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The exposure of Farmers and their families to pesticides in an agricultural community

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Dedication

To

My father soul
My mother

My husband and sons

My brothers and sisters

With love and respect

Acknowledgments

After thanking *Allah*, who grated me the power to finish this work.

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Abbreviations

GC/MS	Gas chromatography/mass spectrometry
ppm	part per million
EPA	Environmental Protection Agency
CAS	Chemical Abstracts Services
IPM	Integrated Pest Management
WHO	World Health Organization
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
SBuChE	Serum Butyl cholinesterase
AChE	Acetylcholinestrase
NOISH	National Institute for Occupational Safety and Health
PSD	Pesticides Safety Directorate
HSE	Health and Safety executive
FAO	Food and Agricultural Organization
OC	Organoclorine
OP	Organophosphorous
ATSDR	Agency for Toxic Substances and Disease Registry
CPPAES	Children's Post-Pesticide Application Exposure Study
EQA	Environment Quality Authority
UNRWA	United Nation for Work Agency
ARIJ	Applied Research Institute-Jerusalem
SPSS	Statistical Package for Social Sciences
AAPCC	American Association of Poison Control Centers
WRI	Word Resources Institute
DDT	Dichloro diphenyl trichloroethane
CDCP	Centers for Disease Control and Prevention

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Abstract

Continuous use of chemicals such as pesticides has resulted in harmful effects to the environment, caused human illness, and impacted negatively the agricultural production and its sustainability. Farmers and their families are likely to be exposed to agricultural chemicals, even if they are not involved in farm activities. They have higher chances for exposure, directly or indirectly, to pesticides.

Analysis were conducted on fourty three of soil samples collected from several places such as open fields, inside the greenhouses, and nine dust samples collected from the houses, the pesticides stores, and the vehicles of the farmers in the area.

Soil and dust samples were collected from three agricultural areas in eastern Nablus district i.e. Al-Fara'a, Al-Bathan, and An-Nassariyya. The samples were analyzed for the presence of the most widely used pesticides by the farmers in the study area. The samples were analyzed using gas chromatography/ mass spectrometry GC/MS. The detected pesticides were methamidophos, chlorpyrifos, penconazol, endosulfan, and triademanol. Most of the analyzed samples showed considerable residues of the five pesticides.

A questionnaire was developed to assess the knowledge, attitude, practice and toxicity symptoms related to pesticide practice among fifty farmers in the area. Analysis of the returned completed questionnaire revealed that there was a relation between answers of it and the pesticide residues in the soil and dust of the study area. It was concluded that most of the farmers and their families reported suffering from toxicity symptoms due to the exposure to extensive amounts of pesticides. Additionally, farmers reported that they have misused and mishandled these pesticides despite their knowledge about the adverse impact that could result. The highest percentage of self-reported toxicity symptoms was found among the farmers who do not wear protective clothes during the pesticides applications.

Prevention and intervention programmes would include health education regarding the use of protective gear and monitoring the health status of farmers exposed to pesticides.

Chapter One

Introduction

1.1 Introduction

Pesticides are chemicals with harmful effects on both the human beings and the environment (Wilson and Tisdell, 2001). Pesticides are substances that are used to prevent, repel, or destroy pests organisms that compete for food supply, adversely affect comfort, or endanger human health (FIFRA, 1996). These chemicals are known to remain for long periods of times in water, soil, air, and food (Goncalves and Alpendurada, 2005; Lewis *et al*. 2001).

The worldwide consumption of pesticides in (1994-1995) has reached 2.6 million metric tons. Of this, 85% is used in agriculture (Aspelin, 1997). Although the largest volume of pesticide is used in developed countries, its use is growing rapidly in developing countries (Word Resources Institute (WRI), 1998). The quantity of pesticides used per acre of land has also increased (WRI, 1998). In addition to the increase in quantity of pesticides used, farmers use stronger concentrations of pesticides, they have increased the frequency of pesticide applications and increasingly mix several pesticides together to combat pesticides resistance by pests (Chandrasekara et al., 1985; WRI, 1998). These trends are particularly noticeable in Asia and Africa (Wilson and Tesdell, 2001). The recording, educating and controlling of pesticides in the developed countries is formalized based on the guidelines published by the international institutions, such as World Health Organization (WHO), Environmental Protection Agency (EPA). (Lewis *et al*. 2001; WHO 2004).

