STICHTING GREENPEACE COUNCIL
GREENPEACE international

Keizersgracht 176
1016 DW Amsterdam
The Netherlands

Telephone (31) 20 5236555
~~Fax (31) 20 5236500~~
Telex 18775 GPINT NL

3, Sun Street
Lewes
East Sussex
BN7 2QB
United Kingdom

TEL: 44 (273) 480334
FAX: 44 (273) 471631

Prof. A.A. Abdel-Gawaad
Prof. of Environmental Pollution
Faculty of Agriculture
Moshtohor
Kaliobia
EGYPT (P.O. Box 613 El-Maadi, Cairo, Egypt)

13 March 1991

Dear Prof. Abdel-Gawaad

It was a pleasure to speak to you on the phone. Enclosed is a first draft of Greenpeace's report on organophosphorous pesticides in the Mediterranean region which I have prepared.

We would be very pleased if you could review this first draft. At the moment the text does not contain any references, but these will all be included before the final document is prepared, and the list of references will be sent to you.

The document that you wrote for us will be appended to this report, together with other material that we have commissioned. Please could you send your references and revision of alternatives section as soon as possible, thank you.

I assume that the figures you gave for pesticides used are all active ingredients and not formulated products, but could you confirm this. Also, I was interested to know what studies suggest that 50 per cent of pesticides used end up in the soils. (See point 6.2.3 in my report). Do you have references for this?

If possible, please could you let me have your comments by fax (number above) by 25 March at the latest. If this is not possible, please could you let me know.

Thank you very much for all your help.
Yours sincerely

Topsy Jewell

DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT

THE USE OF ORGANOPHOSPHOROUS COMPOUNDS IN THE MEDITERRANEAN REGION

For submission to the
Joint Scientific and Technical Committee,
Barcelona Convention, May 1991

Greenpeace International
14 March 1991

1. INTRODUCTION

1.1 Organophosphorous Pesticides

Organophosphorous (OP) pesticides are used in large quantities in the Mediterranean region to control pests in agriculture. By their nature they are highly toxic substances introduced deliberately into the environment. Yet it has been estimated that less than one per cent of pesticides applied in the field actually reach their target (ref) and the rest enters water, air and soil as toxic waste.

The price that is paid for this chemical war against pests is the poisoning of people, the destruction of bees and other beneficial organisms, the contamination of water and food and the less well known impacts on terrestrial and aquatic ecosystems. Ironically, however, the use of enormous quantities of pesticides at huge cost to the farmer has not decreased the overall loss of crops to pests. This figure has remained steady at about 30% both before and after the introduction of chemical pesticides. (REf)

1.2 THE MEDITERRANEAN ACTION PLAN

OP compounds (with the exception of any which might be considered to be biologically harmless or rapidly converted into biologically harmless substances) are listed in Annex I to the Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-based Sources. This is one of the Protocols to the Barcelona Convention (Convention for the Protection of the Mediterranean Sea Against Pollution). The contracting parties to the Barcelona Convention decided that an assessment of the state of pollution in the Mediterranean Sea should be prepared for each group of substances listed in Annex I. On the basis of these assessments, control measures were to be recommended. (FAO/OP/4 25 November 1987).

An assessment document (UNEP(OCA)/MED WG. 12/4, 5 April 1990) for OP compounds was duly prepared by the Secretariat with draft recommendations and presented to the Joint Scientific and Technical Committee held in Athens, 28 May - 1 June 1990. The report reviewed the literature on OP compounds and in some cases identified levels of OP pesticides in marine waters which reached

levels that could be damaging to marine life. (p. 31) But it concluded that further research and monitoring was needed before specific marine pollution control measures should be implemented for the protection of marine life (p. 32) This decision was based on a belief that:

> "the scientific rationale for control depends on whether (a) the levels actually encountered in the marine environment are close to those which are likely to prove harmful to the ecosystem or cause adverse effects in man through any exposure route; (b) harmful levels may eventually be reached if inputs
>
> are not controlled" (p.31)

With this in view, the report recommended that control measures need not be proposed to the contracting parties before 1993.

The Joint Scientific and Technical Committee, however, agreed that more information should be provided to the Secretariat by September 1990 and that, based on this information, the Secretariat should propose, if necessary, a new set of recommendations to the next Joint Committee meeting in May 1991.

In response to the Committee's decision, Greenpeace International commissioned reports from independent experts in four Mediterranean countries: Morocco, Tunisia, Egypt and Greece, for submission to the Secretariat and the next Joint Meeting in May 1991. The reports cover production, imports and use of OP pesticides in these countries together with evidence of environmental impact of OP pesticides.

1.3 THE PRECAUTIONARY APPROACH

The supposedly scientific rationale for pollution control used in the 1990 MAP assessment report and quoted above, has in recent years been called into serious doubt by scientists around the world. In summary there is: (a) no way of predicting what levels of a substance are going to be harmful in different compartments of the marine ecosystem; and (b) the idea of a threshold level at which concentrations of a substance becomes harmful is based on a doubtful theory of the assimilative capacity of the environment. This is the view that a receiving body of water can assimilate and detoxify a certain quantity of a harmful substance without sustaining damage.

For many scientists, this assumption is no longer considered to be acceptable and has been replaced by a precautionary approach to pollution control. This approach assumes that a substance may cause harm unless comprehensive data are available to show that it does not. Adoption of precautionary action implies a shift in approach from proof of environmental harm to proof of environmental safety of a substance.

Indeed, the contracting parties to the Barcelona Convention have agreed to "fully adopt the principle of precautionary approach

regarding prevention and elimination of contamination of the Mediterranean Sea area". Greenpeace, therefore, is very concerned that recommendations regarding OP pollutants in the Mediterranean are being proposed in the light of a bankrupt theory of pollution control and fail in any way to meet a precautionary action approach.

At the moment, vast quantities of OP pesticides are used in Mediterranean agriculture and there is evidence that they are contaminating the Mediterranean Sea. Greenpeace believes that their reduction and eventual phase out, along with other synthetic agro-chemical inputs, is essential to the successful implementation of a precautionary approach to end the contamination of the region.

1.4 "CLEAN" AGRICULTURAL PRODUCTION

The message of this report is an optimistic one. It is possible to implement the precautionary principle by shifting from agricultural practices which require huge inputs of pesticides to alternative, ecological agricultural methods which do not require chemical inputs. In every part of the world farmers have shown that it is possible to maintain yields by using less chemicals and fertilizers and by preserving soil and water resources. Moreover the expertise already exists to ensure that an effective long term plan could be put into action.

