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CEHA Special Studies: No. 1

USE AND AFTER EFFECTS OF INSECTICIDES

WORLD HEALTH ORGANIZATION
EASTERN MEDITERRANEAN REGIONAL OFFICE

AMMAN - JORDAN
APRIL 1991

1. Introduction

Insecticides are part of a wide group of chemical substances known as pesticides, which could be grouped according to the purpose of application, such as herbicides, fungicides, rodenticides, acaricides, molluscicides, nematocides and insecticides.

Insecticides are chemical compounds of different structure designed and used to kill and control insects through the various stages of growth.

Their major use is in agriculture, public health and homes. They became indispensable all over the world.

Insecticides have made a major contribution to increasing the food supply by reducing the world wide crop harvest losses due to pests and diseases which are estimated at about 30-35%. The major losses are suffered by the developing countries.

Among the 800,000 species of insects there are about 10,000 plant eating species.

Insecticides play a major role in controlling disease-transmitting insects such as flies, mosquitoes, and cockroaches. For instance, annual death rate from malaria has been reduced from 6 million in 1939 to 2.5 million in 1965 and to less than 1 million to date. Similarly an important progress has been made in controlling other diseases such as yellow fever, sleeping sickness, and others.

Insecticides are chemical compounds designed to be toxic to certain insects. Unfortunately they affect other creatures including human beings, because they have a wide range of toxicity.

Their toxicity to man starts from the manufacturing stage, through application and even after irresponsible disposal.

Insects may develop resistance towards excessively used insecticides. This necessitates the use of more powerful insecticides, thus increasing expenses.

The mis-and excessive use of insecticides, especially the non-degradable, lead to their accumulation in the environment (soil and water) and consequently increase their hazard to man.

Government agencies and legislative bodies are concentrating their efforts to ensure proper use of insecticides, minimize risks, and warn against the dangers of their improper use.

The objective of this document is to provide information and understanding of the use of insecticides in general and their after effects. Examples about this matter from Jordan will be specifically tackled.

The study includes an inventory of major insecticides used in Jordan. The health effects caused by excessive exposure and polluting of the environment with these insecticides are reviewed.

A field study of one particular insecticide, which is widely used in Jordan, is presented with respect to its hazard on health through different stages of handling.

Finally, recommendations on environmental health protection from insecticides pollution and further activities in this field are suggested.

2. Insects and Insecticides

Insects exhibit wide diversity in form and function of their mouth parts, cuticular coating, reproductive system, development stages and socio-economic importance.

These insects are also different with regard to multiplication process though they mostly multiply by laying eggs.

The larvae are different from adult insects with regard to characteristics and resistance to insecticides.

There are useful and harmful insects to man and environment. Unfortunately, insecticides do not distinguish between these two types of insects.

Insecticides are used in the following forms:

- Contact poison, as the case of some organochlorine, carbamates and pyrethroids and organophosphorous.
- As a bait to be eaten by insects such as organochlorine, carbamates, and organophosphorus.
- As inhalation poison such as methyl bromide, nicotine, chlorpikrin, and ethylene oxide.

As far as application of insecticides is concerned, following are the major types:

- Dusting.
- Spraying.
- Fogging.
- Fumigation.

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- Dusting.
- Spraying.
- Fogging.
- Fumigation.

Some modern methods to control insects

This includes the following:

- Chitin inhibitor insecticides which destroy the outer layer of the insects.
- Sexual insecticides usually have distinguished odour that attract male and female insects from remote areas to one region to facilitate their destruction.
- Insect traps used in the past, have recently been reused. They are insecticides with distinguished odour and colour that attract the insect to lay eggs in the trap where they can be easily destroyed.
- Biological methods of combating insects that have recently emerged, can be implemented through the following:

  a) Disrupting multiplication through producing eggs that do not hatch.

  b) Eliminating the appetite of insects.

  c) Production of parasites which live on insects and consequently destroy them.

  d) Sterilization of insects by using chemicals or radiation.

  e) Preservation of useful insects that devour harmful insects.

3. Inventory of Major Insecticides in Jordan

The use of pesticides, including insecticides, is growing rapidly in Jordan to cover various purposes. The agricultural sector ranks first in the consumption of all types of pesticides mentioned in Table (1) (Page 14)

Jordan valley is the major area of consumption especially for the protected agriculture in green houses. To control the use of insecticides and to minimize hazards and toxicity, strict rules and regulations have been issued. Several types of insecticides with higher toxicity and resistance were banned in Jordan.

3.1 Authorities and Establishments Associated with Insecticides

Following are the major institutions involved in the field of insecticides and their major activities:

3.1.1 Ministry of Agriculture:

- Issuing and ensuring the application of regulations and instructions related to the use and handling of all pesticides.
- Registration of all imported and locally manufactured pesticides as well as issuing licences for their use.
- Controlling the use of insecticides in the agricultural sector and providing guidance to farmers through practical demonstrations.
- Issuing advisory bulletins to farmers.
- Taking full responsibility in the wake of any imminent danger to agriculture, such as locust attacks.
- Conducting analysis of pesticides residues on agriculture crops produced in Jordan. The Ministry's technicians, usually, collect samples on regular bases from vegetable and fruit markets.

3.1.2 Ministry of Health

- Obtaining and spraying insecticides related to public health in special infested areas and those without municipal services.
- Contacting World Health Organization to obtain information about international health regulations on insecticides, and providing this information to concerned parties in Jordan.

3.1.3 Municipality of Greater Amman

The Greater Amman Municipality has a special division for combating insects and rodents in all areas of Greater Amman. More than 800 persons are involved in this division and providing services to more than one and a half million people. The municipality buys from local factories or dealers all insecticides required for accomplishing the required tasks (insecticides have to be registered at the Ministry of Agriculture).

These insecticides are usually sprayed regularly on infected areas, garbage collection sites, streets, and sanitary networks.

3.1.4 Ministry of Industry and Commerce

- Ensuring the compatibility of imported pesticides with Jordanian standards and specifications.
- Ensuring that the limits of pesticide residues in imported crops are within the Internationally accepted specifications.
- Controlling locally manufactured insecticides and ensuring that the insecticides industry is in line with the set regulations and public safety.

3.1.5 Municipalities of Cities and Villages

- Spraying insecticides in infected areas and garbage collection sites.

3.1.6 Royal Scientific Society (RSS)

One of the major activities of RSS is to conduct applied research in projects related to industrial chemistry.
Pesticides and insecticides are among the subjects that drew the attention of RSS researchers. RSS activities and contribution includes:

- Conducting applied research projects related to various pesticides and insecticides used in Jordan and determining their residues in crops.

- Testing and analysing insecticides, (imported and locally manufactured) to ensure their compatibility with Jordanian standards and specifications.

- Providing technical consultations related to formulation, composition and analysis.

- RSS is an active member in all technical committees related to pesticides.

3.1.7 Jordanian Universities

- Conducting research related to the following fields:

  - Use of pesticides and their effects and side-effects on insects and plants.
  - Toxicity and metabolites.
  - Jordanian Universities are active members in various committees related to this field.

3.2 Regulations and Instructions Related to Pesticides in Jordan

The Ministry of Agriculture is considered the main authority for establishing, following up and enforcing the regulations and instructions related to handling, manufacturing and importing pesticides and insecticides. These regulations cover the conditions and actions required for local manufacturing, registration and handling of pesticides used in agriculture. They are also applied to insecticides that are usually used for household and public health purposes by authorities other than the Ministry of Agriculture such as the Ministry of Health and the municipalities.

Following are the major rules and regulations concerning pesticides in Jordan:

3.2.1 Instructions for Obtaining a Licence to Import Pesticides

(Resolution number 1 (1986) issued in accordance with article 66-B of the Agricultural Law number 20 issued in 1972).

a. Importing of pesticides is forbidden, unless a licence is obtained from the Ministry of Agriculture, according to a special application form.

b. To be eligible for a licence, the applicant must have a university degree in agriculture with a specialization related to pesticides, or must have an agricultural engineer with an experience in the field of pesticides.

c. The holder of a license to import or handle pesticides has to employ an agricultural engineer or technician to conduct sales and deal with people. This is not applicable to wholesale dealers.

d. The licence is valid for one year and must be renewed annually.

e. Foreign pesticide companies that have offices in Jordan, are not allowed to import or conduct pesticide sales in Jordan.
However, they are permitted to import quantities not exceeding 10 kg from every kind of pesticide as samples once and for all.

f. Every person with a licence to import pesticides must have a special record from the Ministry of Agriculture for registering the amounts imported, their types, imported date, sales price and the "In" and "Out" quantities.

g. Pesticides have to be kept in a suitable place away from foodstuff, feedstuff and water resources, and fulfilling the Ministry of Agriculture's specifications for storing them.

3.2.2 Instructions and Conditions for Pesticides Registration

(Resolution number 2 1986) issued in accordance with article 66-A of the Agricultural Law number 20 issued in 1972.

a. The Ministry of Agriculture appoints a technical committee, known as the "Pesticides Registration Committee" from the various scientific and technical institutions in Jordan. The main task of this committee is to give technical aid and consultation for registration of pesticides.

b. Pesticides may not be imported and dealt with unless registered at the Ministry of Agriculture.

c. Imported pesticides from non-producing and non-manufacturing companies are not eligible for registration. Before registration of any pesticide the following documents must be submitted:

   - A certificate, proving that the exporting company is a producer and/or manufacturer and that it is not only a refilling or third party company.

   - An official certificate from the exporting company showing its activities in pesticides production. This certificate has to be authenticated from official authorities in the country of origin.

d. Scientific and research establishments may be exempted from these terms for research and development purposes only.

e. Unregistered pesticides may be imported by licensed company as samples for experimental evaluation with quantities not exceeding 14 kg in every case and for one time only. The sample packages have to be labelled as "Test Sample".

f. A registration form for each pesticide has to be obtained from the Ministry of Agriculture and be filled with the required information including the commercial name, active ingredients, concentration and package capacity. Besides, the following documents must be submitted:

   - A certificate from official authorities in the country of origin stating that the same pesticide is registered and/or approved in the said country with the same specifications offered for registration in Jordan.

- A certificate from governmental authorities (Ministry of Agriculture or Health) providing approval and clearance for the use and handling of the same pesticide in the state of origin and with the same purpose to be registered in Jordan.
- A certificate from a recognized laboratory in the state of origin showing that the analytical results of the active ingredients and their concentrations are compatible with the specifications required.
- Technical bulletins in Arabic and/or English language showing all detailed information related to every pesticide, including chemical composition, chemical and physical properties, toxicity, antidote, uses, pest it controls, safe period, and others.
- Methods of analysis for the formulated product and its residue on crops.
- Packages must carry Arabic typed labels.

g. If a pesticide is not registered in the country of origin but manufactured by internationally recognized company for import purposes because it has no use in the manufacturing country, then a registration and validity certificates are required from at least two European countries from the EEC and/or the U.S. Environmental Protection Agency (EPA).

h. The "Pesticide Registration Committee" will thoroughly study and evaluate all documents and make a decision about the requested insecticide based on the following facts:

- Efficiency and activity.
- Expiry date.
- Any rejection or restriction of its use by the Ministry of Health in Jordan, or any Arabic or foreign country, or World Health Organization, or any environmental protection agency.

i. The registration committee has the right to submit samples to any scientific institution in Jordan for experimental studies and evaluation.

j. If registration of a pesticide is granted, the applicant has to submit the following:

- Four original samples, one kg of each insecticide, carrying a certified label authorizing its use in Jordan.
- A standard sample of the active ingredients with information showing its concentrations and/or degree of purity.

k. After registration, no change or addition to the pesticide is permitted unless approved by the committee.

l. The committee may demand more quantities of insecticides before registration for experimental and evaluation purposes.

m. A registration of pesticides may be cancelled under any of the following conditions:

- After four years from date of registration.
- If the pesticide was proved to be inefficient under local conditions or side effects were observed from its use.
- If it was proved to be registered under false information.
- If it was banned by the Ministry of Health or other international health organizations.
- If it was proved that unauthorized change was made in the certified label approved by the registration committee.

3.2.3 Instructions for Importing Pesticides

(Resolution number 3 1986) issued in accordance with article 67 of the Agricultural Law number 20 issued 1972.

a. When an application for pesticides is submitted, the following information has to be provided:

- Commercial name, active ingredients and their concentrations.
- Amount to be imported and type of packaging.
- Name and address of the exporting company and shipping information.

b. Each imported pesticide must be analyzed for active ingredients to check compatibility with label information.

c. A permission from the Ministry of Agriculture is required before clearance of pesticide from customs authorities.

d. Each package must carry a label containing the following information in Arabic:

- Name of pesticide, origin, registration number and net quantity.
- Manufacturing and expiry dates.
- The application fields including dilution ratios, production and expiry dates as well as safety period.
- Precautions required before and during use, and first aid treatment in case of an accident.
- Side effects on the various crops, fish, bees, ..etc.
- Importer's name and address.
- A poison sign.

e. Repackaging and refilling of pesticide, are not permitted unless security and safety precautions are met.

f. When repackaging or refilling of insecticides a special package must be provided to avoid contact with other materials. Food and beverage package should not be used for pesticide refilling under any condition.

3.2.4 Trading and Handling of Pesticides (Insecticides):

(Resolution number 4 1986) issued in accordance with article 66 of the Agricultural Law number 20 issued 1972.

a. Every dealer or importer who owns a licence for handling pesticide has to provide a store fulfilling the conditions and regulations of the Ministry of Agriculture. A record for the amounts imported and sold, names and addresses of the customers must be kept.

b. Pesticide packages have to be stamped and tightly closed to preserve the active ingredients and to minimize the dangers of spilling.

c. No packages without the above-mentioned label information may be sold or placed for sale.

d. Pesticide have to be kept and stored in their original packages.

e. Pesticide with oral LD50 (1-50) mg/kg by ingestion and LD50 (1-300) mg/kg by skin and inhalation may not be sold unless a permit from the Ministry of Agriculture is obtained.

f. No technical or agricultural bulletin may be issued or distributed by any local or foreign company without the approval of the pesticide registration committee.