Some pesticides are not biodegradable and can accumulate; this has aggravated the problem (Bohmont, 1983). Humans may be exposed to pesticides through their occupation, accidental, or inertial routes. Some of these chemicals accumulate and persist in human tissues due to their lipid solubility and resistance to metabolism as organochlorines (OC) (Jandacek and Tso, 2001).

The ability of OC to bioaccumulate has also been seen in predatory animals at the top of the ecological pyramid. In the late 1960's, Dead Sea Eagles in the Baltic and North Sea areas were recorded with up to 36,000 ppm of DDT in pectoral muscle (Bohmont,1983).

OC are retained by fat tissue so they can stay in the body for long time. The fat cells in the breast can store organochlorines and so it can be measured in breast milk. The negative effects of OC can occur within one hour after absorption acute effects can last up to 48 hours. Some organochlorines (Endosulfan) are rapidly and easily absorbed through the skin (Murphy H., 1997). Endosulfan is found in food, soil, water, and in air among other organochlorines (Kumar and Philips, 2006).

Reports on human exposure in Southern Spain to persistent bioacumulable organochlorine pesticides have indicated considerable exposure to endosulfans (Cerrillo I. *et al.,* 2005). Therefore, women of reproductive age in Southern Spain appeared to be currently exposed to endosulfans. Because these chemicals can be mobilized during pregnancy and lactation, further research is warranted to investigate the health consequence in children resulting from exposure to chemicals suspected of immunotoxic, neurotoxic, or endocrine-disrupting effects (Cerrillo I. *et al.,* 2005).

One other commonly used pesticide that persistant in the environment is Organophosphates OP. These groups of pesticides have the tendency to bioaccumulate in the food chain (Blair, Zahm *et al.* 1992). In fact, man as one of the meat-eaters at the top of this food chain could get very high doses of pesticides in this way. Organophosphates, also known as cholinesterase inhibitors, are widely used pesticides that may cause poisoning after accidental or suicidal exposure (Curl *et al.*, 2002; Weiss, *et al.*, 2004; Alavanja, M. *et al.* 2004; Akca T. *et al.*, 2005).

Organophosphates as a class have become the most frequently used pesticides because of their rapid breakdown into environmentally safe products. However, they have far more immediate toxicity than organochlorines and other related products. They are used in agriculture, homes, gardens, and in veterinary practice. They all produce toxicity by inhibiting acetylcholinesterase (AChE) and cause a similar spectrum of symptoms (WHO, 2004; Salvi R.M. *et al.*, 2006; Mourad T.A., 2005; Kawahara *et al.*, 2005).

Symptoms and signs of organophosphorus poisoning include: headache; giddiness; nervousness; blurred vision; dizziness; weakness; nausea; cramps; diarrhea; and chest discomfort. Other might be sweating, pin-point eye pupils, watering eyes, excess salivation, rapid heart beat, excessive respiratory secretions, and vomiting. Advanced stage of poisoning usually result in convulsion, loss of bowel control, loss of reflexes, and unconsciousness. Quick action and proper medical treatment can still save persons in the advanced stages of poisoning, even though they may be near death. (Bohmont, 1983; Murphy H., 1997; Serap A. *et al.*, 2003; Blair A. *et al.*, 2005; Salvi R.M. *et al.*2006).

1.2 Pesticides History & Classification

Under the food and Environment Protection Act 1985, a pesticide is defined as any substance, preparation or organism prepared or used, among other uses, to protect plants or wood or other plant products from harmful organisms; to regulate the growth of plants; to give protection against harmful creatures; or to render such creatures harmless (Weiss, 2004). The term pesticide therefore has a very broad definition which embraces herbicides, fungicides, insecticides, rodenticides, soil-sterilants, wood preservatives and surface biocides among other (PSD, HSE 1998).