1.5 AIMS OF THIS REPORT

The aims of this report are:

1.5.1 to show that sufficient concern over the adverse impacts of OP compounds already exists in other fora for contracting parties to the Barcelona Convention to take immediate action in the Mediterranean region;

1.5.2 to show the failure of many existing pollution control measures to implement a true precautionary approach and to learn from these problems for more effective implementation in the Mediterranean region;

1.5.3 to show how the richer environmentally aware countries in northern Europe are profiting from production and exports of hazardous, and in some cases banned, OP pesticides to Mediterranean countries;

1.5.4 to reveal the extent of environmental problems arising from the use of OP pesticides in four Mediterranean "case study" countries;

1.5.5 to review the alternatives to intensive chemical agriculture in the region;

1.5.5 to recommend action to be taken by the contracting parties to the Barcelona Convention in order to implement the

precautionary approach to contamination in the region;

2. EXISTING MEASURES TO CONTROL OP PESTICIDE INPUTS

In recent years, OP compounds have come under closer scrutiny by international and national regulating bodies in Europe. In 1989 the 10th meeting of the International Rhine Commission concerned with pollution of the Rhine River, agreed to reduce inputs of azinphos-methyl, fenthion, parathion-ethyl, parathion-methyl, and dichlorvos. Representatives of OP pesticides have also been identified as substances requiring priority action in the 1990 North Sea Ministerial Declaration. These are included in annex 1A of the Declaration and are: azinphos-ethyl, azinphos-methyl, fenitrothion, fenthion, malathion; parathion-ethyl, parathion-methyl and dichlorvos. The North Sea Ministers agreed "to achieve a significant reduction (of 50% or more) of inputs via rivers and estuaries between 1985-1995 for each of the substances contained in annex 1A". The Declaration also makes specific reference to pesticides: "to aim for a substantial reduction in the quantities of pesticides reaching the North Sea and to this end by 31 December 1992, to control strictly the use and application of pesticides and to reduce, where necessary, emissions to the environment".

In addition, OP pesticides are on the U.K's Red List proposal, including: dichlorvos, azinphos-methyl, fenitrothion, and malathion. Others, including: azinphos-ethyl, demeton-o, dimethoate, fenthion, mavinphos and parathion are included in the U.K. list of first priority candidate Red List substances. These pesticides were chosen based upon the criteria of toxicity, persistence and bioaccumulation.

In 1990, the Council of the European Commission (EC) adopted a Directive to control direct discharges of certain OP compounds from production and formulation sites. The Directive covers: azinphos-ethyl, azinphos-methyl, fenitrothion, fenthion, malathion; parathion-ethyl, parathion-methyl and dichlorvos. The chemicals were chosen based on criteria of toxicity, persistence and bioaccumulativity, adopted in a former Directive concerned with "pollution caused by certain dangerous substances discharged into the aquatic environment by the Community" (76/464/EEC).

3. PROBLEMS WITH REDUCTION STRATEGIES AND SELECTION CRITERIA BASED ON TOXICITY, PERSISTENCE AND BIOACCUMULATION

The dramatic words of the 1990 North Sea Declaration, the U.K. Red List proposal, Rhine list, and EC's emissions Directive, all sound like good news for the North Sea environment. But the question is whether the rhetoric can be translated into effective action which, in reality, will alleviate the threat to the marine environment of hazardous substances including OP compounds.

In practice, the business of ranking substances according to persistence, toxicity and bioaccumulation and the subsequent setting of reduction levels is still inextricably linked with

beliefs in the assimilative capacity of the environment. The two main problems with this assumption is first that the quantity of substances that can be assimilated in any given compartment of the receiving environment cannot be calculated (except for oxygen depleting substances). Secondly, if they could be calculated, then the techniques simply do not exist which are sensitive enough to monitor the degree of damage being done.

In fact, the failure of the concept of assimilative capacity to deal with current pollution problems is indicative of its subjective rather than scientific nature. In practice our ability to assess the threat of chemicals using criteria based on toxicity, persistence and bioaccumulativity has proved unable to cope with the diversity of chemical and biological species found in a marine coastal area such as the North Sea. Indeed, nearshore plant and animal communities - whether in the North Sea or Mediterranean - are bewilderingly complex and it would be dangerous to think that they could be protected or "managed" by simply reducing inputs of dangerous substances selected for their potential risk to the environment.

The following is a brief look at some of the problems with these selection criteria.

3.1 Toxicity

3.1.1 LD50 Tests

Much of the discussion of environmental effects of OP compounds is based upon evaluation of relative LD50 values. While these allow a broad classification of likely environmental hazard to the particular target species tested, it is not possible to reliably extrapolate the results of these to entire ecological communities. Although there are few data for OP pesticides, there do exist practical illustrations of this problem for other pesticides. Recent research on the herbicide atrazine has shown that the community response may occur at levels well below those at which effects are observed in test species. In this study, community responses were observed at levels of 0.1ug/l of pesticide whereas the effective concentrations using Daphnia pulicaria in sublethal tests were at least an order of magnitude higher at 2mg/l.

The relevance of toxicity tests, therefore depends on the test conditions and species used. In many cases, full evaluation of the toxicity of a substance in a complex ecosystem will be deficient and often these shortcomings are not highlighted in the literature used. But since much of the overview on ecological effects depends upon toxicity test data, it would seem desirable to draw attention to this fact.

3.1.2 Enzyme Inhibition

The major path of activity of OP pesticides is the inhibition

of a group of enzymes called esterases, which includes acetylcholinesterase. Inhibition of this enzyme is associated with the most important effects in humans. A number of other enzymes, however, are also known to be phosphorylated. These include acid phosphatase, aliesterases, lipases, trypsin, chymotrypsin, succinoxidase and dehydrogenase. While there is no known clinical significance attached to these interactions in humans, the possible impacts of similar reactions with enzyme systems of organisms in the marine environment remain unknown.

3.1.3 Synergistic Effects of Chemical Mixtures

Most studies which have tested the potential hazards of pesticides to organisms are restricted to the effects of a single chemical in isolation. This is usually the only legal requirement made of the manufacturer. However, in the natural environment, organisms may be exposed simultaneously to a number of chemicals. Despite the potential importance of possible interactions, little work has been done on the synergistic effects of compound mixtures on receiving ecosystems.