3.3 Insecticides Use in Jordan

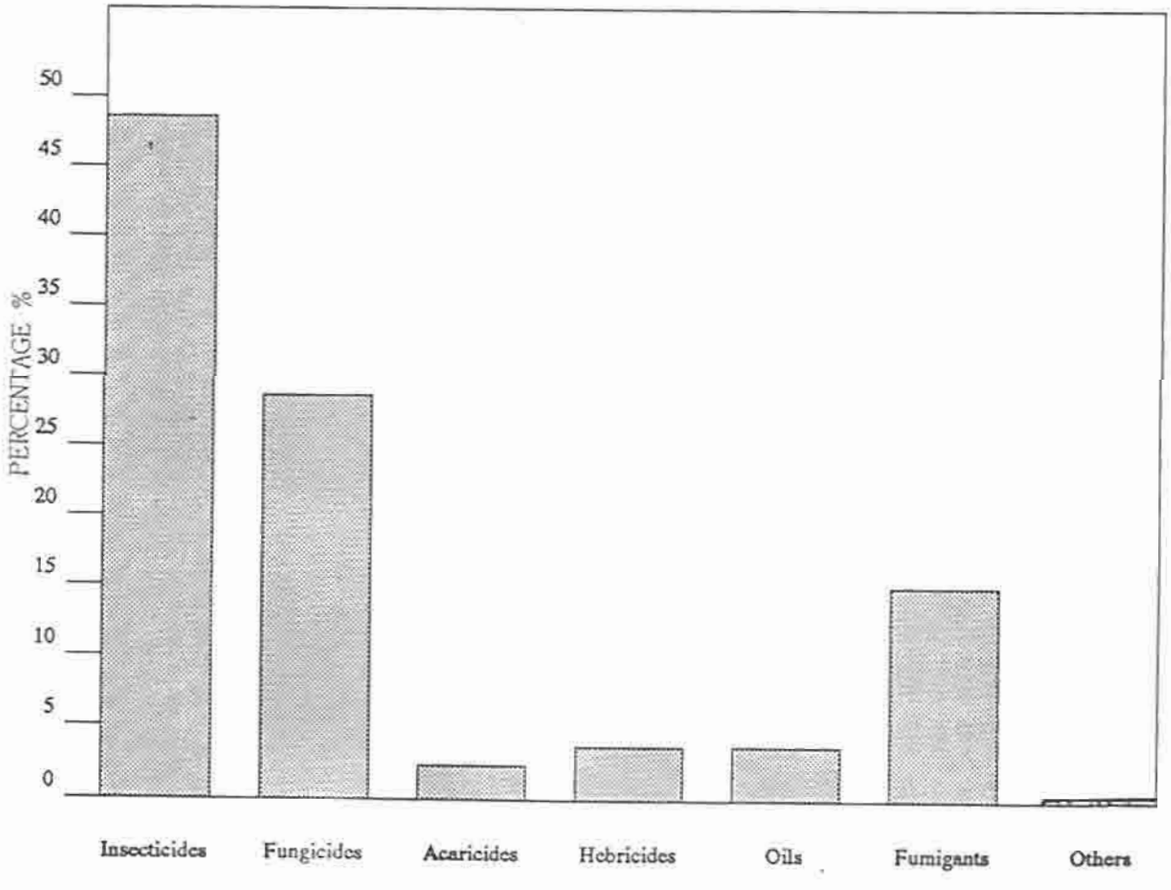
There is a restriction on using and handling of highly toxic and nondegradable insecticides such as the chlorinated hydrocarbons. However, there are some exceptions especially in the public health sector where it can only be used by a governmental authority such as the Ministry of Health.
Insecticides are considered the major pesticide consumed in Jordan. Table (1) shows the major pesticides consumed in Jordan in 1988, and graphical illustration is shown in figure (1).
Insecticides are usually used in agriculture, public health and household purposes. The distribution of these insecticides over these sectors is shown in Table (2) and graphical illustration is shown in figure (2).

Table (3) shows common names of insecticides registered in Jordan

Table 1. Consumption of Pesticides in Jordan in 1988

Type of Pesticides	Amount consumed (Kilogram) or (Liter)	(%)
Insecticides (total)	949.200	46.6
Fungicides	591.100	29.0
Acaricides	51.600	2.53
Herbicides	65.300	3.21
Oils	64.500	3.17
Soil-Store fumigants and seed dressing	304.600	15.0
Rodenticides and Molluscicides	9.500	0.466
Others	2.700	0.133

Figure 1 : Distribution of Insecticides According to Application Sectors



Most of the insecticides are imported and some of them are locally manufactured in three Jordanian factories.
Their manufacture in Jordan is based on formulating the imported active ingredients with other solvents and chemicals as well as filling them in packages, containers, or aerosols.

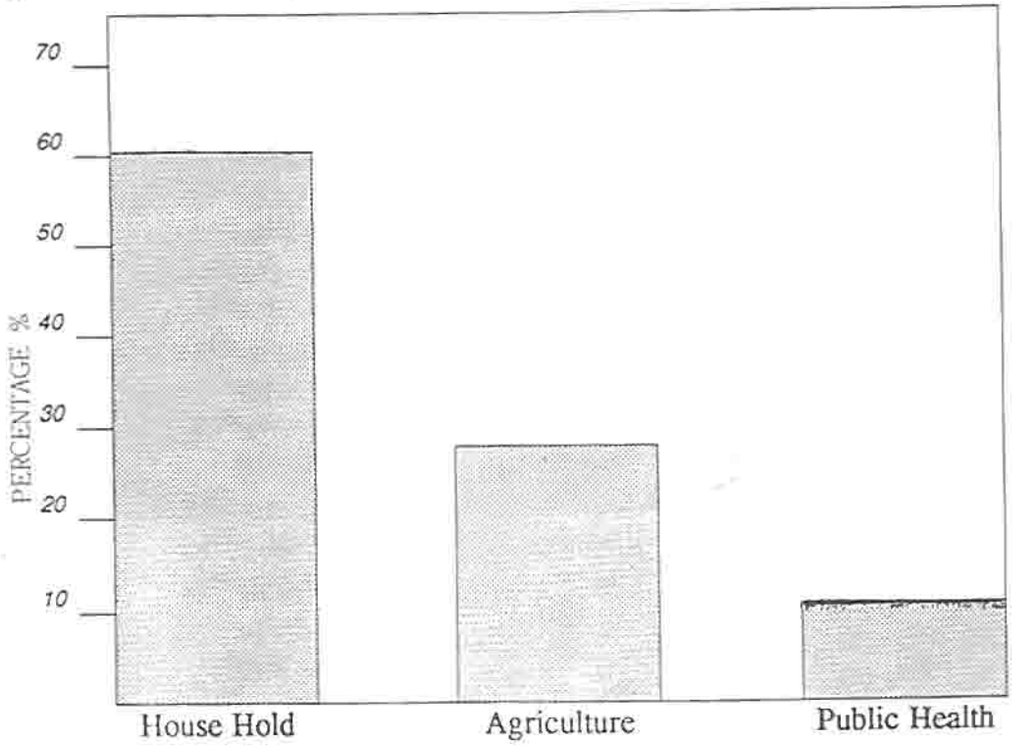
Peyrethroids represent the major insecticide used in Jordan especially for agricultural purposes.
Pyrethroids are relatively low toxic with higher LD 50 values and a less decomposition rate than other types.
Also organophosphorus and carbamate insecticides are still being used in Jordan.
Some organochlorine compounds are still in use. DDT is only used by the Ministry of Health.

Locust control, is considered as one of the Ministry of Agricultural (MOA) responsibilities. In 1988 MOA, have used Sumithion, an Organophosphorus contact insecticide, the used quantity were about 4-5 tons. Diazinon is also available in appropriate quantities at MOA stores for emergency cases.
Organochlorine compounds are not used for Locust Control in Jordan.

Table 2 : Distribution of Insecticides According to Application Sectors

Name of Sector	Amount Consumed (Kilogram) or (Liter)	%
Household	573.300	60.4
Agriculture	267.700	28.2
Public health	108.200	11.4

Figure 2 : Consumption of Insecticides in Jordan in 1988



Insecticides, have been classified according to their uses, which is based on their registration at the Ministry of Agriculture: It is clear that, insecticides which might be used in agriculture can also also used in public health. Accordingly the said table 1, table 2 can be considered as a guide line only.

Table (3): Insecticides Registered and Used in Jordan

Organophosphorous	Pyrthroids	Carbamates	Organochlorine
Azinophos Ethyl Azinophos methyl Carbophenethion Chloropyrifos Dichlorovos Dimethoate Diazinon Ethoprophos Formathion Fenitrothion Fenthion Methidathion Monocrotophos Methamdophos Malathion Mevinphos Omethoate Primiphos Methyl Phosphamidon Phenthoate Phosmet Quinalphos Temephos Trichlorofon Triazophos	Allethrin Alphacypermethrin Bioallethrin Cypermethrin Cyfluthrin Deltamethrin Fenpropathrin Pyrethrum Permethrin Pynamin forte Heptanophos Pyrethrin Tetramethrin Piperonyl-butoxide Fenvalerate Flucythrinate	Bendiocarb carbaryl Carbofuran Ethiofencarb Formetanate Oxamyl Pirimicarb Propoxur Butocarboxim Methomyl	DDT Endosulfan

3.3.1 Highly Toxic Insecticides

As noted earlier, a special permit must be obtained for dealing with highly toxic insecticides. The dealer and importing company must sign a statement committing themselves to sell these pesticides only through an agricultural engineer who should explain to buyers precautionary measures needed when using these pesticides.

Furthermore, the buyer must commit himself to deal with these materials according to the precautionary measures and instructions included in the label.
Common and commercial names of these pesticides are listed in Table (4).

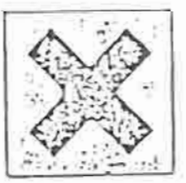
Containers and packages of highly toxic insecticides must carry special warning labels to draw the attention of users to the degree of toxicity (LD50).
In Jordan they use the international signs appearing in Table (5).

Statements indicating that the product is safe and/or does not contain poisonous materials and/or has no side effects on animals and human beings may not be written on the package label.

Table (4) : List of Highly Toxic Pesticides
Requiring A special Permit

Common Name	Commercial Name	
Alluminum-Phosphide	Phostoxin	Inorganic
Alluminum-Phosphide	Quick phos	Inorganic
Azinophos-methyl	Gusatox	Inorganic
Azinophos-ethyl	Gusathion A	Organophosphorous
Bromodiolone	Supercaid	Coumarine
Bendiocarb	Ficam	Carbamate
Brodifacom	Klerat	Coumarine
Chlorophacinone	Actosin	Indane
Chlorophacinone	Lepit Konzentrat	Indane
Chlorpyrifos	Dursban	Organophosphorous
Cumatetrayl	Racumin	Coumarine
Carbofuran	Furadan	Carbamate
Carbophenothion	Trithion 4E	Organophosphorous
Monocrotophos	Nuvacron	Organophosphorous
Ethoprophos	Mocap 20 EC	Organophosphorous
Phosphemidon	Dimecron 50	Organophosphorous
Formetante	Dicarzol	Carbamate
Monocrotophose	Hukron	Organophosphorous
Methomyl	Golden Marlin	Carbamate
Meven phos	Phosdrin	Organophosphorous
Methomyl	Lanatc	Carbamate
Methioalthion	Superacid	Organophosphorous
Monocroptopho	Azodrin 40	Organophosphorous
Methiocarb	Mesurol snail bait	Carbamate
Methamidophos	Tamaron	Organophosphorous
Methiocarb	Mesurol 50 WP	Carbamate
Methyl bromide	Methyl bromide	Halo carbons
Omethoat	Folimat	Organophosphorous
Oxamyl	Vydatc	Carbamate
Quinalphos	Ekalux	Organophosphorous
Wafarin	Ars bait rat killer	
Thallium sulphate	Zelio paste	Thalium sulphate
Methyl bromide	Methy Bron	Halocarbons

Table (5) : Warning Signs and LD50:s for Highly Toxic Insecticides

Classification	Warning Sign	LD 50 mg/kg			
		Oral		Dermal	
		Solid	Liquid	Solid	Liquid
Highly Toxic		less than 5	less than 20	less than 10	less than
Very Toxic		5-50	20-200	10-100	40-400
Medium Toxicity		50-500	200-2000	10-1000	40-400
Low Toxicity		More than 500	More than 2000	More than 1000	More than 4000

3.3.2 Insecticides Handling in Jordan

Insecticides have been used in Jordan for agricultural and public health purposes for a long time. However, studies and research on the side effects of these insecticides on human beings and the environment have been conducted only in the last few years.

In 1979, the Department of Community Medicine carried out a field study about poisoning with insecticides and pesticides in Balqa Governorate. Poor registration and lack of reliable laboratory tests led to inaccurate results. The study depended on the cases that have been treated with Atropine which is used in cases of poisoning.

In 1981 the Royal Scientific Society started a three-year programme to study insecticide and pesticide residues in fruits and vegetables. This study proved that there was misuse of insecticides in agriculture mainly in the Jordan valley. Most of the poisoning cases were the outcome of misusing of insecticides such as multiple spraying and wrong storage procedures. Some fruits and vegetable samples contained a high level of insecticide residues.

The Ministry of Health conducted a survey on human exposure to chemicals in Jordan for the period 1982-1984 using reports on chemical poisoning obtained from hospitals. Insecticides and pesticides were the main sources in 1982. It added that infants were affected by house spraying and some children were poisoned by eating unwashed vegetables and bathing in contaminated water.