More specifically a pesticide may be defined as any chemical used to control pest populations directly or to prevent or reduce pest damage. Though the ending “cide” is derived from the Latin word cida, meaning “to kill,” not all pesticides actually kill the target organism. For example, some fungicides may simply inhibit the growth of a fungus without killing it (Bohmont, 1983). The term pest includes harmful, destructive, or troublesome animals, plants or microorganisms (Klaassen, 2001).

The first recorded use of inorganic chemicals to control insect pests comes from classical Greece. Where the ancient Romans are known to have used burning sulphur to control insects (WHO, 1993). They were also known to have used salt to keep the weeds under control (Bohmont, 1983).

In the Ninth century, the Chinese appear to have independently discovered the value of arsenicals and soon afterwards tobacco extracts were used in Europe. Pyrethrum, a natural insecticide derived from chrysanthemum flowers, and soap were widely used, as was a combined wash of tobacco, sulphur and lime (WHO 1993).

The 1940's witnessed the discovery of most of the major families of insecticides still in use at the end of the century, which are organophosphates, carbamates, synthetic pyrethroids and other organochlorines (WHO, 2004).

Many pesticides are currently in use, there are more than 865 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace (U.S.EPA, 2002).

In Palestine there were 123 pesticide, 14 of them were cancelled or banded, among which are organochlorine (endosulfan) pesticides which are a large group of chemicals, many of which persist in the environment (Saleh, *et.al* 1995). They are of interest because of reports of their ubiquitous persistence in different environmental media, and their ability to bioaccumulate and biomagnifies in food chains, and to their capacity for long-range atmospheric transport (Cerrillo.I *et.al* 2005). There are more than 40 different organophosphate pesticides on the market today, and they each cause acute and sub-acute toxicity, they all produce toxicity by inhibiting acetylcholinesterase (AChE) (Mourad T.A., 2005). Triazol fungicides effects on fertility, sexual behavior, and reproductive organ development (Zarn *et al*, 2003).

These pesticides are commonly used in excessive amounts by farmers in the study area. Most of the farmers reported that they used these five pesticides because the cost of them is low compared with other and they were general pesticide used against many pests. On the other hand some farmers were found using endosulfan which was cancelled or banned so that the author investigates these five pesticides. In addition of the adverse effect of these pesticides on farmers and their children health and on environment.

1.3 Pesticides investigated in this study

1.3.1 Chlorpyrifos (Dursban®)

Chlorpyrifos is an exceptionally well understood and widely studied molecule. More than 250 studies have been conducted examining the uses and impacts of this molecule on human health and the environment (Gibson, 1998). The toxicity of chlorpyrifos like other OP pesticides is attributed specifically to the inhibition of the enzyme acetyl cholinesterase. The use of this insecticide continues to increase both in domestic and agricultural application, a reflection of the safety of this agent relative to the other related compounds. Nevertheless, recent studies indicate that spraying of chlorpyrifos in the indoor environment may pose considerable risk to public health (Rahman *et al*, 2004).

Trade or other names:

Dursban® ' Lorsban® ,Dowco® ,ENT 27311®, OMS 971®,Bordan®, detmol UA®, Empire®, Eradex ®, Paqeant ® , Piridane ®, Scout ®, and Stipend® .

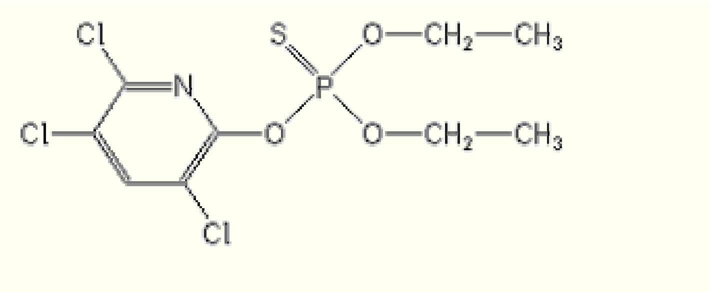
Physical Properties:

***Chemical Name:** 0, 0-diethyl 0-(3, 5, 6-trichloro-2-pyridyl) phosphorothioate .

***CAS Number:** 2921-88-2

***Molecular Weight:** 350, 62

***STRUCTURE:**



1.3.2 Methamidophos (Tamaron®)

Methamidophos is a highly active, systemic, residual organophosphate insecticide/acaricide/avicide with contact and stomach action. Its mode of action in insects and mammals is by decreasing the activity of an enzyme important for nervous system function called acetylcholinesterase. This enzyme is essential in the normal transmission of nerve impulses. Methamidophos is a potent acetylcholinesterase inhibitor (Hussain, 1987).