The ability of certain organochlorine pesticides to promote the activation of many OP pesticides is a case in point. For example, the pretreatment of mice with DDT resulted in increased susceptibility to parathion. Dimethoate toxicity has also been enhanced in mice following exposure to dieldrin. Similarly the toxicity of malathion, dimethoate and chlorpyriphos have been shown to increase in partridges following exposure to some fungicides. Simple toxicity testing, therefore, cannot be taken as an indicator of likely environmental effect. Indeed, ecotoxicological community based studies appear to be largely incapable of separating the effects of the vast array of variables in operation.

3.2 Persistence

The persistence of compounds in the environment is commonly used as a second index of potential environmental hazards. But it is here that control schemes reveal perhaps their most obvious shortcomings. "Persistence" is defined in terms of half-life in water. This assumes that disappearance from water equates with the removal of the hazard from the aquatic environment. It also appears to assume that a short half-life equates with compound degradation. These are astonishing assumptions. Examination of the literature makes it clear that they are unjustified and calls into question the credibility of the entire approach.

3.2.1 Toxic Breakdown Products

In the first instance, disappearance of a substance from water may be accompanied by the production of further environmentally undesirable substances. For example, the OP pesticides demeton-o, fenthion and parathion all have toxic breakdown products. There are, in any case, a large number of uncertainties attached to the

mechanisms and degradation pathways for materials in the aquatic environment.

3.2.2 Effects of Partitioning in the Aquatic Environment

The failure to consider the effects of partitioning in the aquatic environment is another major drawback. For example, adsorption to particles in the sediments may modify the degradation process, leading to certain situations where concentrations of a substance may actually increase in the overall aquatic environment, despite apparently low concentrations in the water itself. This phenomenon has been reported for the pesticides malathion, endosulfan and fenvalerate where the half-lives in seawater/sediment matrices may be as much as an order of magnitude greater than the half-lives of these pesticides in seawater (CHECK REF WITH DR PAUL, No. 127). Another example is provided by the organochlorine pesticide lindane. The appearance of this pesticide in different compartments of the environment proves that manufacturers claims of a short half-life and rapid elimination from the environment by degradation are seriously misleading.

3.2.3 Atmospheric Transport

In recent years, scientific knowledge of pesticide volatility and transport via the atmosphere has increased dramatically. It has been found that more than seventy per cent of lindane evaporates during the first twenty four hours after application - perhaps helping to account for industry claims that the substance "disappears" soon after application. Similar results have been obtained for the OP pesticide mevinphos. In a study of the contribution of inputs to the contamination of the North Sea, it was calculated that 566 tonnes of parathion-ethyl enter the North Sea annually from the atmosphere [ref NS atmos report].

The main conclusion of these studies is that laboratory testing of pesticides for volatility (vapour pressure) do not accurately model the evaporative behaviour of pesticides in the field. As a result of these new findings, the German Government has decided that evaporation experiments must be included in the authorisation procedure for pesticides [Agrow]. The key point here is that there is a real danger in assuming that the disappearance of a substance from one environmental medium precludes its subsequent activity in another or its eventual reentry to the original one.

3.2.4 Surface Microlayer

Persistence studies have to date failed to take account of the surface microlayers of either marine or freshwater systems. These microlayers are distinctly different from other portions of the aquatic environment, comprising an organic film associated with particles and organisms which can be detected by remote sensing.

Enrichment of the microlayer with metals, poly chlorinated

biphenyls (PCBs), poly aromatic hydrocarbons (PAHs) and chlorinated hydrocarbons has been recorded at levels between 10 and 10,000 times levels found in subsurface water. Recent research has been conducted on microlayer samples from the North Sea, where enrichment of a number of metals and of the organometallic compound tributyl-tin was found up to 200km away from the coast. This mechanism for the concentration of so-called non-polar compounds from both the water and the atmosphere is due to the presence in the microlayer of lipids, fatty acids and polysaccharide/protein complexes. On the basis of the lipophilicity of OP compounds, it might be expected that the surface microlayer is a particularly vulnerable component of the environment.

The sea surface microlayer is vital to a wide variety of organisms since it provides the necessary environment for the eggs and developmental stages of many species and is of critical importance to decapods and fishes during the reproductive season. This coincides with the period of maximal pesticide application in spring and early Summer when aquatic pesticide concentrations are likely to be higher.

Already a number of studies have found developmental defects in pelagic fish embryos from polluted areas in the North Sea. In the German Bight, up to 50% of the whiting embryos which undergo early development in association with the microlayer were deformed. No similar studies appear to have been carried out in the Mediterranean.

3.2.5 Lack of Techniques to Detect Substances

Finally, absence of persistence cannot be assumed simply on the basis of absence of data. While data on the organochlorine pesticides have been routinely collected over the past decade, the analytical techniques for monitoring other pesticides, including OP pesticides, have only recently been developed. Even today, only a few laboratories are able to detect pesticides in certain environmental matrices. Amongst others, the OP pesticides dimethoate, parathion-ethyl and parathion-methyl have recently been detected in rainwater in Germany [ref: lindane report]. Parathion-ethyl, parathion-methyl and fenitrothion have also recently been detected in North Sea water.

3.3 Bioaccumulation

It is generally noted that bioconcentration potentials are lower for OP compounds, despite their high lipophilicity, than for the organochlorines. This is attributed to their relative instability in water and organisms due to mechanisms of hydrolysis and ester cleavage. This is not true for all OP compounds, however. U.K. Red List proposal documents provide a fish bioconcentration factor of 335 for parathion while the toxicity of parathion is enhanced by degradation to diethyl 4-nitrophenyl phosphate. Similar considerations

apply to other of the OP pesticides and these are similarly detailed in the relevant sections of the Red List documents.

3.4 Difficulties with 50% Reductions

At First Glance, the setting of binding international targets in terms of percentage cuts appears to be an effective way of countering pollution problems which are caused by a variety of sources in numerous countries. But there exists two key problems which serve to render such measures essentially unworkable. The first is the poverty of baseline data. How can the extent of reductions be assessed if there is little or no baseline data against which to measure variation? The second issue is the problem of monitoring reductions. This is difficult enough for point sources such as industrial plants, but is near to being impossible for diffuse sources such as pesticide inputs to agriculture. A particular problem in the Mediterranean, as indicated in the 1990 MAP assessment, is the lack of reliable data on quantities of OP compounds produced or used in the region.

3.4.1 Poverty of Baseline Data

These problems exist even for the relatively well monitored North Sea areas. In 1989 [?] Greenpeace commissioned from independent experts, a series of reports on the degree of success or failure in meeting the requirements of the 1984 ? North Sea Ministerial Declaration for fifty per cent reduction in emission of the most toxic, persistent and bioaccumulative pollutants. The studies were conducted in Belgium, the Netherlands, the Federal Republic of Germany, the U.K., Denmark, Norway and Sweden. The reports found that the quality of baseline data varied between non-existent and limited for these countries.