In 1983 the Pesticide Residue Analysis Laboratory, at the Ministry of Agriculture, conducted a comprehensive study entitled "Evaluation of the Residue Situation of the Most Frequently Used Pesticides on and in the Economically Important Fruits and Vegetables in Jordan".

The objectives of this study were to determine the actual residue and the size of pollution, as well as means to reduce these residues.

The gathered information, proved that insecticides are the most used pesticides in Jordan (57%). More than 25% of the samples contained residues exceeding the (MRL) Maximum Residue Limit values. Most of the samples came from areas covered with plastic. The most frequently pesticide residues, which seem to accumulate in the Jordan valley, consisted of carbamate and pyrethroid insecticides.

There is a problem of high insecticide residues with variations from crop to crop and region to region. The solution may be carried out by farmers themselves in the first place, because through good agricultural practice (spraying only when necessary, following the safety periods, using the right dosage recommended, and proper usage of water especially under plastic), a lot can be achieved to reduce the hazards of these high levels of pesticides.

The Ministry of Agriculture is responsible for disseminating the information regarding the safety periods and the proper usage of pesticides.

Jordanian Universities and research institutes are invited to conduct research programmes in residue methodology and the effect of pesticides on plants, animals, and soil in various areas of the country.

The Ministry of Agriculture issued a simplified booklet about pesticides and insecticides to be distributed to and used by farmers.

This booklet includes a list of common and trade names and registration numbers of all insecticides used in Jordan. It also includes risks of these materials, best ways of handling and spraying, rate of application and mixing, names of insects to be treated by each compound, names of crops assigned, safety periods, LD50's, and the ability of the insecticide to be mixed with others.

The Municipality of Greater Amman issued a bulletin about insecticides in use, spraying methods (dusts, wettable powder, and aerosols), names of insects assigned for each insecticide, first aid in case of poisoning, directions for treatment by doctor, methods of storage and methods of dumping empty packages.

There are some problems in Jordan related to dealing with insecticides. These include storage, determination of the types and quantities to be sprayed as well as methods of eliminating their residues and disposing of empty packages.

4. Toxicological Risks of Insecticides

Insecticides are used to protect human beings from fatal diseases caused by insects and to improve agricultural products. However, misuse, handling and storage may cause various toxicological risks that are in most cases complicated and may be classified as follows:

1. Health risks to human beings as a result of misuse, exposure and residues in foodstuff.

2. Accumulation of insecticides in soil and environment:

   As a result of uncontrolled spraying of insecticides, they might accumulate in soil and undergo chemical transformations to form new compounds that might be more or less toxic than the original ones. Some of these compounds may penetrate the soil and contaminate the ground water even under correct application. Factors affecting penetration include insecticides degradability, solubility in water, nature of soil, level of ground water, rainfall, irrigation as well as the period between consecutive spraying in the same place and region.

The Ministry of Agriculture is responsible for disseminating the information regarding the safety periods and the proper usage of pesticides.

Jordanian Universities and research institutes are invited to conduct research programmes in residue methodology and the effect of pesticides on plants, animals, and soil in various areas of the country.

The Ministry of Agriculture issued a simplified booklet about pesticides and insecticides to be distributed to and used by farmers.

This booklet includes a list of common and trade names and registration numbers of all insecticides used in Jordan. It also includes risks of these materials, best ways of handling and spraying, rate of application and mixing, names of insects to be treated by each compound, names of crops assigned, safety periods, LD50's, and the ability of the insecticide to be mixed with others.

The Municipality of Greater Amman issued a bulletin about insecticides in use, spraying methods (dusts, wettable powder, and aerosols), names of insects assigned for each insecticide, first aid in case of poisoning, directions for treatment by doctor, methods of storage and methods of dumping empty packages.

There are some problems in Jordan related to dealing with insecticides. These include storage, determination of the types and quantities to be sprayed as well as methods of eliminating their residues and disposing of empty packages.

4. Toxicological Risks of Insecticides

Insecticides are used to protect human beings from fatal diseases caused by insects and to improve agricultural products. However, misuse, handling and storage may cause various toxicological risks that are in most cases complicated and may be classified as follows:

1. Health risks to human beings as a result of misuse, exposure and residues in foodstuff.

2. Accumulation of insecticides in soil and environment:

   As a result of uncontrolled spraying of insecticides, they might accumulate in soil and undergo chemical transformations to form new compounds that might be more or less toxic than the original ones. Some of these compounds may penetrate the soil and contaminate the ground water even under correct application. Factors affecting penetration include insecticides degradability, solubility in water, nature of soil, level of ground water, rainfall, irrigation as well as the period between consecutive spraying in the same place and region.

3. Effects on soil microorganisms:

Some insecticides affect the bioactivity of microorganisms in soil. This is dependent on intensity and intervals of spraying. These microorganisms usually reactivate when the effect of such insecticides diminishes. However, studies related to this subject are still inadequate.

4. Effects on animals:

It has been noticed that there is a decline in the number of animals, especially the rare ones, due to improper insecticide treatment in the areas where they live and multiply.

4.1 Effect of Insecticides and their Residues on Human Beings

Toxic materials are those with dangerous effects on human beings, even under exposure to trace amounts.

As Paracelsus said: "Only the dose determines the poisoning". The mechanism of biological activity of insecticides is not very clear. They can inhibit enzymes and thus block respiration. They affect the transmission of nerve impulses, and can also interfere in the biosynthesis of protein and DNA. All insecticides, whatever their types are considered to be toxic to human beings with different degrees of intoxication. Symptoms may develop rapidly or after a delay for several hours from exposure, depending on the type of insecticide.

Exposure to insecticides may be direct or indirect.

Poisoning occurs mainly as a result of use in agricultural, industrial contacts, accidental exposure and homicide. This is due to improper handling and dealing with such materials.

Non-agricultural workers can also be poisoned after working in areas recently treated for insect control.

Children are frequently poisoned while playing in areas recently treated for insect control or by playing with instruments used in chemical application or by ingestion.

Adults have been known to be poisoned by ingestion or by mistaking the chemical for liquor or medicinal remedy.

These different types of contact and exposure may vary among countries and between rural and urban areas.

Man poisoning due to food contamination has also been observed in different countries.

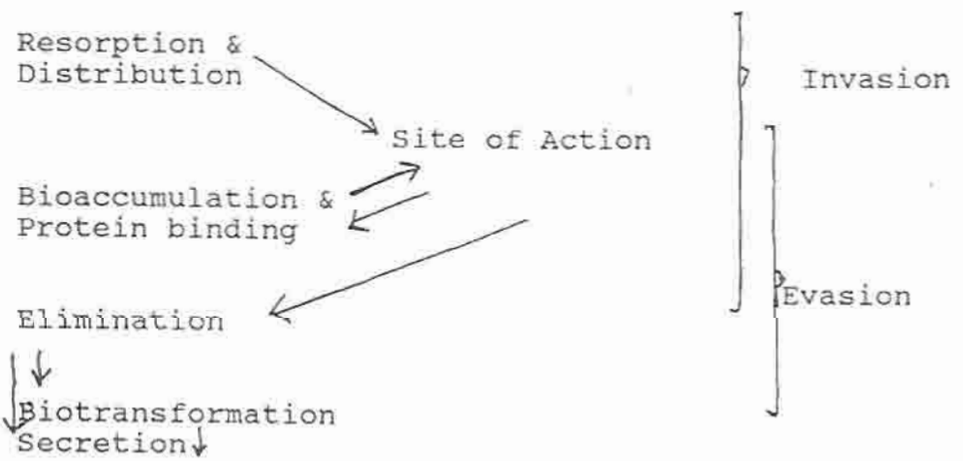
Indirect exposure is caused by dissemination of these materials through air, water and soil.

Insecticides may pollute water by direct discharge of industrial waste and effluent, or by seepage from buried toxic wastes.

Insecticides and their residues are uptaken by human being through the following means:

- Inhalation: The size of an insecticide particle (aerosol, spray, fog, smoke) plays an important role in the degree of intoxication and absorption through throats and lungs. Volatile and ionic insecticides are highly toxic by inhalation.,
- Gastrointestinal tract: Several toxic substances are absorbed through the stomach especially fat soluble ones. Lipophilic insecticides are fat insoluble and thus have to be dissolved in the intestinal tract before causing toxic effects.
- Dermal Uptake: Acute poisoning cases might be caused by accidental spillage on skin and clothing.
  Lipophilic insecticides have high degree of permeability through skin. After penetration, they spread through different parts of the body.

Toxicity with insecticides is proportional to their concentration and accumulation in the body as a result of biological invasion and evasion factors which are illustrated by the following:



Through biotransformations, various metabolites of every insecticide are formed with different degrees of intoxication as well as risks on the health. Enzymes, such as Cytochrom P-450, which is available in lung, kidney, and lever play a major role in these biotransformations.

Every insecticide has a half life time, which is the time required to decrease its activity and concentration to the half. Hydrophilic insecticides which are water soluble have shorter half life time. On the other hand, lipophilic insecticides, which are persistent, have longer half life time.

Elimination and secretion of insecticides usually occur through kidneys and feces. Some of the factors affecting the elimination and secretion are affinity, pH and polarity of the insecticide and the associated metabolites.

Insecticides with molecular weight less than 300 are usually eliminated through urine, while those that are more than 500 are eliminated through feces.

Elimination through dermal and exhalation is very little. Secretion of insecticides is independent of the uptake pathway.

4.2 Deposition, Reconstruction and Secretion of Insecticides:

The intrinsic reactive chemical nature of insecticides, means that if they enter the body, they are immediately liable to a number of biotransformations and reactions with protein in the site of action, forming a protein-poison complex deposited in that part of the body. Following exposure to another toxic material, this other toxic material may replace the first toxic one in the complex and release it into the blood.

Deposition mechanism of toxic materials is usually complex and dependent on pH and age. Infants are usually very sensitive to intoxication with insecticides.

Lipophilic insecticides such as DDT show high affinity for deposition in fat rather than biotransformations. When these insecticides are released into the blood as a result of sickness or strong diet, poisoning symptoms appear. Before these insecticides can be eliminated from the body, a reconstruction stage occurs through enzymatic reactions and metabolite formation. It is noteworthy that the formed metabolite may be more toxic than the original ones.

4.3 Individual Poisoning Sensitivity:

People react differently to insecticides and toxic materials. The individual poisoning sensitivity for insecticides is determined by several factors such as age, sex, psychological and physical conditions as well as other materials previously uptaken by the body.

Infants are extremely sensitive to insecticide poisoning. The main reason for that, lies in the fact that the enzymes needed to carry biotransformation reactions and secretion of insecticides as well as their metabolites, are not formed yet.

Children 1-8 years old have better resistance to insecticide poisoning than adults, since their bodies contain all the enzymes required for biotransformation reactions and the size of the liver is relatively large compared to the size of the body.

Adults poisoning sensitivity and absorption of insecticides, is dependent on the average body liquid quantities especially in the intracellular regions.
Highly fat tissues enhance poisoning. Hormones available in one sex but not available in the other, may help in insecticide secretion.

Type of nutrition affects fat tissues in the body. Minerals, available in food, help in detoxication process of insecticides.

The continuous exposure to insecticides, such as DDT and HCCH, may creat resistance, since the body gets used to a certain insecticide and develop a mechanism for biotransformation and secretion of it.

4.4 Poisoning Effects of Insecticides in the Site of Action:

Poisoning effects of insecticides usually occur through physical and chemical processes and interaction between the insecticide and the body substrate. The outcome of the above-mentioned interaction could affect the nervous system, inhibit some important enzyme activities and block the transport of oxygen in the blood.

Poisoning by insecticide occurs in different forms depending on amount and time of action, and could be classified as follows:

Acute poisoning:

This is due to uptaking of big dose at one time.

Sub acute poisoning:

This is due to uptaking of relatively small doses in short intervals.

Chronic poisoning:

This is due to exposure to very small amounts for a very long period. This poisoning is the most popular one and is due to uptaking of residues in foodstuff.
It becomes acute following its accumulation in the body.

Following are some important terms used to express the toxicity of insecticides:

LD50 :

This is defined as the dose required to kill 50% of the population of test animals (Rats, Mice) and is expressed as mg/kg of the body weight. It could be established as oral or dermal.
Insecticide should also be classified as bee toxic, fish toxic or toxic to birds and other animals.

The smaller the LD50 value, the more toxic the insecticide will be.

Acceptable Daily Intake (ADI):

This is defined as the daily exposure level of insecticide residue (mg/kg of body weight per day) that appears to be without risk over the entire lifetime of human being, based on all known facts at a given time.

Maximum Residue Limits (MRL)

This concept is implemented to protect the health of consumers. It takes into consideration a certain safety factor.

Foods containing residues more than MRLs are considered to be unsafe. It is expressed as (mg/kg).

5. Field Case Study

As part of this study, one of the Jordanian insecticide factories was chosen and analyzed for stages of manufacture, storage and handling of these types of products. Comments on local storage, distribution and applications are also made to demonstrate potential danger, exposure, and compliance with applicable regulations and instructions.

5.1 Insecticides Industry in Jordan

Insecticides industry in Jordan is relatively small with regard to size, capacity of production, number of workers and number of factories.

Recently there were four small factories producing insecticides, their duties are formulation, blending and packaging of a number of different types of insecticides. One of these factories has recently been shut down for failure to abide with regulations and specifications. The remaining three factories manufacture insecticides, for agricultural, public health, and household purposes, in containers of different sizes or as aerosols. This industry use basically active ingredients of pyrethroids compounds. A small percentage of organophosphorous compounds are also used. The products are sold in Jordan and neighboring countries.

All active ingredients and other chemicals including solvents used in the manufacturing process are imported with the exception of kerosine. Containers used in the packaging process are made locally.

These factories comply to different degrees with national and international regulations,on fire extinguishers, first aid, safety, manufacturing conditions, storage of raw materials, and distribution, as well as disposal of wastes and contaminated containers. A governmental committee comprising a number of institutions frequently inspect these factories to ensure compliance with laws and regulations related to safety measures and quality of products.

