burts & Harvey) 'Vondalhyd' (Bos Chemicals Ltd)	273 1.6.67	2 mg/L	3 weeks

HERBICIDES CLEARED FOR AQUATIC USES (Continued)

Common name of a.i.	Proprietary products cleared under Pesticides Safety Precautions Scheme (and manufacturers) with relevant label recommendations	Official Recommendations		
		Number and date of issue	Permitted concentration	Safety interval before use for irrigation
diquat	'Aquacide' (Chipman Ltd) 'Reglone' (Plant Protection Ltd)	554 2.6.69	2 mg/L	10 days before overhead irrigation
paraquat	'Esgram' (Chipman Ltd)	786 1.4.71	2 mg/L	as for diquat
terbutryne	'Clarosan' (Ciba-Geigy Ltd) (provisional clearance only)	1079 2.9.74	0.1 mg/L	1 week *
chlorpropham & maleic hydrazide & 2,4-D	'Vondrax' (Bos Chemicals Ltd)	629 3.3.70 (chlorpropham)	5 mg/L	3 weeks
dichlobenil & dalapon	'Fydulan' (Duphar Midox)			
2,4-D and maleic hydrazide	'B & H 43' (Burts and Harvey)			

* not published yet