Given that calls for improved monitoring practice have been repeated internationally for the past twenty years or more, including at the first North Sea Conference in 19??, these results are hardly reassuring.

3.4.2 Difficulties in Implementing reductions

Lastly, and perhaps most crucially, there is the issue of implementation. The studies showed that while the change in rhetoric at the 1984 North Sea Conference was dramatic, very little action has actually been taken to reduce emissions of hazardous substances to the North Sea environment. (ref: GP reports)

4. PRODUCTION

4.1 Toxic Emissions from Production Plants

There is only one company within the EC currently involved with the production of fenitrothion, malathion, parathion-ethyl and parathion-methyl - the four most used OP pesticides in the

Mediterranean according to the MAP assessment. The company is A/S Cheminova in Denmark. Outside the EC, these pesticides are produced in a number of countries including Brazil, Mexico, India and China, but not in any Mediterranean countries. Cheminova produces the following quantities of OP pesticides each year (figures for 1988):

fenitrothion	1,000 tonnes/year *
malathion	11,000 tonnes/year
parathion-ethyl	6,000 tonnes/year
parathion-methyl	6,000 tonnes/year

* this figure represents plant capacity rather than the actual amount produced.

In response to EC Directive 76/464/EEC on emissions from manufacturing plants, a study was conducted by the EC on "technical and economic aspects of measures to reduce water pollution caused by the discharge of certain organophosphorous compounds" (1989). The study found that the discharge of phosphorous from Cheminova into the North Sea amounted to 3.3 tonnes per day in 1988 - representing the totality of phosphorous discharged from Denmark outside the agricultural sector. Owing to

particular tidal and stream conditions, ten per cent of the discharge ends up in the Lim Fjord. Since the ecosystem in the Lim Fjord is extremely vulnerable, any emission of phosphorous is undesirable. The company have been required to reduce emissions to a minimum in a two-step reduction plan: first to reduce emissions from 3.33 tonne/day to 270 kg/day and then, after 1993, to 40 kg/day. Cheminova have expressed doubts that they will be able to meet the second reduction target of 40 kg/day.

4.2 Toxic Emissions from Formulating Plants

Many more countries, both within and outside the EC, formulate the OP pesticides. Spain stands out as a country with a particularly large number of companies formulating parathion and malathion. Companies in Italy, France and Greece (EC REF), Egypt, (Gawaad) and Morocco (Besri) also formulate OP pesticides. The EC study found that there are a number of pathways by which waste water can be contaminated by formulating companies. These include the cleaning of process equipment, spilling and leakage losses, flushing of used raw material drums and the discharge of off-specification or old stocks of formulated end products.

4.3 Export of Polluting Technology

While the EC report claims that in the Netherlands, preventative measures implemented at formulation plants have reduced contamination of waste water to minimal levels, no information is given for other countries. The level of contaminated discharges at formulation and production sites will depend to a great extent on national legislation and the upholding of environmental laws. Any lack of legislative measures to curb pollution from OP

compounds could represent a serious discrepancy between the regulatory framework of northern European and Mediterranean countries. This could act to encourage the transfer of undesirable technologies from the Northern producing and exporting countries closer to the product markets in the Mediterranean. The German company Bayer, for example, already formulates ethyl and methyl parathion in Morocco. (Besri) The risk of manufacturing companies moving to the Mediterranean to take advantage of less stringent environmental legislation and lower labour costs, has other implications. The manufacturing plants and processes used are relatively easily adapted for the manufacture of other materials, such as chemical weapons.

5. PESTICIDE EXPORTS

Cheminova is responsible for a large proportion of global production of the four OP pesticides: malathion, fenitrothion, parathion-ethyl, and parathion-methyl. Most of the production is exported for use in countries outside the EC. (See Table 1).

TABLE 1: Quantities of OP pesticides produced and exported by Cheminova in Denmark.

t/y	malathion	fenitrothion	parathion
total EC production	11,000	-	12,000
total world production	25,000	< 5,000	40,000
EC import	0	-	0
EC export	10,000	-	10,000

In the EC countries, fenitrothion is hardly used except in Spain. Malathion, which is marketed by Cheminova in a large number of countries all around the world, is also used more extensively in the Mediterranean EC countries than in the northern EC countries. Parathion is employed more often in all EC countries, but again the largest quantities are used in the Mediterranean EC countries. (See Tables 2-4)

TABLE 2: Estimated quantities of malathion used in EC countries.

COUNTRY	QUANTITY USED (t/y)
Belgium	< 1
Denmark	5 - 10
France	0
Germany	0
United Kingdom	0
Greece	50 - 100

Ireland	4
Italy	40 - 50
Luxembourg	0
Netherlands	1
Portugal	5 - 10
Spain	400 - 600

TABLE 3: Estimated quantities of parathion used in EC countries.

COUNTRY	QUANTITY USED (t/y)
Belgium	20 - 30
Denmark	20 - 30
France	250 - 400
Germany	120 - 230
United Kingdom	0
Greece	200 - 300
Ireland	0
Italy	600 - 800
Luxembourg	2
Netherlands	55 - 70
Portugal	50
Spain	230 - 350

TABLE 4: Estimated quantities of fenitrothion used in EC countries.

COUNTRY	QUANTITY USED (t/y)
Belgium	0
Denmark	2
France	20 - 40
Germany	0
United Kingdom	< 5
Greece	< 5
Ireland	< 1
Italy	10 - 20
Luxembourg	0
Netherlands	3
Portugal	0
Spain	100 - 200

5.1 Export of Banned Pesticides

Environmental law in some, mainly the northern, EC countries has cut down the use of several OP compounds because of their high eco-, and sometimes human, toxicity. (ref EC document). In Denmark, where these pesticides are produced, the registration of parathion-ethyl was voluntarily withdrawn by industry in 1988 and

parathion-methyl is not registered for use in Denmark. However, in other parts of the world including the southern EC countries, consumption of malathion and parathion is still quite high. There is a distinct North-South divide in consumption patterns, even within the EC itself. It is a repetition of the pattern in which more prosperous and environmentally-aware countries end the domestic use of hazardous products whilst continuing to profit from exports at the expense of the health and environment of other countries.