Table 6 lists the active ingredients used at these factories.

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Table 6 : List of Active Ingredients and Solvents Used in Insecticide Formulation in Jordan

Common Name	Group	Acute Oral LD50 for Rats mg/kg
Bioallethrin	Pyrethroids	425 -575
Cypermethrin	Pyrethroids	250 -4123
Prermethrin	Pyrethroids	430 -4000
Tetramethrin	Pyrethroids	5000
Fenithrotion	Pyrethroids	800
Fevalerate	Pyrethroids	7500
Bibrony botoxide	Pyrethroids	7500
Diazionon	Organo phosphorous	300 - 400
Mallation	Organo phosphorous	2800
Dichloros	Organo phosphorous	50 - 102
Dimethoate	Organo phosphorous	500 - 600
Amitraz	Tiazu pentadiene	800
Solvents:		
Kerosene		
Xylene		
Light oil		
White spirit		
emulsifiers		

5.2 The Chosen Factory

The chosen factory is located in the industrial area of Amman, far from residential areas and drinking water sources. This area is supplied with necessary facilities including electricity, water, sewerage, good access roads for materials, fire fighting equipment and other services.

The number of employees at the factory is 12. The superintendent, an agricultural engineer specialized in insecticides, was trained abroad and introduced to a number of insecticide industries in Britain.

The factory's maximum production capacity is 2,000 tons per year of various kinds of insecticide, in different sizes of containers including aerosols. The current annual production is only 150 tons.

The factory's insecticide products are used in the following sectors:

Agriculture	10 %
Public Health	30 %
Veterinary treatment	60 %

Active ingredients, solvents, and other necessary materials for the manufacturing process are blended automatically. The aerosols materials are blended manually but filled automatically.

The factory production has a seasonal nature where the demand increases during summer and drops in winter time. In the factory, there is a small laboratory for quality control of imported material and the formulated end products. There is also a small laboratory for the breeding of insects to test formulated products on them.

5.2.1 Raw Materials and Formulated Products

The factory produces insecticides which contain the following active ingredients in different percentages:

Pyrethroids : Cypermethrin, Tetramethrin, Permethrin, Bioallethrin.

Organophosphorous : Dimethoate, Diazinon.

Solvents : Xylene, Kerosene, White Spirit, mineral oil and emulsifiers.

All materials are checked on arrival for identification of quality and condition.

The acute oral LD50 of the above mentioned "Pyrethroids Technical Product" vary between 600-5000 mg/kg and for the "Organophosphorous" Products between 300-850 mg/kg.

All above mentioned active ingredients are imported from abroad, by air and sea, with concentration of 92-99% in metal barrels with capacity of 200 liters. These barrels are tightly closed to avoid spillage during shipping and storage.

All solvents are imported except mineral oils since they are manufactured locally at the Jordan Petroleum Refinery Company.

After the process of blending and formulating, the product is packaged in containers of various sizes (20, 5, 1, 1/2 liter). Aerosol cans for household purposes, are filled in 500 milliliter sizes. All products are labelled with the following information: name and address of manufacturing Company, trade name of product, common name, the chemical composition of active ingredients, uses, toxicity, safety period, methods of application, medical instructions and first aid, registration number at the Ministry of Agriculture, date of manufacture, expiry, and volume of contents.

The factory uses various sizes of locally made containers for the products. Locally made aerosol containers are also used, but the valves are imported. Propane and butane gases produced at the Jordan Petroleum Refinery Company are used in aerosol, instead of Freon (which was used earlier) to protect the environment.

5.2.2 Production Control

The factory examines all manufactured aerosol containers to make sure that they can stand pressure, by keeping them for 3.5 minutes in water with 50oC. The factory examines imported stuff and locally made products in its laboratory which contains a number of equipment, including Gas-chromatograph. Furthermore, there is an agreement between the factory and Royal Scientific Society (RSS) to control production. The RSS takes samples from various batches, examines them to ascertain their compatibility with the specifications on the label.

5.2.3 The Building

The walls of the building are made of non-flammable concrete. The building is totally roofed whereby rain water is kept away. It is open-sided so that there are openings up and down the walls to ensure proper ventilation of all parts of the factory.
Furthermore, all chemical materials are protected from direct sun light.

The floor of the factory is made of concrete impermeable to liquids. There are no cracks in the floor and could easily be cleaned. Not all points in the factory, where leaks could occur, have a catch tray. Pumps for insecticides have no splash guards. It is noteworthy that not all these measures are adopted in all insecticide factories in Jordan.

5.2.4 Wiring and Electrical Equipment

All electrical equipment including wiring is in good condition. All wires are made of non-flammable material. The equipment is earthed to prevent static electricity and made in a way to forestall the occurrence of sparks.

As for the gases propane and butane, the pumping process is conducted pneumatically so that motors used for this purpose are kept in a place away from gas tanks to avoid explosions or fires.

5.2.5 Ventilation

Inhalation of insecticides is one of the fastest ways of poisoning. That is why, ventilation of the entire factory is very important as fumes, vapors, and dust can go quickly from the lungs into the blood stream.

The building is open-sided to provide good ventilation. The openings are in the walls near the floor and the ceiling. Exhaust ventilation is placed near the filling machine. There is no special treatment or filters for exhaust air emitted in the atmosphere. There is good ventilation in the areas where the products and the raw materials are stored. These measures are not adopted in all factories where raw materials have noticeably been stored without the adoption of ventilation precautions.

5.2.6 Storage of Raw Material and Products

Good storage conditions of insecticides through the adoption of the related specifications and regulations reduces the possibility of spillage and contamination of atmosphere and storage areas. This also helps avoid dangers and ensures successful fighting of fires. It is advised to store raw materials, solvents and end-products separately. It is also important to have clear space between all outside walls and the stacks of insecticides to allow access for inspection and free movement of air for ventilation and for fire fighting.

It was noticed that the raw materials (active ingredients) are mainly stored in 200 liter drums in roofed open areas to protect them against heat and direct sunlight. The drums are stacked together so that no spillage could occur. The solvents are stored separately underground and at low temperatures. The gases for aerosols are stored in large cylinders in separate places.

Knowing that the factory's production is mostly according to the market demands, no large quantities of products are stored for long periods of time. Yet if stored, access is ensured to allow for inspection and free movement of air.

5.2.7 Fire Fighting

Fires in an insecticides factory can have severe consequences, because some insecticides are a fire risk and others can become so if they decompose.

It is important that fire fighting equipment be located at the most delicate and dangerous spots of the factory. The equipment must include fire extinguishers, fire blankets, hose reels, fire alarms. Adequate amounts of water should always be available. In our case study, we found some fire fighting equipments at different location of the factory. There were no fire extinguishers, blankets, or even hose reels. Fire alarm was available within the factory. Records about regular checking and maintenance of the fire fighting equipments were available. Signs indicating smoking restriction areas were also available. There was no fire fighting team at the factory because a fire brigade was stationed at the industrial area within a ten-minute response time. Emergency plan and evacuation procedure for implementation during a fire emergency, for the factory and the neighboring areas, were non - existent.

5.2.8 Health Safety and First Aid

One of the main hazards of insecticides is intoxication (poisoning) which can be caused by absorption through the skin, by inhalation, or by ingestion. This might happen if operating practices are not well defined and implemented, and if safety measures are not given enough attention.

In our case study, we could notice the following:

- There was no special pre-employment medical examination for staff working at the factory.
- There was no regular checks for cholinesterase level or any other check or record for the employee's health conditions.
- There was only one shower for emergency cases.
- There was no arrangement with a hospital or a doctor for immediate assistance in emergency cases.
- First aid procedures were not clearly followed or implemented.
- There were no special first aid equipment or medicines.
- Though there were changing and washing facilities, yet there were no clear instructions to change clothes before going home.
- A separate area for eating, drinking and smoking was available.
- Frequent and regular washing of dirty clothing was not controlled.
- Operators did not always wear the necessary personal protective equipment and clothing.
- There was no record in the factory for any past incidents.

5.2.9 Waste Disposal

Discharge of insecticides or contaminated products is a big risk to environment. Factory drainage system must not be connected directly to water ways or public sewerage. Spillage of insecticides in the factory is ideally decontaminated safely by absorption into a suitable dustless solid absorbent and then destroyed in a safe way. All hazardous waste including products which are off specification, packaging materials, residues and absorbents, should be disposed of by incineration in a controlled incinerator or in an approved land fill site. In our case study, washing and waste water as well as off specification insecticides are not allowed to flow into the drainage system of the industrial area. They are collected in an underground tank to which caustic soda is added in order to decompose active ingredients. The content is analysed before and after the addition of caustic soda to make sure the decomposition of active ingredients has taken place. Later, the content of this tank is spread on land in the area neighboring the factory for final disposal.

Though there are no laws to prevent this measure, yet this process is not sound. There are no records about the real composition of these materials before spraying as this measure could flush out the material with rain water. Contamination of ground and surface water is also possible.

The packaging materials are not disposed of in a controlled manner.

5.2.10 Emergency

In our case study, one emergency shower was available. Protective suits and self-contained breathing equipment were also available. There were no signs to indicate the location of emergency equipment and escape route. No special arrangement was made with the civil defence department or police to deal with emergency conditions such as explosion or fire.

5.3 Transport and Dispatching

In addition to all requirements, it is very important to take the following points into consideration when loading and transporting insecticides:

- It is not allowed to load insecticides alongside food and feed stuff or any other material intended for human use.
- The vehicle must be in good condition and must be checked each time before loading. Special attention should be given to the floors to avoid damage of the insecticide containers. A suitable fire extinguisher must be available in the vehicle.
- Load must be stable in the vehicle so as to avoid falling on the floors and possible spillage.
- Driver compartment must be separated from the load to avoid contamination.
- Driver must be aware of the nature of his load with regard to its dangers and how to act in emergency cases.
- It is important to check containers before loading for possible spillage and leakage.
- Any spillage inside the vehicle must be handled immediately. Protective and clean up equipment should be available.
- Different products with different composition and toxicity should be separated from each other.

- In the vehicle, there should be a document containing the following information for each load:

  - Name and address of the dispatching company and the receiving persons.

  - Name and specification of the products being carried.

  - Precautions and hazards in case of emergency.

In our case study, we noticed that the company used its own truck for the transport of its products inside Jordan.

The truck is used only for this purpose. The truck was in good condition and there was a barrier between the load and driver. The driver was not well informed about the danger, and hazard of the product.

There was no document containing information about the product. There was no record for accident or emergency cases when transporting and dispatching of insecticides.

5.4 Selling and Distribution to the End User

Through this study, we visited a number of merchants and supermarkets which sell insecticides to get acquainted with methods of storage, selling, and distribution.

It was found out that insecticides used in public health and agriculture are sold in assigned stores and those authorized by concerned authorities.

Household insecticides particularly aerosol are sold in supermarkets where different commodities are sold too.

Following are the most important observations made during these visits:

A) Household insecticides and aerosols:

- These insecticides, of different kinds and sources, are sold at groceries where food and other goods used on daily bases, are kept. The insecticides and food stuffs are stored together in boxes so that it is difficult to differentiate which is which.

- The official committee entrusted with sales of and dealing with insecticides does not inspect these stores. Therefore these stores are not subject to effective control.

- In most cases, merchants have no information or awareness about the dangers of these insecticides and how to deal with situations related to storage, spillage, or contamination.
  In some cases, they have no idea about instructions written on containers.

- Some merchants do not have fire fighting equipment for emergency cases.

- Some containers are exposed, during storage, to high temperatures in summer time thus increasing the chances of possible explosions.

B) Public health and agricultural insecticides

- These insecticides are only sold in licensed stores where they are kept in containers of different sizes, but the control is not sufficient.

- A specialized committee places these stores under surveillance.

- These stores contain various kinds of insecticides, seeds, fertilizers, decorative flowers, and matters related to agriculture kept next to each other.

- It was noticed in a few cases that insecticide containers are refilled in same stores.

- When entering some insecticide stores, smell of insecticides and solvents permeates the place. This implies that ventilation is poor and that there were no exhaust fans capable of cleaning the air.

- There are no safety precautions that could be applied in cases of emergency.

- When cleaning such stores, water is allowed into public sewerage or street gutters.

- First aid equipment is not available.

- People working in such places have no health records and they do not undergo medical examinations. They could be exposed to insecticide vapours throughout the day.

- Available insecticides are sold to anyone regardless of extent of their toxicity. There are no records listing the names of people buying toxic insecticides as well as purpose and the quantity sold.

- Highly and moderately toxic insecticides are not kept separately.

5.5 Application and End Use

In the application of all types of insecticides there is a risk of adverse side effects on human health and environment if necessary precautions are not implemented.
It is generally assumed that the majority of insecticide poisoning is related to exposure on a regular basis. Furthermore, insecticide poisoning causes loss of human productivity, increased costs of medical and health care services, and negative effects on people well being in general.

In our case study, the factory produces insecticides for public health household purposes including aerosols, agriculture and veterinary treatment (mainly for cattle dip).

Though the production of insecticides used in agriculture does not constitute the majority of the factory production, yet most of these products are consumed locally. Agriculture, is one of the most important fields in which insecticides are used in Jordan.

5.5.1 Insecticides for Public Health

Most of insecticides for public health are used by official authorities such as the Ministry of Health, the municipalities, and the Greater Amman Municipality.

These institutions have the necessary protective equipment for spraying of garbage dumps, sewerage, houses in the countryside. Fogging is also applied in some populated areas at certain times of the year to control reproduction of insects.

It is noteworthy that application through fogging is conducted without notification of residents so that they undertake precautionary measures. In this case, fog permeates houses and public facilities. It may contaminate food, water, and household appliances. Though the harm caused might be minimal, it could be avoided. The ministry of Health sprays DDT in houses located in the Jordan valley region villages. It is noteworthy that the condensation of DDT in houses subjects residents to slow and continued exposure to such chemicals.