Trade or other names:

Product names include Monitor®, Nitofol®, Tamaron®, Swipe®, Nuratron®, Vetaron®, Filitox®, Patrole®, Tamanox®, SRA 5172®, and Tam® (Meister, 1995).

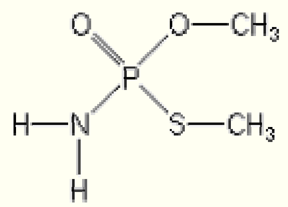
Physical Properties:

***Chemical Name:** O,S-Dimethylphosphora-midothiolate

***CAS Number:** 10265-92-6

***Molecular Weight:** 141.12

***STRUCTURE:**



1.3.3 Endosulfan (Thionex®)

Endosulfan is chlorinated hydrocarbon insecticide and acaricide of the cyclodiene subgroup which acts as a poison to a wide variety of insects and mites on contact. Although it may also be used as a wood preservative, it is used primarily on a wide variety of food crops including fruits, vegetables, cereals, maize and other grains (Cerrillo I. *et al.,* 2005).

Trade or other names:

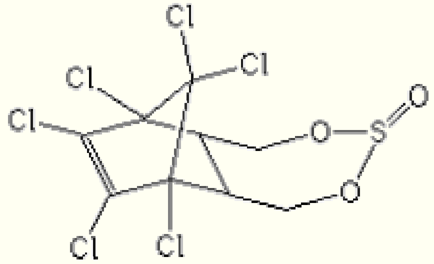
Trade or other names for the product include Afidan®, Beosit®, Cylodan® , Endocel®, Endocide®, Enddosol®, FMC 5462®, Hexasolfan®, Hildan®, Hoe 2671®, Insectophene®, Malix®, Phaser®,Thiodan®, Thimul®, Thifor®, and Thionex®.

Physical Properties:

***Chemical Name:** 6,7,8,9,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9 methano-2,4,3-benzadioxathiepin 3-oxide.

***CAS Number:**115-29-7 (alpha-isomer,959-98-8;betaisomer,33213-65-9).

***STRUCTURE:**



1.3.4 Penconazol (Ofir®)

Penconazole is a systemic triazole fungicide with preventive and curative properties for the control of powdery mildew disease of different crops. It stops the development of fungi by interfering with the biosynthesis of sterols in cell membranes. It is used on fruit, especially apples and grapes, and vegetables (Tokelaar and Koten, 1992).

Trade or other names:

CCA-71818®, Topas®, Ofir®, Topaz®, Omnex®, Award®.

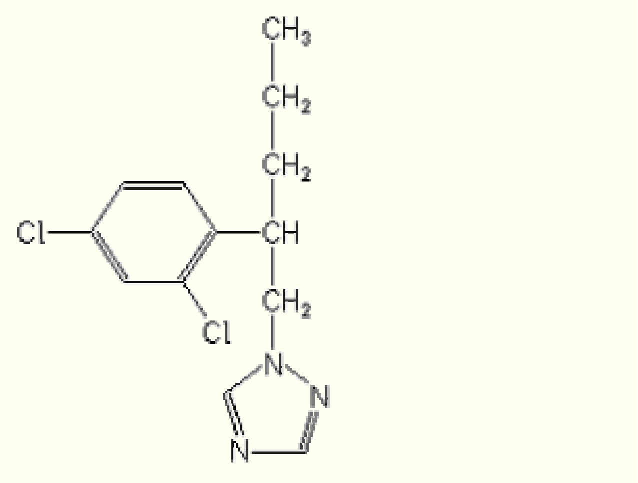
Physical Properties:

***Chemical Name:** 1-(2-(2, 4-diclorophenyl) pentyl)-1H-1,2,4-triazole

***Molecular Formula:** C13 H15 CL2 N3

***Molecular Weight:** 284.2

***STRUCTURE:**



1.3.5 Triademanol (Payfidan®)

It is likely that effects on fertility, sexual behavior, and reproductive organ development will occur depending on dose level and duration of treatment of laboratory animals. Based on the inhibitory activity of triademanol on key enzymes involved in sex steroid hormone synthesis, For human health risk assessment, data on comparative potencies of azoles fungicides to fungal and enzymes activity are needed (Zarn *et al*, 2003).

Trade name: Payfidan®

Physical Properties:

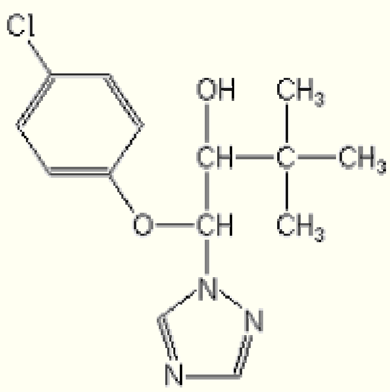
***GAS Number:** 55219-65-3

***Formula**: C14 H18 CLN3 O2

***Chemical Name:** B-(4-chlorophenoxy)-& (1, 1-dimethylethyl)-1H-triazole- ethanol

***Moleccular Weight:** 295.5

***STRUCTURE:**



1.4 Children Exposure

Children represent a sensitive sub-population in terms of exposure to pesticides because they have high metabolic rates and immature immune systems (curl *et al.*, 2002). Children eat more food per Kg compared to adults and have distinctive patterns of activity and behavior (Lu C., 2004).

Children can be exposed to pesticides through a variety of pathways, including dietary and nondietary ingestion, inhalation of indoor and outdoor air, and dermal contact with contaminated surfaces (Lu. *et al.*, 2000). Addition to dietary exposure, children can be exposed to pesticides through contaminated environments. The contamination can come either from the application of pesticides in indoor or outdoor environments for pest control purposes, from agricultural spraying taking place in the community or from parental take-home mechanisms (Lu. *et al.*,2000).

The unique behaviors and activities of children place them at greater risk for heavier exposure to contaminants such as pesticides present in air, water, and soil, compared with adults who live in the same environment (Weiss, 2000). Outdoor play activities of children often result in hand contact with the lawn, soil, or objects on the ground (Lu *.et, al.*, 2004).

Children are less likely than adults to wash their hands before eating, and they often eat without utensils (Weiss, 2004). Their breathing zones are closer to the ground, where pesticide residues accumulate, increasing inhalation exposure to heavier-than-air toxicants and low-lying particulates (Bearer, 2000; Sexton *et al*., 2003).

Farmers and their children may be exposed to higher doses of pesticides than other children of the same age group who live in areas where pesticides are not used. Families of farmers have increased risks of neuroblastoma, nervous system tumors, Hodgkin disease, bone and brain cancer, and childhood leukemia (Andersen *et al*. 1996; Mourad TA., 2005).

One pathway by which children may be exposed to higher levels of agricultural chemicals is take-home exposure. This pathway involves the transport of contaminants from the workplace to the residence by air, water wells, or via workers clothing or body. Compounds that are likely to cling to and are difficult to remove from clothing, shoes, skin, or hair (such as beryllium, asbestos, lead, and pesticides) are potential take-home contaminants, and take-home pathway has been well documented for several of these compounds (Richard A., 2005). Poisonings are particularly common in rural areas and third-world countries where these agents are widely available (Yassin M. *et al*., 2002).

Because children's activities often occur in or near their residence, realistic risk assessments must necessarily involve characterization of children's exposure to Organophosphates in residential settings (Adgate and Sexton 2001; Cohen H, *et al*. 2000; Landrigan, *et al*. 1999; Zartarian, *et al*. 2000; Lu C., 2004).