5.2 Trade in Toxic Waste

The environmental risks posed by pesticides may also be regarded in the light of the hazardous waste trade issue. OP compounds are classified as hazardous waste by the United Nations Environment Programme (UNEP)'s waste trade agreement, the Basle Convention (198?). More recently, in January 1991, the Organisation of African Unity (OAU), representing all African countries except Morocco and South Africa, adopted an agreement known as the Bamako Convention, which bans the import of toxic waste into member countries. The definition of toxic waste agreed also explicitly includes waste containing OP compounds. It is a profound irony that while it is internationally agreed that OP compounds in waste are so dangerous that the international movements of such wastes are severely restricted and banned from import into almost all African countries, OP pesticides are still routinely traded and deliberately spread into their environments.

6. USE AND ENVIRONMENTAL IMPACT OF OP PESTICIDES

By far the greatest source of aquatic contamination in the Mediterranean region is the direct application of the OP compounds used in agriculture. The most used OP pesticides according to the 1990 MAP assessment, that is parathion-methyl, parathion-ethyl, malathion, and fenitrothion, are also all priority action compounds for pollution control in the North Sea states.

The use and environmental impact of OP pesticides in four Mediterranean countries, Morocco, Tunisia, Egypt and Greece were the subject of studies commissioned by Greenpeace International from independent experts in these countries. These reports contain details of OP pesticide imports, use and ecotoxicological data.

The reports portray a disturbing picture. They reveal that thousands of tonnes of OP pesticides are put into the Mediterranean environment every year. As a result, there is not only an important potential risk to the marine ecosystem, but a cost in lives, people's health, loss of livestock and honey bees, and contamination of domestic and export crops all of which have serious economic implications. (REf: Pimental, Bougerra)

6.1 Quantities of OP Pesticides used in the Mediterranean

6.1.1 Morocco

The report from Morocco notes that an average of one million hectares are treated every year. Crops produced for export, including citrus fruits, cotton, bananas and roses, are treated intensively with OP pesticides. About 20 different kinds are in common use and the report suggests that a total of 1,150.63 tonnes of OP pesticides (active ingredient) are used each year. Examples of use include nearly 22 tonnes of dimethoate and 34 tonnes of parathion-methyl on olives, 33 tonnes of azimphos-ethyl on roses, 14 tonnes of parathion-methyl on vines and 40 tonnes of phenamiphos on banana trees. Fenthion is used to control bird pests and fenthion, malathion, dichlorvos, and fenitrothian are used in locust control. The report states that during the Autumn of 1986, between 400-1000 sq. km. were treated daily against locusts.

6.1.2 Tunisia

The report from Tunisia reports a total of 594,250 tonnes of 14 different OP pesticides imported into Tunisia in 1988, and 316,180 tonnes of 13 different OP pesticides in 1989. These were the only figures given in official statistics and relate to the formulated product, not the quantity of active ingredient. The report also notes that smuggling of some particularly toxic pesticides into the country also takes place. Moreover, parathion-ethyl which is officially banned in Tunisia is still imported for use on fruit and olive trees. There is no production of OP pesticides and exports of these pesticides are negligible.

The extra large amounts of pesticides imported in 1988 are explained by the locust infestation in the country. Large amounts of fenitrothion, malathion, and phosphamidon were used in locust control. OP pesticides are otherwise used mainly on fruit and olive trees, cotton, and vegetables.

6.1.3 Egypt

In Egypt, it was calculated that over the past 47 years, 690,450 tonnes of pesticide active ingredients have been injected into the environment. 70% of all pesticides are used in cotton production. High quantities of OP pesticides have been imported for use since 1973 when there was a decrease in the use of organochlorine pesticides. 35 OP pesticides have been in use over the past 16 years. Although more recently, synthetic pyrethroids have come into extensive use, a total of 17,581 tonnes of OP pesticides (active ingredient) were applied to the environment in the last five years or 24% of total pesticide use. Dimethoate, a U.K. first priority candidate Red List substance, leads as the most used OP pesticide. Nearly 4,000 tonnes of this pesticide was used in the last five years.

6.1.4 Greece

There are no official figures for quantities of pesticides used

in Greece, so figures are estimates only. The Study reports that permits were given for quantities of OP pesticide active ingredients varying from 1,800 tonnes for 1987 to 2,870 tonnes for 1989. The most used OP pesticides according to 1989 import statistics are: azinphos-ethyl, chlorpyrifos, dimethoate, fenthion, methamidophos, methidathion, monocrotophos, parathion-methyl, and phorate.

The report makes special mention of the intensive use of the OP pesticides fenthion and dimethoate to control pests in olive groves. The chemicals are sprayed from the air at an application rate of 90g active ingredient/ha. An estimated amount of 140 tonnes of fenthion and 80-90 tonnes of dimethoate are used per year according to the report.

6.2 Environmental impact of OP pesticides in the Mediterranean

6.2.1 Morocco

Government programmes to test drinking water samples taken from regions where chemical campaigns against locusts have been carried out revealed trace levels of malathion and fenthion at some sampling centres. Otherwise, levels of pesticides studied were impossible to detect by the analytical method used.

6.2.2 Tunisia

The report from Tunisia suggests that about 75% of chemicals applied may subsequently be transported by air to the Mediterranean Sea. There are no parts of the country which are more than 230 km from the sea and the most important fruit and olive growing areas are directly on the coast. Parathion is sprayed from the air onto 55 million olive trees and spray drift is recognised to be a major problem in the country. Some years ago, a large fish kill in the sea was attributed to an accident with oleoparathion.

Pesticide contamination of water has barely been studied in Tunisia. Yet the biggest river in the country, the River Medjerda, crosses some of the most important agricultural areas of the country where cereals and vegetables are intensely grown, and provides drinking water to over 30% of the country's population.

Azinphos-methyl, dichlorvos, dimethoate, fenthion, malathion (all priority action chemicals in Northern European countries) and methidathion are used on orange tree groves (on over three million trees). Since these groves are very common in the country, the report states that these chemicals must be widespread contaminants of the Tunisian ecosystem.

6.2.3 Egypt

Studies of atmospheric concentrations of OP pesticides during the cotton spraying season revealed high levels of OP pesticides at

the time of spraying (131.9 ng/m3) and for some days after (21.9ng/m3 after a week). Total solid materials in the air of the cultivated areas were found to be contaminated all through the year by traces of OP pesticides.

It was also found that Nile River water, which empties into the Mediterranean, was contaminated during the cotton spraying season when about one million fedans are sprayed each year. The study calculates that between 6 to 53.2 tonnes of OP pesticides are potentially transported yearly by the River Nile to the Mediterranean.

Studies (REFs ??) have indicated that from a total of 690,450 tonnes of all pesticide groups, 345,225 tonnes find their way to pollute the Egyptian soils. Although it was found that OP pesticides were relatively less persistent, residues of parathion, chlorpyrifos, malathion and phenthoate were detected from trace amounts to quantities of the order of parts per million in soil samples.