As for uses of aerosols in houses, it is noticed that these insecticides are sprayed without appreciation of their toxicity. These insecticides might be sprayed near places where food is kept.

Storage of these products in sunlight or near heaters could cause it to explode or become not so effective.

5.5.2 Insecticides for Veterinary Treatment

Dipping animals in insecticides may lead to concentration of residues in different parts of their bodies. In our case study the chemicals used in this field are pyrethroids which have little toxic effect.

The concentrations are 1:1000 or less. This would reduce the dangers to which animals might be exposed. Most of the company's production is exported to neighboring countries while a small percentage is used locally.

The Ministry of Agriculture provides necessary treatment to animals in various regions in Jordan by conducting dipping baths especially for this purpose and abides by safety regulations.

5.5.3 Insecticides in Agriculture

The sector of agriculture is regarded as an important part of Jordanian economy. This sector grew in the past years through agriculture in greenhouses which spread in particular in the Jordan valley where the weather is characterized by being warm in winter and hot in summer. This weather needs precautionary measures for insecticide application. In greenhouses, insecticides evaporate quickly into the atmosphere in closed areas where ventilation is poor. Furthermore, as plantation is dense there, farmers spray insecticides in large quantities and at very frequent intervals. Hot weather conditions and lack of education makes the use of insecticides more dangerous.

Our comments in this field which is based on our observations, can be summarized in the following points:

- Application is done by workers or farmers who have insufficient training and knowledge of the hazards of insecticides they are using as well as needed precautions.

- Many workers live close to farms thus increase the risk of exposure to insecticides.

- There are little directions or supervision on the handling, use, and time of application. The instruction written on cans or containers are sometimes not followed.

- Waiting period between spraying and harvest is not always followed. Application happens sometimes shortly before harvesting and marketing. Such agricultural products may contain large amounts of residues which increase exposure via food.

- Residue analysis done by different institutions shows a considerable levels of residues in some crops mostly from green houses. In open fields, the level for same crops was much lower.

- There is currently a control on crops produced from different parts of the country to analyse residues on them. Measures are being adopted against violators.

- In many cases insecticides were sprayed without protective clothing and the used clothes were worn for a long time after being contaminated. Some workers smoked during or after spraying without washing their hands.

- Some of the highly toxic and officially banned insecticides (Lindane) are occasionally used.

- Diluted insecticides left over in cans were poured in neighboring areas where they could contaminate water used for different purposes and soil.

- Empty cans and containers, that were not destroyed, were used for different purposes and sometimes filled with water.

- Insecticide containers were not stored in locked cabinets away from children's reach. Sometimes they were stored near food or other items intended for human use.

- There were no data about the total number of poisoning caused by misuse of insecticides. There were neither hospitalization data nor population surveys.

6. Conclusions and Recommendations

Insecticides are toxic chemicals that are applied to kill insects which threaten our health or food resources. On the other hand, if they are not properly managed their toxicity will threaten the health of population and will cause serious environmental pollution endangering all living things and the ecological relations for a stable existence.

Using some of the data and experiences available in Jordan, as a case study, these investigations demonstrated examples of methodologies, findings, legislation and interpretations applicable for safe management of insecticides and for assessing potential impacts of various practices. The investigation provided examples of legislation and enforcement procedures technically and administratively of different types of insecticides. The outstanding objective of all these activities is to control the potential harm of these substances throughout all the stages of their manufacture, importation, storage, transport, applications, and disposal ... etc. Similar to policies enforced for toxic chemicals, control is required from the cradle, to the grave.

It is generally conceded that there is a need for more effective control to ensure proper handling of insecticides in the member states of the Eastern Mediterranean Region (EMR) of the World Health Organization (WHO).

Some of them may have not achieved the Jordan levels of legislations and enforcement described in this investigations. For this reason, it is recommended that this report be used as an example or source of checklists to guide future activities by the member states in this important area. These activities may be implemented with or without the support of the WHO may and include the following:

6.1 Assessment of Existing Insecticide Hazards in the EMR

It is recommended that this activity be carried out in the form of a national survey and interpretation with a durations from six months to one year. Types of data, nature of hazard and required actions for alleviating potential threats to health and environment, will vary according to the conditions in each member state. Based on the organizations and contents of this report, the following may be considered as a generic (or model) terms of reference for such assessment studies to be performed by member states:

Model:
Title: Assessment of Insecticide Environmental and Health Hazard in (Member State)
Tasks:

1. National needs and uses of insecticides.
2. Types, quantities and sources of used insecticides.
3. Handling stages of insecticides and how they are regulated.

4. Records of past hazards and future predictions.
5. Need for regulation.
6. Enforcement action plan.

6.2 Development of Appropriate Legislation

Regulation of insecticides in Jordan was described and the institutions responsible for its enforcement were listed with the ministries of Agriculture and Health being at the top of the list. Legislation is the expression of the community's need for a final solution to the problem. Therefore, it should vary from one community to another depending on its social and economic conditions.

Moreover, environmental health legislation should be a dynamic process in a given community to adjust not only to the changing social economic conditions but also to the continuing increase of our knowledge on which legislations is partly based.

Need for legislation will be documented on the bases of the assessment studies recommended in item (7.1).
The following are examples of items or activities which may be included in an insecticide legislation for protecting community health and environment.

Model:

Insecticide Control Legislation (Could be part of toxic chemical control legislation).

The legislation should regulate the safe use and safe handling of these materials, the following points should be covered:

1. Registration procedure including the authority responsible for it.
2. Importation requirements and procedures.
3. Trading and handling.
4. Storage and distribution.
5. Manufacturing and formulating.
6. Fields and methods of application.
7. Specifications for end product and quality control.
8. Labelling.
9. Restrictions of the use of highly toxic materials.
10. Intervention in cases of emergency.
11. Residue limits in food water and atmosphere.

Following are examples of legislative requirements:

Labelling

Insecticides offered for sale must have labels in local language. The label should include the following information: Trade and common name of active ingredients. Percentage of all ingredients, methods of applications, uses, safety instructions and precautions, guidelines for first aid in case of poisoning, hazard class and toxicity (color or symbol), physical characterization, instructions for storage, content, date of manufacture and of expiry.
It is advisable also to state the route of poisoning for example, harmful by inhalation, in contact with skin or if swallowed.

Application

- Full protective clothing should be used.
- Adequate washing facilities should be available close to the site of application.
- Eating, smoking and drinking should be prohibited during application and before washing.
- Working in spray mist must be avoided.
- Unprotected persons should be kept out of treated area immediately after spraying.
- Avoid application by hand and contact with insecticide.
- Application equipment must be in good condition.
- Arrangement for first aid and medical treatment in cases of poisoning must be available.

Waste Disposal and Decontamination

Wastes of insecticides should be disposed of in a manner that minimize their release into the environment and their exposure to Human being.

Untreated waste should never be drained into public sewerage or in an area where run off from other uncontaminated areas could happen.

Contaminated waste water should undergo primary and secondary treatment. The best way to get rid of waste is to burn them in an efficient incinerator or decompose them with hydrolysing agent.

Spillage and contaminated areas can be covered with lime, sawdust, earth or other suitable materials.
Absorbant material should be placed in a secure container for safe disposal.

Empty cans and containers should be decontaminated by rinsing several times with water and detergents.
Decontaminated containers should never be used for food or drinks. Cans and containers which are not decontaminated should be burned or destroyed and buried.

Health and Safety

Regularly exposed people should undergo a pre-employment and annual general medical examination. They should be regularly observed for identification of poisoning. Health History must be available for all workers, so that data on the occurrence of insecticide related illnesses among this group could be identified and suitable follow up procedures can be established.

Coordination with hospital, physician and health care staff must be made for immediate assistance. Specific antidotes and necessary drugs must be available.
First aid procedures and treatment for all cases before persons are seen by a physician must be known and followed.

Transport and Storage

Insecticides must be transported and stored in clearly labelled leak proof containers. They must be secure from access by children and other unauthorized persons. No food or drinks should be stored or transported in the same compartment.
Classification of the product as hazardous is necessary.

The law may include duties of involved parties with allocations of resources and means of enforcement.
Following are some examples:

Industries

- Good manufacturing practices and proper handling of both materials, and equipment.
- Written working instructions and a procedure for all operations and safety measures must be available and have to be followed by all staff.
- Supervision by trained experienced supervisors.
- Responsibilities within the factory must be clearly defined and understood.
- Closed systems, automation of industrial process and ventilation are necessary to reduce exposure.
- Formulation should be done with the advice from the manufacturer of active ingredients.
- Protective and fire extinguishers must always be available and be in good condition.
- Maintenance program for all formulating and packing equipment must be carried out regularly in order to prevent leaks and drips.
- End product and active ingredients must be checked regularly for quality. Samples from each batch must be kept as reference.

Ministries

- Inspections and routine monitoring.
- Ensuring that regulations and instructions are followed and issuing penalties against violators.
- Application of highly toxic materials in special infected areas.
- Education and training.
- Establishing standards and specifications and ensuring compliance of products to these standards.
- Obtaining related information from International Organizations and distributing them to the concerned parties in the country.

Academic Institutions

- Conducting investigative monitoring related to exposures and residues.
- Conducting research programmes related to local conditions.
- Providing technical consultation.

6.3 Manpower Development

Safe handling and application should be the subject of regular training workshops for involved staff especially field crew. Field staff and salesmen should know enough to guide citizens and farmers who come in contact with insecticides for various reasons.

Training materials should be prepared for different levels. Communication media should be used to raise public awareness.

Model: Two Week Training Workshops on Insecticide Safety

Trainees: Environmental health officials responsible for preparing insecticide formulations and field applications - Manufacturing technicians and Transporters.

Agenda:
Lectures:

- Local legislation and international guidelines.
- Toxicologic risks of insecticides and their effect on human beings and the environment.
- Health safety and emergency measures.
- Proper applications (materials and techniques).
- Using the right insecticide and dose at the right time.

Discussions:

Attendants should participate in the discussion by demonstrating their own experience in their field of work.

Field Demonstration

Insecticides application in agriculture and public health sector using different methods and techniques should be demonstrated. Emphasis on proper procedure and avoiding common mistakes, should be included.

6.4 Future Special Studies:

As a result of the assessment investigations recommended in item 7.1, a variety of special studies may follow to guide decisions and actions on recognized problems or controversial issues. Based on the familiarity with the Jordan practices as a result of this study, and the general features of the region, the following topics may be considered for special studies:

Development of Formulated Products and Application Techniques

These studies should be conducted to find out the appropriate material and equipment which suit the needs of the country (environmental and climatic conditions) as well as to achieve more efficient insecticides and application methods with the least toxic side effects.

Insecticides Efficiency

The efficiency of different types and different formulations of insecticide (imported and locally formulated) should be studied under local conditions. Results should be analysed for future applications. Persistence of insects to individual insecticide should be documented. Timing for application to achieve the best controlling results should also be studied. It is also important to determine waiting period for individual insecticide used in agriculture (green houses and open fields).

Environmental Effects

Fate studies of the transportation and distribution of insecticides in the local environment are necessary. Also studying the degradation speed and pathways of these substances and their metabolism under local conditions is necessary for tracing the sources of contamination and develop intervention programs to reduce pollution incidents within the country.

Health Safety and Environmental Epidemiology

Following studies related to this matter should be conducted:

- Identification of groups who are exposed to insecticides for long periods of time.
- Collecting of clinical data and hospitalized treatment cases and characterization of each case.
- Studying the relation ship between insecticides exposure and diseases occurrences, i.e. birth defect, cancers neurotic effects ...etc.

Monitoring Programmes

Establishing and conducting monitoring program in the following areas:

- Monitoring of biological exposure data for potentially high risk groups of people (blood, cholinesterase, insecticides level and their metabolism in blood and urine...etc.)
- Monitoring programs to measure insecticides in food (local and imported), water (surface and ground water) and soil.

These programs should be evaluated periodically for future action plans. Laboratories which are involved in such monitoring programs must be well equipped with the necessary modern equipment needed for such analysis. Staff should be well trained to be able to carry out this monitoring program in a proper way and be able to evaluate their results.

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Summary

Insecticides, a major part of pesticides, are used to control and kill insects effecting agriculture and public health. Inspite of the effect of these toxic materials, they also effect the environment and other creatures, including human beings, when precautionary measures and related instructions are not followed.

This report discusses the applications and handling of insecticides through various stages in Jordan, and consequently can serve as a reference for similar studies in countries of the WHO eastern Mediterranean Region.

Following are the most important points covered in this report:

1. Inventory of major insecticides in Jordan:

The report mentions major institutions involved in the field of insecticides as well as their activities and authorities which are related to the following: issuing and enforcing laws and regulations, registration, industry and product control occupational health measures, application in infected areas and conducting applied research in this field.

The major institutions are: Ministry of Agriculture, Ministry of Health, Ministry of Industry and Commerce, Municipalities of Greater Amman, Municipalities of Cities and Villages, Royal Scientific Society, and Jordanian universities. The report list Jordanian laws and instructions which regulate importing, handling, registration, and dealing with insecticides. It includes annual quantities and types of all licensed insecticides in Jordan, in addition to an annex listing names, structure properties, and toxicology of selected common insecticides.

2. Toxicological risks of insecticides:

Misuse of insecticides may cause several toxicological risks to human beings and living creatures. It also may lead to accumulation of toxic materials in the environment especially in soil and water, Exposure to insecticides and consequently poisoning may occur through applications, manufacturing, and residues in food and water. Sensitivity to poisoning depends on the type of insecticides, chemical composition, dose, duration of exposure, age and physical condition.

Insecticides are uptaken by human beings through inhalation, dermal or gastrointestinal. This depends on application techniques and the way of exposure.