6.2.4 Greece

The presence of OP compounds have been studied in the Thermaikos Gulf, in Northern Greece. Concentrations of malathion and parathion in sea water and sediment samples were measured from January to December in 1988. Concentrations ranging from 0.2 to 4.6 ng/l for the water samples and from 3 to 33 ng/l for the surface sediments were found. Peak concentrations occurred in Spring and Autumn. Particularly high concentrations were observed at the River Axios estuary which runs into the Thermaikos Gulf. OP residues were also detected in a study of the freshwater system of the Ioannina basin and Kalamas River. Concentrations of azinphos-methyl, parathion-methyl, and diazinon were found with peak levels in the Summer.

The report states that there is a serious problem with the quality of freshwater surface waters in Greece due to pesticide contamination. In the Pinios river basin, for example, it is estimated that 1,000 tonnes of insecticides are used each year and that 200 tonnes of pesticides or their metabolites reach the nearby Pagasitikos Gulf in the Mediterranean Sea. The report draws attention to problems in the Pagasitikos region in recent years with respect to fisheries and marine ecosystem stability due to pollution and eutrophication. The report also mentions evidence to suggest that problems with OP pesticide contamination of drinking water may exist.

6.3 Effects of OP pesticides on Humans

According to a report of a WHO/UNEP Working Group (1989), there are one million acute, severe, accidental or work related pesticide poisonings each year worldwide. Very little information is available on chronic health effects of pesticides, yet the report calculates that worldwide there are about 50 million people who prepare or use pesticides intensely and a further 500

million exposed to pesticides to a lesser extent. The report indicates that the introduction of OP pesticides has raised the risk of adverse health effects in so-called developing countries.

It is well known that most pesticide poisoning cases are not reported or identified as such and so it can be assumed that the figures quoted in the country reports represent only the "tip of the iceberg" of pesticide poisoning problems in the Mediterranean.

6.3.1 Morocco

According to hospital statistics, about 112 cases of acute poisoning between 1983-85 were probably caused by pesticides. 19% of these were accidental and of these a third were work related. OP pesticides were responsible for most (66%) of these.

6.3.2 Tunisia

Parathion, phosdrine, dichlorvos and dimethoate as well as other OP pesticides have all been implicated in human poisoning cases. Spray drift from aerial spraying of OP pesticides is a real problem since it causes contamination of foods, traditionally left out to dry.

6.3.3 Egypt

The report suggests that approximately 1,260,000 workers are potentially exposed to OP pesticides applied in agriculture. During 1988, a study of acute poisoning cases showed that insecticides were a cause of one third of the poisonings recorded. Poisoning symptoms were detected in workers engaged in formulation and packaging of pesticides and 31% of pesticides detected in the blood of these workers were OP compounds.

6.3.4 Greece

The report identifies a study that concludes that pesticides are the main cause of acute poisonings and that OP pesticides are the main class responsible. Between 1982-85 a total of 212 lethal poisonings were recorded in northern Greece and some 1,500 cases of acute pesticide poisonings are reported each year to the relevant agency in Athens. In a detailed epidemiological study on the island of Crete, a population of agricultural workers exposed to OP and carbamate pesticides was compared to a population not usually exposed to pesticides. The results of this study lead to the conclusion, according to the report, that the intensive utilisation of pesticides has had serious harmful effects on the health of the people studied.

6.4 Residues on Food

There is generally a dearth of information on pesticide residues on food since official monitoring varies from non-existent to

infrequent. Apart from the threat of residues to the health of consumers in the country of production, residues on export crops can cause consignments to be turned away because of illegal residue levels in the importing country. This economic risk is becoming more and more acute as the health conscious markets of the north are adopting more stringent laws on residue levels in food.

Ironically, it is usually the countries that have banned or limited the use of these pesticides which continue to export them to countries where they contaminate food imports. The pesticide importing country loses twice - first from the environmental and health damage caused by the use of these pesticides and secondly from lost revenue on contaminated exports.

6.4.1 Morocco

The report gives figures for OP pesticide residues in virgin olive oil, lamp oil, and olive oil cake. 0.1ppm of dimethoate were found in the virgin oil and in olive oil cake while trace amounts of parathion-methyl were found in all three olive oil products.

6.4.2 Tunisia

The study reports analyses of foods sold in the local markets that showed 57% of citrus fruit samples to be contaminated with malathion, 4% with parathion and 30% with Methidathion. 17% of artichoke and 43% of carrot samples revealed the presence of parathion despite the fact that parathion is banned from use in Tunisia. The use of fat soluble OP pesticides on olives was also of great concern to the author of the report since concentrations of between 1-2.5mg/kg of parathion, seven weeks after treatment have been reported in other countries. Olive oil is a staple food in Tunisia and is also an important export.

6.4.3 Egypt

Studies in Egypt monitoring pesticide residues in food revealed that food was contaminated with organochlorine pesticides and the OP pesticides methoxychlore, malathion and pirimiphos-methyl.

6.4.4 Greece

Although pesticide residues in food are not monitored on a regular basis in Greece, OP pesticide residues in olive oil were monitored for the two year period, 1988-89. The report revealed that residues of azinphos-ethyl, methidathion and parathion-methyl were detected in a few samples. Of these, the azinphos-ethyl residues appear to present a significant problem. Between 4% and 6% of samples had fenthion residue levels exceeding the Maximum Residue Limit set by the FAO/WHO Codex Alimentarius Commission, according to the report. Significantly, the report also revealed that exports of Greek olive oil had been rejected from the EC because they were found to have residues of OP pesticides higher than the EC standards allow.

In an article in the international agrochemical journal "Agrow", the Greek Cypriot government was reported to be concerned about excessive pesticide residues in food, particuarly in food crops exported to the EC (where the U.K was said to be the principle importer of Greek-Cypriot produce). Monitoring of food samples in 1989 revealed that 40% of one crop of Cypriot strawberries contained pesticide residues in excess of EC limits and a number of other crops, including cucumbers, tomatoes, green beens, lettuces and potatoes also contrained high residue levels.

7. THE ALTERNATIVES

7.1 Ecological Agriculture and the Precautionary Approach

The reports commissioned by Greenpeace leave little doubt that extensive application of OP pesticides to the Mediterranean environment is causing severe problems. What we know is that the air is contaminated, fresh and marine waterways are polluted, people are being poisoned and staple and export food crops are contaminated.

What we do not know is the impact these OP residues are having on sensitive ecosystems such as the marine surface microlayer (especially as a result of seasonal inputs via the atmosphere and rivers) or the chronic effect on the health of people regularly exposed to residues in food and water.

If environmental degradation and people's health are considered a priority in the Mediterranean then a precautionary approach in agricultural production needs to be adopted and alternatives to intensive use of pesticides looked for. This does not mean substituting one type of pesticide for another with future unknown adverse impacts, but of switching to ecological agricultural practices that do not require chemical inputs. These methods are already successfully employed all over the world where farmers have found that they can maintain yields while cutting the cost of expensive chemical inputs.

Ecological agriculture means reducing reliance on non-renewable energy resources, including petrochemical inputs; ending the serious chemical and nutrient pollution of water from pesticides, fertilisers and animal wastes and promoting ecological production through soil management, alternative animal husbandry, recycling of organic material, crop rotation and the application of numerous biological and cultural pest control methods.

Integrated pest management (IPM) is a step towards such ecological methods of pest control. IPM combines a variety of control techniques to reduce and keep pest populations at acceptable levels. It seeks maximum use of biological control, pest-resistant crop varieties, and cultural practices. Pesticides are used only if the target pest reaches an economic injury level, and then only if they can be used effectively and efficiently.

7.2 Examples of Ecological Agriculture in the Mediterranean

7.2.1 Greece

According to the author of the Greek report, there are several hundreds of ecological or organic farmers in Greece and organic farming is practised on a regular basis in at least 20 different regions of the country. They produce vegetables, fruit, cereals, olives, grapes, and wine as well as olive oil, raisins and citrus fruits for export.

Particular efforts have been made in Greece to end the use of chemicals in olive groves. The report discusses research on alternative methods which have reduced chemical applications by 99% in some groves. One such method is mass trapping where the pests are caught on treated strips hung from the trees. However, at the moment such methods are only effective in isolated groves where pest species cannot immigrate from other areas. Moreover, direct costs of control appear to be somewhat higher due to the secialised equipment used for trapping. But the report anticipates that these costs could be reduced with mass production of materials and reduction of administrative and management costs. Already mass-trapping is used in 2.5 million olive trees covering an area equal to 2% of the entire Greek territory. Mass trapping has also been used in cherry orchards with some degree of success and the report reveals that a large scale project for other crops is now in progress. It will focus on the reduction and/or elimination of pesticides and fertilizers in citrus fruits, apples, vines and vegetables.

7.2.2 Tunisia

Orange trees in Tunisia produce 200,000 tonnes of fruit and earn 30 million dollars a year. Orange production, however, is threatened by a species of white fly introduced into the country in the late 1960s. The chemical control of these flies is difficult and costly. Farmers already extensively use OP pesticides for a number of pests many of which, the report says, are more or less resistant to the chemicals used. Pesticides have failed and the report states that the best solution is biological control. A natural enemy of the fly is a parasite indigenous to Chile which has already been successfully introduced into France and Corsica. The parasite, however, will only thrive if pesticide use is stopped. But, the report says, farmers are "hooked" on chemicals and little incentive has been provided for them to stop. There is no real control of pesticide residues on the orange crops and chemical companies have a strong influence in the country.

7.2.3 EC's Olive Programme to Develop Environmentally Safe Pest Control Systems for European Olives.

The EC is funding a substantial four year research and development programme to look for alternatives to pesticides in olive

production (ECLAIR 209). The budget is over $8 million and the project involves research institutions, farmers co-operatives and commercial companies producing olive oil from Spain, Italy, Greece and the U.K. The programme aims to involve the co-operation of growers in all aspects of the programme to ensure the research is targeted effectively. The project is concerned only with the EC olive producing countries, Spain, Italy, and Greece which together produce 64% of the world production of olive oil and 50% of the production of picked olives.

Farmers in these countries spend about $90 million a year on pest control of which half relates to pesticide use. A project briefing states that the use of these chemicals results in the direct threat to the safety of the agricultural workers and spray operators; the development of pesticide resistance; the threat to the consumer of toxic residues on the products; and general environmental pollution caused by the chemical pesticides to living organisms, both terrestrial and aquatic.

The stated objectives of the project are: to reduce the environmental effects of pesticides in European olive production so as to safeguard operators and consumers and to improve fruit and oil; to reduce chemical inputs in general in European olive production; by reducing these agricultural inputs, to increase profitability of high quality oil; to develop and test an integrated pest management (IPM) system in several countries and to develop a technology transfer package for general European use; and to maintain a long term aim to develop a system for the production of "biological" olive oil, with minimal chemical inputs.

7.2.4 Non-chemical Pesticides, Insect Viruses

Certain insect viruses called baculoviruses can be used to kill pests without the problems of toxic residues, pest resistance, or damage to the environment. They can be applied like pesticides and the cost of development is much lower than the cost of developing a chemical insecticide. In addition viruses can be produced and formulated locally using cheap ingredients.
The major disadvantage of baculoviruses is that the infected pest takes about three days to die so that some crop damage occurs before control is achieved.

The Egyption cotton leafworm (Spodoptera littoralis) attacks a variety of vegetable, fodder and fibre crops and is regarded as a recurrent major pest problem in the Mediterranean region. The leafworm is notorious for its rapid development of resistance to chemicals and resistance has been reported in most classes of insecticides. The use of a baculovirus to control the leaf worm has been assessed in field trials on a number of crops in Crete. Results obtained showed that the application of the virus resulted in high levels of larval mortality. Some problems remain, but research shows that limitations can be overcome.

7.2.5 IPM in Cotton in Egypt.

About 60 percent of global pesticide use is on cotton. But, in many cases, this intensive chemical onslaught against cotton pests has led to an increase in pest numbers and species due to resistance and elimination of natural predators. This in turn has resulted in the application of ever increasing amounts of insecticides with the ensuing human and environmental costs. Integrated pest management, and the development of a number of alternative pest control techniques has therefore become a priority in many cotton growing countries, including in Egypt.

Alternative methods currently being tested in Egyption cotton fields, include the employment of insect pheromones for mass trapping and disruption of mating of pest species, the application of baculovirus and the collection of egg massess by children. Different methods are effective against different pest species and the emphasis is on an integrated approach combined with preserving and building up natural preditor populations.

Where IPM methods have been practiced, the number of pesticide sprays per season have been dramatically reduced from as many as 25 sprays per season at times of crisis to 2-4 sprays, depending on the farmer. (pers communication, Jeff Waage, CIBC). An important, positive side-effect of implementing IPM methods is the survival of honey bees which are badly effected by insecticides. Honey is an important export commodity in Egypt.