The deposition, reconstruction and secretion of insecticides in the body depends on their types and chemical character. The report dealt with the main groups of insecticides used in Jordan with regard to their properties, composition, resistance to degradation, effect on the environment and toxicity.

3. Field case study:

The case study was conducted to collect information on the extent of exposure to the dangers of insecticides in Jordan and the extent to which regulations are followed. The study includes a representative insecticides factory and discusses site, building, available services, raw materials, type of products, production control, electrical equipment, storage, health safety, first aid, waste disposal and emergency measures. The report concludes that the chosen factory adheres satisfactorily to regulations. It also mentions observations about common mistakes practised in this field.

The report also covered general description and comments on the transport and dispatching, selling,

4. Conclusions and recommendations:

The findings mentioned in this report demonstrate example for safe management of insecticides. There is a need for more control to ensure proper handling of these toxic materials. This report can serve a model to guide future activities by member states of the Eastern Mediterranean Region (EMR). in the following activities:

- Assessment of existing insecticide hazards in the EMR.

- Development of appropriate legislation to regulate safe use and handling of insecticides.

- Manpower development.
  Through training courses and workshops on the safe use and handling of insecticides.

- Future Special Studies:

The report provides suggestions for future special studies to guide decisions and actions on environmental problems related to insecticides. The following topics are suggested:

- Development of formulated products and application techniques which meet the need of the country.

- Efficiency of insecticides under local conditions.

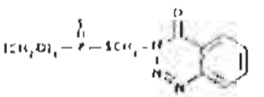
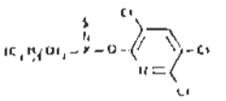
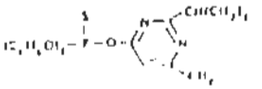
- Effects of insecticides on environment.

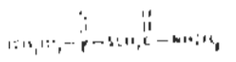
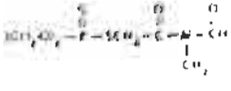
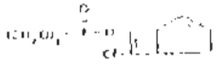
- Exposure and health safety.

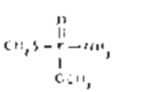
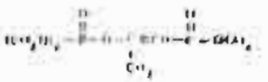
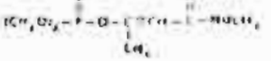
- Monitoring programmes to collect data about exposure to insecticide residues in food and water.

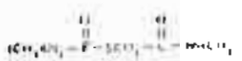
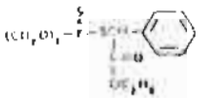
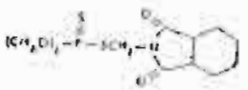
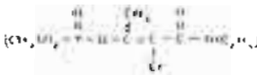
Annex I

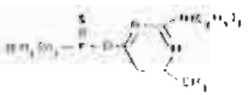
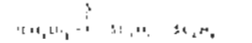
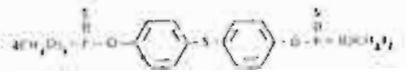
Names, Structures, Properties and Toxicology of Selected Common Insecticides Registered in Jordan

Common Name / Trade Name	Chemical Structure	Properties
Azinophos methyl cotnion gustathion retiltrazotion Group : Organophosphorous	 Toxicology: Acute oral LD50 for rats 16.4mg/kg. ADI for man 0.0025 mg/kg	Colorless crystals Solubility: 33mg/L H_2O, >Kg/L dichloromethane & toluene. Hydrolysis: rapidly by cold alkali or acid.
Chloropyrifos dursban lorsban Group : Organophosphorous	 **Toxicology:** Acute oral LD50 for rats 135-163mg/Kg. **ADI for man** 0.01mg/Kg	Colorless crystals with smild mercaptan odour. Solubility (25°C): 2mg/L H_2O, 6.5kg/kg acetone Hydrolysis: Increase with pH, Temp. Copper 1.5d (50% hydrolysis, pH 8)
Diazinon basudin diazol nucidol Group: Organophosphorous	 Toxcicology : Acute oral LD50 for rats 300-400mg/Kg toxic to honeybees. ADI for man 0.002 mg/Kg	Clear colorless liquid Solubility (25°C) 40mg/L H_2O, completely miscible in polar organic solvents. Hydrolysis 50%-11.77 hr at pH 3.1, 185d at pH 7.4, 6d at pH 10.4
Dichlorovos atgard DDVP task Group: Organophosphorous	 Toxicology : Acute oral LD50 for rats 56-108mg/Kg. highly toxic to birds ADI for man 0.004 mg/Kg.	Colorless to amber liquid with aromatic oder. Solubility (25°C): 10g/L water, miscible in most organic solvents.

Common Name	Trade Name	Chemical Structure	Properties
Dimethoate	Cygon Fotion Rogor Group : Organophosphorous		Colorless crystals. Solubility 21°C 25g/L H2O > 300g/Kg alcohols. Hydrolysis 50%: 12d at pH 9. Toxicology : Acute oral LD50 for male rats 500-600mg/Kg. LD50 for honey bees 0.009mg/Kg ADI for man 0.002mg/Kg.
Fenitrothion	accothion cyfen sumithion Group: Organophosphorous		Yellow brown liquid Solubility 50% 14mg/L H2O >1Kg/Kg ethanol. Hydrolysis (50%) 4.5hr by alkali, in 1Or NaOH. Toxicology : Acute oral LD50 for rats 800mg/Kg ADI for man 0.003 mg/Kg
Formothion	aflix anthio Group: Organophosphorous		Odourless and colorless viscous oil. Solubility: (24°C) 2.6g/L H2O completely miscible in polar organic solvents. Hydrolysis 50%<1d at PH 3-9. Toxicology : Acute oral LD50 for rats 360-500mg/Kg ADI for man 0.02mg/Kg
Heptanophos	Hostaquick Group: Organophosphorous		Pale amber liquid. Solubility : 2.2g/L water miscible with most organic solvents. Toxicology : Acute oral LD5 for rats 96-121 mg/Kg.

Common Name	Trade Name	Chemical Structure	Properties
Malathion Group: Organophosphorous	Carbetox Carbofos Sadafos Zithiol	 Toxicology : Acute oral LD50 for rats 2800mg/Kg. Topical toxicity for honeybees 710ng/bee ADI for man 0.02mg/Kg.	Clear amber liquid Solubility (25°C): 145 g/L. Miscible with most organic solvents.
Methamidophos Group: Organophosphorous	hemidop tamaron	 Toxicology : LD50 for rats 30mg/Kg ADI for man 0.0006mg/kg	Crystalline solid. Solubility (25°C) = 2kg/L water. < 100g/L in benzene, methanol. Decomposition 50% = 140hr at 40 C, pH 2 and 120hr at 37°C and pH 9
Mevinphos Group: Organophosphorous	gentid phosdrin	 Toxicology : Acute oral LD50 for rats 3-12mg/Kg ADI for man 0.0015 mg/Kg	Pale yellow liquid, completely miscible in water and most organic solvents. Hydrolysis 50% = 120d at pH6. 35d at pH 7, 1.4 hr at pH11
Monocrotophos Group: Organophosphorous	azodrin ronocron nuvacron	 Toxicology: Acute oral LD50 for rats 14mg/Kg Highly toxic for honey bees LD50 0.033-0.089 mg/bee ADI for man 0.0006mg/Kg.	Colorless hygroscopic crystals. Solubility: completely miscible in H2O & CH3OH.700g/Kg acetone. Hydrolysis 50%: 96d.at pH 5; 7d at pH 9.

Common Name / Trade Name	Chemical Structure	Properties
Omethoate **dimethexon** **folimat** Group: Organophosphorous		Colorless to yellow oil miscible with water, acetone, ethanol.
	Toxicology : Acute LD50 for rats 50mg/Kg **ADI for man 0.0003 mg/Kg**	
Phenthoate **pap** **tanone** **cicial** Group: Organophosphorous		Colorless crystallin solid Solubility (25°C): 200mg/L H2O 120g/L hexane stable in buffer solution 5.9 < pH < 7.0
	Toxicology : Acute oral LD50 for rate 300-400mg/Kg **LD50 for honeybees 120ng/bee** **ADI for man 0.001mg/Kg**	
Phosmet **decunthion** **imidan** Group: Organophosphorous		**Colorless crystalline solid** **Solubility=22mg/L water, 650g/L acetone.** **Hydrolysis 50% = 13d at pH 4.5, <12hr at pH 7, 4hr at pH 8.1**
	Toxicology : Acute oral LD50 for rats 113mg/Kg **ADI for man 0.02 mg/Kg**	
Phosphamidon **dimetro** **fanfor** Group: Organophosphorous		Yellow liquid, corpletely riscible in water and polar organic solvents. Hydrolysis 50% 60d at pH5, 12d at pH9.
	Toxicology : Acute oral LD50 for rats 17.4 mg/Kg highly toxic to honeybees ADI for man 0.0005 mg/Kg.	

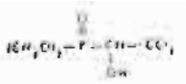
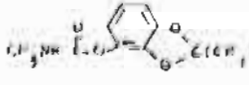
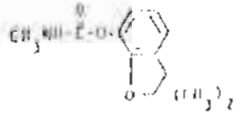
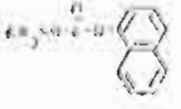
Common Name	Trade Name	Chemical Structure	Properties
Pirimphos methyl	actellic Group: Organophosphorous		Straw colored liquid. Solubility (25°C) = 5mg/L H2O, miscible in most organic solvents. Hydrolyzed by conc. acid & alkali.
Thiometon	ekatin intrathion Group: Organophosphorous		Colorless oil with characteristic odor. Solubility (25°C): 200mg/L H2O, readily soluble in most organic solvents. Hydrolysis (50%)=25d at pH3, 27d at pH6, 17d at pH9
Temphos	abate timitox Group: Organophosphorous		Colorless crystalline solid, almost in soluble in water, hexane, soluble in acetonitrile & toluene. Hydrolysis occurs at 2 < pH < 9 at rate dependent on temp. pH of the medium
Triazophos	Hostathion Group: Organophosphorous		Yellowish oil Solubility (25°C) = 35mg/L H2O, >1Kg/Kg acetone, 310g/Kg ethanol.

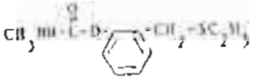
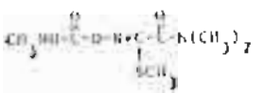
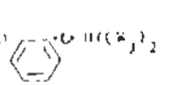
Toxicology : Acute oral LD50 for rats 2050mg/Kg
ADI for man 0.01 mg/Kg.

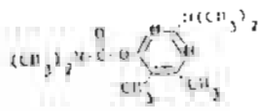
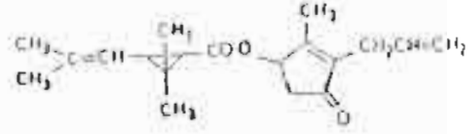
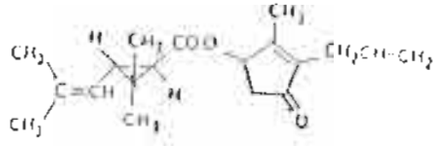
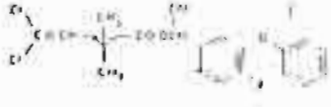
Toxicology : Acute oral LD50 for rats 120-130mg/Kg
ADI for man 0.001 mg/Kg

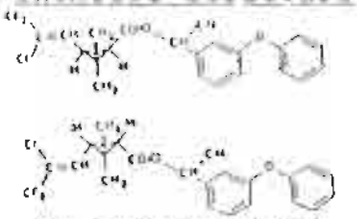
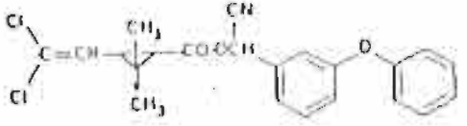
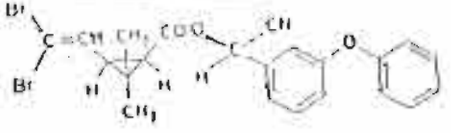
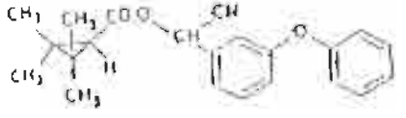
Toxicology : Acute oral LD50 for rats 8600mg/Kg
LD50 to honeybees 0.0015 mg/bee

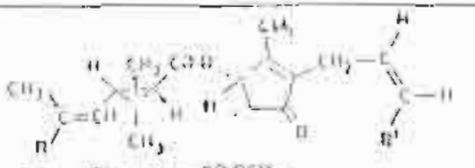
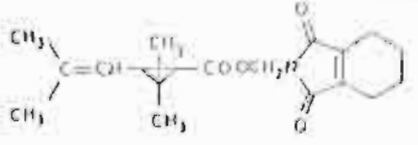
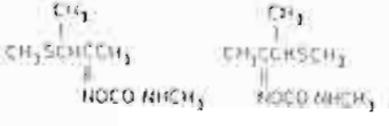
Toxicology : Acute LD50 for dogs 320mg/Kg
ADI for man 0.0002 mg/Kg.