Unlike the spraying of chemicals, IPM is a complex and sometimes scientificaly sophisticated approach to pest control which requires a commitment to research, development and implementation for maximum success. Chemicals are essentially only a short term solution to a long term problem, whereas IPM techniques offer long term solutions.

7.2.6 Locust Control

The case for OP pesticides and locust control cannot go unmentioned. Both the Moroccan and the Tunisian reports refer to OP pesticide imports for locust control during the 1986-89 outbreak. Formidable amounts of pesticides were applied to the environment during this last infestation. In 1988 the four northwest African countries of the Maghreb region used 11 million litres of insecticides and the four most affected Sahelian countries, 2 million litres at a total cost of $100 million. (p.52)

Concern for "plague" and "famine" are familiar justifications for chemical control programs. But a recent study by the U.S. Congress' Office of Technology Assessment (OTA) (A plague of Locusts - Special Report, 1990), questions this justification and also the effectiveness of using thousands of tonnes of toxic chemicals to prevent or end locust and grasshopper plagues.

The study found that crop losses due to locust infestations amounted to a very small proportion of a country's total crop

output. In 1986, FAO figures indicate that crop losses due to locusts and grasshoppers in nine Sahelian countries was 1.5 percent of total production. Other sources reveal that Desert Locusts have in the past caused, on average, about 1.4 percent of overall crop loss due to insect pests in the same area, or about 0.2 percent of the total crop production. In peak plague years only about 4 percent of crop losses or about 0.6 percent of total crop production was lost to locusts. (p. 50)

The assessment concluded that the "popular image of a locust outbreak leading to famines seems to have little basis in fact". Famines have complex causes and the report notes that the problem is more one of food distribution and food access than food production.

The report then questioned whether chemical control is actually responsible for keeping these crop losses so low. In fact, it found that "generalizations regarding the effectiveness of locust control are highly suspect and some costly decisions are being made with little data to support them". (51)

Some experts, the report states, find that control efforts have had negligible impacts on plague populations and that their decline is due almost entirely to natural causes such as the weather. For example, studies have shown that the 1949 to 1963 Desert Locust plague (when chemical controls were deployed) was no less intense and lasted twice as long as plagues earlier in the century which occured before chemical control was available. Unfortunately, despite the locust being one of the best studied insect pests, key data for resolving the question regarding the impact of control programs are lacking.

Meanwhile, there are also serious indirect costs of control campaigns. The OTA assessment found that during the 1986-89 control programmes, "human and environmental exposure were, at times, dangerously high". (p.57) Insufficient attention was paid to the danger of contamination of scarce food, groundwater, and surface water. Yet, as the report states "no systematic program exists for monitoring the control program's effects on humans or the environment, so the extent of damage is unknown" (p. 59).

Moreover, there are important political aspects of locust control which may influence technical decisions. Most donors have requirements to purchase pesticides from domestic companies. Hense malathion which is manufactured in the U.S. was a major component of U.S. donations in the last campaign. In fact most U.S. funds donated for pesticides in locust control went to U.S. manufacturers (p.52). Furthermore, the report states that the U.S. would be seen as advocating U.S-manufactured alternatives to the use of Japanese- and German-produced fenitrothion which has been accused of causing significant environmental damage. (p.65)

Finally, the OTA assessment strongly recommends that future control strategies move away from intensive chemical inputs towards the development of a "preparedness and prevention

approach" in early warning systems and integrated pest management. Both technologies, it notes, require additional research to be fully operational. Already, a major research effort on biological control of locusts and grasshoppers is underway with a budget of $1 million (although this is only one percent of the amount spent on chemical control in 1988 alone).

The OTA assessment concludes that:

> "starting down a different route now is likely to have long term benefits although the results of taking new directions are likely to be less visiable, less dramatic, and perhaps less satisfying for donors in the short-term than spraying millions of hectares with insecticides". (p.16)

International support for research, development and implementation of alternative methods of locust control is therefore essential in order to ensure that control programmes become more effective and less environmentally damaging.

CONCLUSIONS AND RECOMMENDATIONS

Organophosphorous compounds are included in the Black List of the Barcelona Convention LBS protocol, with the exception of those which may be considered to be biologically harmless or which are rapidly converted into biologically harmless substances. To date there is no scientific certainty that any of the OP compounds are environmentally benign. In view of the uncertainties conferred by excessive reliance on single species toxicity tests, lack of data on vulnerable components of the ecosystem and lack of data on behaviour of OP compounds in the marine environment, it is probable that the potential impacts on marine ecosystems have been significantly underestimated. In addition, the analytical and monitoring difficulties are such that verification of toxic effects will not be possible with any certainty in the Mediterranean.

This indicates that a precautionary approach needs to be applied to the continued emissions of OP compounds. Since the majority of OP compounds are used in agriculture to control pests, a precautionary approach to inputs means the adoption of alternative, ecological methods of pest control. These methods are already being implemented to different degrees in the Mediterranean region for the production of both staple and export crops. Ecological agriculture, however, requires further promotion, investment and support for more research and development in order to compete with the interests and influences of the chemical industry.

While the EC is currently investing in the production of European pesticide-free olive oil, it is also one of the world's major exporters of hazardous OP pesticides. At the same time, the introduction of laws regulating residue levels on imported food are making it more difficult for countries to import their

products into the EC. These double standards must be addressed. In the first instance, the EC should end the production and export of hazardous OP pesticides.

To achieve a phase out of OP compounds in the Mediterranean, and to overcome some of the potential transitional difficulties inherent in the process, the Contracting Parties could agree:

a) To phase out by the year 2000 the production and use of those organophosphorous compounds which are persistent, toxic and liable to bioaccumulate, including, but not limited to, azinphos-ethyl, azinphos-methyl, fenitrothion, fenthion, malathion, parathion, parathion-methyl and dichlorvos.

b) To adopt measures to facilitate the phase out of pesticides including:

i) promotion of non-chemical means of pest control;

ii) financial and technical support of extension and educational services to train farmers in non-chemical pest control and transitional pest control methods;

iii) Support for farmer based research and the long term development of sustainable, ecological agriculture.

c) To report to the Secretariat of the Barcelona Convention with the fullest information on:

i) quantities of organophosphorous compounds produced and consumed in the country;

ii) quantities of organophosphorous compounds imported and exported;

iii) the present national legislative and administrative measures employed to combat and prevent pollution by organophosphorous compounds.

d) To report to the Secretariat on all measures taken in accordance with this decision.