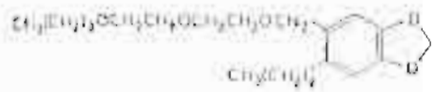
Common Name	Trade Name	Chemical Structure	Properties
Trichlorfon Group: Organophosphorous	anthion dipterex proxol	 Toxicology: Acute oral LD50 for rats 560mg/kg ADI for man 0.01 mg/kg	colorless crystalline powder Solubility (25°C):154g/L H2O soluble in benzene & ethanol, decomposes by hot water & at pH 5.5
Bendiocarb Group: Carbamate	ficar garvox seedox	 Toxicology : Acute oral LD50 for rats 40-156mg/Kg, toxic to honey bees, LD50 0,001mg/bee ADI for man 0.004 mg/Kg.	Colorless solid Solubility (25°C): 40 mg/L H2O 200g/Kg acetone Hydrolysis 50%- 4d at pH7
Carbofuran Group: Carbamate	furan yaltox	 Toxicology : Acute oral LD50 for rats 0.14mg/Kg ADI for man 0.01 mg/Kg	Crystalline solid, solubility Solubility 25°C: 700mg/L H2O, 150g/Kg, acetone unstable in alkaline media.
Carbaryl Group: Carbamate	sevin carbicide	 Toxicology : Acute oral LD50 for male rats 850mg/Kg toxic to honey bees ADI for man 0.01 mg/Kg	Colorless crystalline solid , Solubility (30°C) = 120 mg/L water, 400-450g/Kg, DMF & diemthyl sulphoxide. Hydrolyze rapidly at pH>9

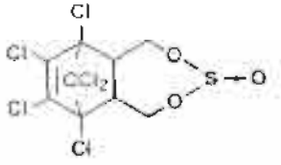
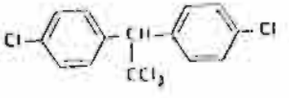
Common Name	Trade Name	Chemical Structure	Properties
Ethiofencarb	croneton Group: Carbamate		Yellow oil, Solubility 25°C: 1.02g/Kg H2O, >600g/Kg dichloroethane. Toxicology : Acute oral LD50 for rats 411-499mg/Kg ADI for man 0.1 mg/Kg
Formetanate	carzol Group: Carbamate		Yellowish crystalline solid Solubility (25°C)- 6.3g/L H2O, 100g/L acetone, 200g/L methanol. Hydrolysis (50%) : 130hr at pH 4, 100min at pH 9. Toxicology : Acute oral LD50 for rats 21.g/Kg
Oxamyl	vydate Group: Carbamate		Colorless crystals with a slight sulphurous odor. Solubility (25°C) : 280g/Kg water, 670g/kg acetone. Decomposition (50%): 7d. in soil. Toxicology : Acute oral LD50 for rats 5.4-8.9 mg/kg ADI for man 0.03 mg/kg
Propoxur	baygon sendran tendex Group: Carbamate		Colorless crystalline powder Solubility (25°C), 2g/L H2O, soluble in most organic solvents. Hydrolysis 50% = 40 min at pH 10 Toxicology : Acute oral LD50 for rats 90-120mg/Kg highly toxic to honey bees ADI for man 0.02 mg/Kg.

Common Name / Trade Name	Chemical Structure	Properties
Pirimicarb aflex pirimor rapid Group: Carbamate	 Toxicology : Acute oral LD50 for rats 147 mg/kg ADI for man 0.005 mg/Kg.	Colorless solid. Solubility 25°C, 2.7g/L H2O, 4.9g/L acetone, decomposed by prolonged boiling with acid or alkali.
Allethrin vape mat Group: pyrethroid	 Toxicology : Acute oral LD50 for male rats 1100mg/kg	Pale yellow to yellow brown liquid. Solubility : >1kg/kg hexane methanol and xylene
Bioallethrin tattak flit aerosol Group: pyrethroid	 Toxicology : Acute oral LD50 for rats 425-575mg/kg	Amber viscous liquid Solubility : virtually insoluble in water,>1kg/kg in hexane
Cyfluthrine baythroid solfac Group: pyrethroid	 Toxicology : Acute oral LD50 for rats 500-800 mg/Kg it is harmful to honey bees.	Pasty yellow mass Solubility (25°C): 2mg/L H2O, 1Kg/L dichloromethane.

Common Name — Trade Name	Chemical Structure	Properties
cyhiothrin karate Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 144-241 mg/Kg ADI for man 0.02 mg/Kg	Yellow brown viscous oil Solubility (20°C):0.003mg/L H2O, 500g/L acetone.
Cypremethrin cyperkill ambo super Group: Pyrethroid	 Toxicology: Acute oral LD50 for rats 251-4123 mg/Kg dependant on isomer, highly toxic to honey bees. ADI for man 0.05 mg/Kg.	Viscous yellowish brown semi solid which is liquid at 60°C. Solubility (21°C):0.009 mg/L H2O, >450g/L acetone. more stable in acid than alkali
Deltamethrin decis Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 135-5000mg/Kg depending on isomers. Highly toxic for honey bees LD50 5ng/bee ADI for man 0.01mg/Kg	Colorless crystalline powder. Solubility (20°C):0.002mg/L H2O, 500g/L acetone. more stable in acid than alkaline media.
Fenpropathrin danitol Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 70.6 mg/kg	Yellow brown solid Solubility (25°C) 0.33mg/L H2O, 1kg/kg xylene.

Common Name	Trade Name	Chemical Structure	Properties
Permethrin Group: Pyrethroid	permasect domexil pif paf	 Toxicology : Acute oral LD50 for rats 430-4000 mg/Kg depending on isomers. ADI for man 0.05 mg/Kg.	Yellow brown to brown liquid Solubility (30°C): 0.2mg/L H2O, 1kg/kg hexane more stable in acid than alkaline media.
Pyrethrins Group: Pyrethroid	ficamplus	 R -CH_3 or -$COOCH_3$ R' -$CH{=}CH_2$ -CH_3 or -CH_2CH_3 Toxicology : Acute oral LD50 for rats 504-900mg/kg highly toxic to fish. ADI for man 0.04mg/kg	Pale yellow viscous liquid. Solubility: sparingly soluble in water, readily soluble in most organic solvents. Hydrolysis: rapidly by alkali
Tetramethrin Group: Pyrethroid	neopynamin raidin	 Toxicology : Acute oral LD50 for rats 5000 mg/kg.	colorless to light yellow brown solid. Solubility (30°C): 4.6mg/L H2O, 20g/Kg hexane, 1kg/kg xylene.
Butocarboxim Group: Carbamate		 Toxicology : Acute oral LD50 for rats 158-215 mg/kg	Liquid, completely miscible in aromatic hydrocarbons.

Common Name _ Trade Name	Chemical Structure	Properties
Fenvalerate Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 451 mg/kg ADI for man 0.02 mg/kg	Viscous yellow or brown liquid. Solubility (20°C) : <1mg/L H2O, 1kg/kg acetone. more stable in acid than in alkaline media.
Flucythrinate cybolt Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 81mg/kg,LD50 for bees 78ng/bee ADI for man 0.02mg/kg	Liquid, Solubility (21°C): 0.5mg/L H2O,> 820g/L acetone Hydrolysis (22°C): 40d at pH5, 6.3d at pH9
Methomyl lannate Group: Carbamate	 Toxicology : Acute oral LD50 for rats 17mg/kg, relatively non toxic for honey bees once spray has dried.	Colorless crystals with sulfurous odor. Solubility (25°C): 58g/Kg water, 720g/kg acetone. Sensitive to sunlight and heat and decompose rapidly in acid and alkali media.
Piperonyl- etisso butoxide star Group: Pyrethroid	 Toxicology : Acute oral LD50 for rats 7500mg/kg ADI for man 0.03 mg/kg	Pale yellow oil stable to light, resistant to hydrolysis.

Common Name / Trade Name	Chemical Structure	Properties
Endosulfan citriplan Group: Organophosphorous	 Toxicology : Acute LD50 for rats 80-110mg/kg highly toxic to fish.	Crystalline solid an odor of sulfur dioxide. Solubility 22°C : 0.32 mg/L Water, 200g/L dichloromethane. Unstable in alkali media.
DDT DDT Group: Organophosphorous	 Toxicology : Highly toxic to micro organisms, fish, terrestrial invertebrates birds, bees and human beings.	White crystalline solid tasteless and odorless. Highly insoluble in water and soluble in organic solvents.

Annex II

Toxicity and Characteristics of Insecticides

Annex II

Toxicity and Characteristics of Insecticides

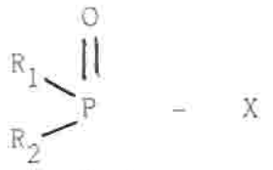
Following is a summary of the most important information concerning toxicity, environmental effects and properties of the major groups of insecticides used in Jordan.

Annex I includes detailed information on the most important insecticides which are widely used in Jordan.

II.1 Organophosphorus Insecticides

II.1.1 General Information

Organophosphorus insecticides are normally esters, amides, or thiol derivatives of phosphoric or phosphoric acid:



They are different from organochlorine insecticides because they degrade rapidly and do not accumulate in the body. Their toxicity is much higher and their reported poisoning cases are much more than that of organochlorine cases.

These compounds are reasonably stable at neutral pH, however, nearly all of them are rapidly hydrolysed by alkali and many are also unstable at pH levels below 2.

Oxidation products resulting from these compounds are dangerous because they are more volatile and become very toxic. This could occur when storing them at high temperature.

II.1.2 Effect on the Environment

All organophosphorus insecticides are subject to degradation by hydrolysis resulting in water soluble products that are believed to be non-toxic at all practical concentrations. The toxic hazard is, therefore, essentially short-term, though the half-life time at neutral pH may vary from a few hours (dichlorvos) to weeks (parathion). If the pH of the soil is slightly acidic (pH 4-5), this half-life time will be considerably multiplied. However, constituents of soil and water may themselves catalyze degradation.

Most organophosphorus insecticides are comparatively of low volatility. Spraying of dispersions may be spread by wind and no evidence of contamination beyond limits of 1-2 km from the spraying source, has been noticed.

Exposure of food materials to organophosphorus insecticides occur mainly during crop-growing stage. Contamination of these materials depends mainly on the interval between applications and harvest and on effects of rainfall which can wash the active agent off and also provide a milieu for hydrolysis.

Organophosphorus insecticides are not very stable in aqueous media. However, accidental leaching may occur from treated areas into rivers and lakes where they may have toxic effects on aquatic organisms before degradation is completed.

Accidental release of insecticides in lakes, rivers and bays, sometimes, cause massive death of fish. These compounds are strongly toxic for small aquatic organisms such as Daphnia.

It is unlikely that considerable amounts of an organophosphorus insecticide, stored in one organism, could survive the hydrolytic processes of consumption and digestion. Degradation in the environment involves both hydrolysis and oxidation to mono-or di-substituted phosphoric or phosphoric acids or their thio analogues. Whatever the precise means of degradation, it is clear that residues of most organophosphorus insecticides are rapidly lost from food crops and are usually barely detectable after 4 weeks of application.

The metabolic fate of organophosphorus insecticides is basically the same in insects, animals and plants. Uptaking by animals and insects may occur through skin, respiratory system, or gastrointestinal tract. The presence of aqueous dispersion agents or organic solvents in a spray concentrate or formulation, may considerably enhance dermal uptake.

II.1.3 Toxicity

Organophosphorous insecticides exert their poisoning effects in both insects and mammals by inhibiting acetylcholinesterase (Ache) in the nervous system with subsequent accumulation of acetylcholine (ACh) which is a neurotransmitter.

The major toxicity of these compound is the covalent binding of phosphate radicals to the active sites of the cholinesterases, transforming them into enzyatically inert proteins, thus inhibit them. This leads to accumulation of acetylchloline at synapses, causing over stimulation and disruption of transmission in the nervous system.

The clinical picture of organophosphorus intoxication results from accumulation of (ACh) at nerve endings. The symptoms of acute poisoning can be summarized in three groups as follows:

a) Muscarinic manifestations : excessive sweating, pinpoint pupils abdominal cramps and bradycardia.
b) Nicotinic manifestations: fasciculation of fine muscles, (diaphragm and respiratory muscles), and tachycardia.
c) Central nervous system manifestations: headache, anxiety, mental confusion and depression of the respiratory centre.

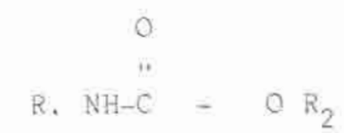
All these symptoms can occur in different combinations, sequence and duration, depending on the chemical, dose, and route of exposure. They may develop rapidly or be delayed for several hours. Symptom may increase in severity for more than one day and may last for several days.

Most mammals have more efficient hydrolytic enzymes than insects and, therefore, are often more efficient in their detoxification processes.

II.2 Carbamate Insecticides

II.2.1 General Information

Carbamates are N-substituted esters of carbamic acid. Their general formula is :



In general, simple esters and N-substituted derivatives of carbamic acid are unstable especially under alkaline conditions. Salts and esters of substitutes carbamic acid are more stable which enhance the stability of synthesizing biologically active insecticides. Carbamate are crystalline solids with low water solubility. They are moderately soluble in benzene toluene and xylene, and highly soluble in polar organic solvents such as methanol, ethanol, acetone.. etc. In general, the vapor pressure of these compounds is rather low, which makes their spread in the environment very low.

II.2.2 Effects on Environment

Bioaccumulation of carbamate in different species and different food chains is low. Their degradation in soil depends on several factors such as leaching, soil moisture, absorption, pH, temperature, photodecomposition, microbial degradation, and soil type.

Carbamates are metabolized or broken down in soil, plants, and animals. Most of the known carbamate metabolites are biodegraded rapidly and are less toxic to the environment than the parent molecules.

The carbamates are degraded easily by soil microorganisms. Environmental conditions that favour the growth and activity of microorganisms also favour their degradation.

Carbamate insecticides absorb radiation available in the solar region and hence would be expected to undergo photo-oxidation as well as metabolic degradation. In water they are subject to photo decomposition under ultraviolet radiation.

Soil microorganisms, are capable of hydrolysing carbamates. Nevertheless, carbamates and their metabolites can affect the microflora and cause changes that may have an important impact on the maintenance of soil productivity.

In general, carbamate insecticides are not very stable under aquatic conditions. When they are deliberately added to an aquatic system, they cause acute toxicity in several fresh-and salt water fish and other aquatic organisms.

An undesirable effect caused by the use of carbamate insecticides is mortality of honey bees, which have a high sensitivity to these compounds.

II.2.3 Toxicity

Health hazards to man occur mainly from over exposure to carbamates.

Most of intoxication cases were spraymen applying insecticides inside houses, or plant protection workers. The main routes of exposure are inhalation and skin.

Poisoning symptoms can be seen few minutes after exposure and can last for few hours.

Most carbamates are active inhibitors of Cholinesterase (ACHE) activity. The regeneration of ACHE is relatively rapid compared with that from phosphorylated enzyme. Carbamate metabolites are generally less toxic than parent compound. Carbamates don't accumulate in mammal bodies, but are rapidly excreted, mainly via the urine and/or feces.

The inhibition of Ache by carbamate esters, causes toxic effects in animals and human beings that result in a variety of poisoning symptoms.

Signs and symptoms of acute intoxication by carbamate insecticides can be categorized in the following 3 groups:

a) Muscarinic: excessive sweating, pinpoint pupils and bradycardia.

b) Nicotinic: fasciculation of fine muscles, diaphragm and respiratory muscles) and tachycardia.

c) Central nervous system: headache, mental confusion and depression of respiratory centre.

All these signs and symptoms can occur in different combinations and can vary in onset and sequence, depending on the chemical, dose, and route of exposure.

II.3 Organochlorine Insecticides

II.3.1 General information

The organochlorine insecticides are usually divided into three main groups comprising compounds related to DDT, &.BHC and Aldrin.

Organochlorine insecticides have important physiochemical characteristics in common. The chemical stability of many members of the above-mentioned groups and their metabolites are high because their molecules are constructed mainly from C-C, C-H and C-Cl bonds. A second physiochemical feature is the low solubility in water. This, coupled with their strongly lypophilic character, leads to their accumulation in biolipids.

Most organochlorine insecticides are waxy solids at room temperature.

Their vapor pressures are low and their volatility leads to atmospheric contamination. &-BHC and most members of the DDT family undergo dehydrogenation in the presence of ethanolic KOH but they are otherwise rather inactive. Some organochlorine insecticides are slowly destroyed by ultraviolet radiation.

II.3.2 Effect on the Environment

The physiochemical properties of organochlorine insecticides and metabolites enable them to be taken readily by organisms. Rates of accumulation vary according to species, duration concentration, exposure and environmental conditions.

Organochlorine insecticides are non-degradable and readily adsorbed to sediments while soil can act as a long-term source of exposure.

Organisms can accumulate these chemicals from the surrounding medium and from food. Such compounds can be transported around the world through the bodies of migrant animals, ocean, and air currents.

It is well known that through manufacturing of organochlorine insecticides, contamination of these products with more toxic compounds such as PCB's and dioxins is possible.

In soil, most organochlorine insecticides persist for months or even years. This happens when high doses are applied to clay soil or to soil rich in organic matters. There is little evidence that, a long-term effect on soil fungi or bacteria, takes place when organochlorine insecticides are applied at normal concentration. However, there may be temporary disturbance in equilibrium, where some soil micro-organisms may suffer a sharp initial decline but then increase again to a higher steady state level.

In plants, there are rapidly transpiring, substantial amounts of even very sparinglly soluble substances which may enter the roots over a period of time and may then move up to accumulate in the edible parts of crops.

Aquatic microorganisms are more sensitive than terrestrial ones. An environmental exposure concentration of 0,1ug/L DDT can cause inhibition of growth and photosynthesis in green algae.

Organochlorine insecticides are highly toxic to fish. Smaller fish are more sensitive than larger ones of the same species.

They can lower reproductivity rate of birds by causing egg shell thinning which leads to egg breakage. However, different groups of birds vary greatly in their sensitivity.

Level of contamination of meat, milk and eggs with organochlorine insecticides is of importance to man especially infants and children, since organochlorine insecticides were detected in meat, milk and eggs of animals fed by contaminated feed.

II.3.3 Toxicity

The toxic effects of members of the three families of organochlorine insecticides differ in detail but all are neurotoxic substances. These insecticides have a destabilizing effect on the nerve membrane. They inhibit one or several enzymes of importance to mechanism of membrane stability or of nerve impulse transmission.

Organochlorine insecticides usually affect the nervous system, causing a variety of poisoning symptoms, among them neuromuscular and behavioral symptoms. A number of degenerative alterations are caused by chlorinated hydrocarbon insecticides, particularly in the liver and the kidney. On the whole, this group of insecticides is not as toxic as the organophosphorous and carbamate insecticides.

II.4 Pyrethroids

II.4.1 General Informations

Pyrethrum is found in the flowers of plants belonging to the family composite and the genus chrysanthemum. Pyrethrum concentrates may be prepared from the ground flowers by extracting with petroleum ether acetone, glacial acetic acid, ethylene dichloride or methanol. After filtration and reextraction, the concentrate contain 90-100% pyrethrins. The pyrethrums are highly unstable in the presence of light, moisture and air. Knowledge of the natural pyrethroids structure made the synthesis of related compounds possible. Their compounds possess similar or higher insecticidal activity than the natural compounds. Furthermore, they are also more stable to light and air.

Pyrethroids are generally esters comprising an acid containing a three - carbon ring joined to alcohol containing a five-carbon ring.

The pyrethroid esters are oily liquids soluble in alcohol, acetone and petroleum ether, but insoluble in water. The esters are unstable and thus lose 20% of their activity every year. These losses can be prevented by adding antioxidants as long as light and water are excluded. In water they are hydrolyzed, the reaction being both acid and base catalyzed.

II.4.2 Effect on the Environment

Because of their physical and chemical characteristics, pyrethroids are comparatively immobile in outdoor environment. Thus spreading between media is restricted. Pyrethroids have very low vapor pressure and water solubility. They are strongly adsorbed from aqueous solutions by solid surfaces. This drastically restricts their movement in air, water and soil in particular.

Pyrethroids are rapidly degraded in soil and in plants. Ester hydrolysis and oxidation at various sites on the molecule are the major degradation processes. The pyrethroids are strongly adsorbed in soil and sediments and hardly extracted with water.

There is little tendency for bioaccumulation in organisms.

Because of low application rates and rapid degradation in the environment, residues in food are generally low.

II.4.3 Toxicity

Pyrethroids have been noticed to be toxic to fish, aquatic organisms and honey bees in laboratory tests.

But in practical usage, no serious adverse effects have been noticed. The toxicity to birds and domestic animals is low.

The rapid knock-down effect on flying insects by pyrethroids suggests that they have a neurotoxic action. The primary target site of pyrethroids in the vertebrate nervous system is the nerve membrane. Pyrethroids without an -cyano group (allethrin) cause a moderate pronologation of the transient increase in sodium permeability of the nerve membrane during excitation.

On the other hand - cyano pyrethroids (cypermethrin) cause a significant prolongation. Pyrethroids may also induce repetitive activity in the various parts of the brain.

Because of the universal character of the processes underlying nerve excitability, the action of pyrethroids should not be considered restricted to particular animals, species, or a certain region of the nervous system.

Laboratory workers and field operators handling pyrethroids have noticed a transient "burning sensation" of the skin in the periorbital area of the face and of other direct skin exposure.

The skin sensations have been interpreted as being caused by spontaneous repetitive firing of local sensory nerve fibers or nerve ending. There is a delay of about 30 minutes before onset of these symptoms following pyrethroids exposure. The sensation generally lasts only a few hours and does not persist for more than one day after exposure.

ملخص

الاستعمال والتأثيرات الناتجة للمبيدات الحشرية

تقرير لدراسة خاصة

المبيدات الحشرية هي جزء اساسي من مبيدات الافات بشكل عام، وهي تستعمل لمكافحة الحشرات في الزراعة والصحة العامة والاغراض المنزلية. وبالرغم من الاثار الايجابية لهذه المواد الكيماوية السامة في قتل الحشرات الضارة فإن لها ايضاً مخاطر على البيئة والاحياء الاخرى وخاصة الانسان فيما اذا لم تستخدم بشكل صحيح مع اتباع التعليمات والاحتياطات الخاصة بذلك في كافة مراحل التعامل.

ويستعرض هذا التقرير استخدام المبيدات الحشرية (كجزء من مبيدات الافات بشكل عام) في الاردن والتعامل معها في كافة المراحل، بحيث يكون مثالاً لتقارير ودراسات مشابهه تجري في هذا المجال في دول اخرى في المنطقة.

وفيما يلي اهم النقاط التي تمت معالجتها في هذه الدراسة:

١. استعراض للمبيدات الحشرية في الاردن

ذكر التقرير اهم الجهات الرسمية والمؤسسات التي لها علاقة بالمبيدات الحشرية واختصاصات وانشطة كل مؤسسة وذلك من حيث اصدار او تطبيق القوانين والتعليمات، تسجيل المبيدات، مراقبة المنتجات والصناعة، اتباع اسس السلامة الصحية والمهنية، استعمال المبيدات في الاماكن الموبوئة واجراء الدراسات والبحوث التطبيقية في هذا المجال.

وفيما يلي اهم هذه المؤسسات:

وزارة الزراعة، وزارة الصحة، وزارة الصناعة والتجارة، امانة عمان الكبرى، البلديات في المدن والقرى، الجمعية العلمية الملكية والجامعات الاردنية.

كما تم ذكر القوانين والتعليمات الاردنية الصادرة بهذا المجال والتي تنظم عملية الحصول على رخص لاستيراد المبيدات وشروط الاستيراد من الخارج والاتجار والتعامل بالمبيدات ومتطلبات التسجيل.

وتم ذكر كميات وانواع مختلف المبيدات الحشرية المستخدمة سنوياً لمختلف الاغراض، كما تم ذكر اسماء كافة المبيدات الحشرية المسجلة في الاردن.

واشتمل التقرير على ملحق ذكر فيه اهم المبيدات الحشرية المستخدمة بكثرة في الاردن وصفات وخواص كل منها.

٠٢ المخاطر السامة للمبيدات الحشرية

ان التعامل الخاطيء مع المبيدات يؤدي الى احداث اثار سلبية على صحة الانسان والحيوان والاحياء الاخرى كما يؤدي الى تراكمها في البيئة كالتربة والمياه.

ويتعرض الانسان لاضرار المبيدات من خلال عدة عوامل كالاستعمال في الزراعة والصحة العامة او من خلال عملية تصنيعها او وجود بقاياها في الغذاء والمياه.

يعتمد الضرر الذي تحدثه هذه المواد في الانسان على نوع المبيد وتركيبه الكيماوي والجرعة وفترة التعرض والعمر والحالة الصحية للشخص.

وتتسرب هذه المواد الى جسم الانسان اما عن طريق الجلد او التنفس او البلغ، ويعتمد ذلك على طريقة الاستعمال وكيفية التعرض. كما انها تتحول او تفرز او تتراكم في الجسم تبعاً لنوعها وتركيبها.

وتم استعراض اهم مجاميع المبيدات الحشرية المستخدمة في الاردن وهي المركبات الفوسفورية والكربماتية والبايرثرويدية والكلورونية وذلك من حيث صفاتها وخواصها الكيميائية والفيزيائية وتركيبها ومقاومتها للتفكك وتاثيرها على البيئة وسميتها.

٠٣ داسة لحالة ميدانية

اجريت هذه الدراسة لجمع المعلومات عن مدى التعرض لاخطار المبيدات الحشرية في الاردن من خلال مراحل التعامل المختلفة، ومعرفة مدى الالتزام في تطبيق القوانين والانظمة الخاص بذلك، وتم اختيار احد مصانع المبيدات الحشرية في الاردن لهذا الغرض.

وقد تم استعراض وضع المصنع من حيث:

الموقع، الخدمات المتوفرة، بناء المصنع، التمديدات والاجهزة الكهربائية، المواد الاولية والمواد المصنعة، مراقبة الانتاج، وصف عملية التصنيع، مكافحة الحريق واستعدادات الطوارىء، التخلص من النفايات والعبوات والسلامة الصحية والاسعافات الاولية.

وقد تبين التزام المصنع بدرجة مرضية بالانظمة والتعليمات الخاصة بهذا المجال.

واستعرضت الدراسة عملية نقل وتوزيع وتخزين وبيع المبيدات الحشرية في الاردن ومدى الالتزام بالاحتياطات الضرورية لذلك.

كما ذكرت الدراسة اهم النقاط التي تمت مشاهدتها عن كيفية استخدام المبيدات الحشرية في الاردن في الزراعة والصحة العامة والاستخدام المنزلي والاخطاء الشائعة في هذه الحالات.

٤. <u>التوصيات والاستنتاجات</u>

بينت المعلومات والمشاهدات التي ذكرت في هذا التقرير اهمية التعامل الصحيح بالمبيدات الحشرية كما بينت ضرورة تشديد الرقابة في هذا المجال. ان هذا التقرير يصلح لان يكون نموذجاً لدراسات وتقارير مشابهه تجري في دول شرق البحر المتوسط.

وقد تم وضع التوصيات التالية في هذا المجال:

١. اجراء دراسات لتقدير مخاطر المبيدات الحشرية الحالية في دول منطقة شرق البحر المتوسط.

٢. دراسة وتطوير القوانين والتعليمات الخاصة بالمبيدات الحشرية في دول المنطقة.

٣. تطوير وتدريب القوى العاملة من خلال اقامة الندوات والدورات التدريبية وورشات العمل المتخصصة في هذا المجال.

٤. <u>دراسات مستقبلية متخصصة</u>

يقترح التقرير تنفيذ دراسات ومشاريع تساعد متخذي القرار في وضع اجراءات تحد من خطورة المبيدات الحشرية واثارها الضارة. ومن المقترح ان تكون الدراسات في المجالات التالية: تطوير خلطات المبيدات وتطوير في اجهزة الاستعمال، فعالية المبيدات الحشرية في الظروف المحلية، تأثيرها على البيئة ومدى تحللها بها، السلامة الصحية للمجموعات السكانية التي تتعرض للمبيدات الحشرية، تنفيذ برامج رصد تحليلية لمراقبة بقايا المبيدات في الغذاء وجسم الانسان والبيئة.