1.5 Adverse Health Effects of Pesticides on Humans

The major predictors of health risk from pesticide exposure are quantity and toxicity of pesticides reaching end-users, field workers, and persons (including children) with casual and indirect exposures to field and food residues, drift, and contaminated groundwater. Past work of the Palestinian National Authority and Israel have documented risks for acute poisoning, daily illness, transient neurotoxic effects, and potential cancer hazards in workers, populations exposed to pesticide drift, and the general population. Risk assessment predicts that reduction in use of agents with high toxicity and pesticide substitution are desired strategies for achieving the largest reductions in risk, but successful implementation and program sustainability depend on maintaining crop yield and increasing farmer earnings (Richter and Safi, 1997).

A study by Lu, *et al*. (2000) indicated that the take-home pathway (This pathway involves the transport of contaminants from the workplace to the residence by air, water wells, or via workers clothing or body.) is a significant contributor to residential contamination in the homes of agricultural workers. This study provides information on OP pesticide exposure from different pathways for children living in two different geographic communities in Washington State where the use patterns of pesticides are different. In addition to dietary exposure, OP pesticides can influence people through contaminated environments. The contamination can come from the application of OP pesticides in indoor or outdoor environments for pest control purposes, from agricultural spraying taking place in the community (Lu *et al*.,2000), from parental take-home mechanisms (Curl *et al*.,2002). The National Institute for Occupational Safety and Health (NIOSH) recommends educating workers and their families about the risks of take-home exposure and about ways by which they can minimize pesticides risks (Richard A., 2005).

Few studies have compared aspects of farmers exposures to those of non farmers families. Simcox, *et al*. (1995) measured four organophosphorus pesticides in household dust and yard soil from 26 farm homes, 22 farm worker homes, and 11 nonfarm homes in Washington. They found higher levels in the agricultural households. Pesticide concentrations in household dust were significantly higher than in soil for all groups. OP levels in farm worker homes ranged from no detectable to 930 ηg/g in soil and from no detectable to 17,000 ηg/g. in dust; all four OP compound were found in 62% of household dust samples, and two-thirds of the farm homes contained at least one OP above 1000 ηg/g. Residues were found less frequently in reference homes and all levels were below 1000 ηg/g.

These results demonstrate that children of agricultural families had a higher potential for exposure to OP pesticides than children of nonfarm families in this region. Children's total and cumulative exposure to this pesticides class from household dust, soil, and other sources warrants further investigation (Simcox *et.al*.1995).

Loewenherz, *et al*. (1997) measured certain OP metabolites in urine of young children from 48 pesticide applicator families and 14 comparison families in Washington. They found higher levels in children from applicator families. In both of these studies, levels increased with residential proximity to orchards.

Another study by Curl, *et al*. (2002) analyzed OP pesticide exposure in 218 farmers and their households in agricultural communities in Washington State to investigate the take-home pathway of pesticide exposure and to establish baseline exposure levels for a community intervention project. House dust samples (n = 156) were collected from within the homes, and vehicle dust samples (n = 190) were collected from the vehicles used by the farmers to commute to and from work. Urine samples were obtained from a farm worker (n = 213) and a young child (n = 211) in each household. The results of this work supported the hypothesis that the take-home exposure pathway contributes to residential pesticide contamination in agricultural homes where young children may be present.

Hore P., *et al*., (2005) studied The Children's Post-Pesticide Application Exposure Study (CPPAES) which was conducted to look at the distribution of chlorpyrifos within a home environment for 2 weeks after a routine professional crack-and-crevice application and to determine the amount of the chlorpyrifos that is absorbed by a child living within the home. Ten residential homes with a 2- to 5-year-old child in each were selected for study. Pesticide measurements were made from the indoor air, indoor surfaces, and plush toys. In addition, periodic morning urine samples were collected from each of the children throughout the 2-weeks period. They analyzed the urine samples for 3, 5, 6-trichloropyridinol, the primary urinary metabolite of chlorpyrifos. The results were used to estimate the children's absorbed dose. Chlorpyrifos in/on the plush toys ranged from 7.3 to 1,949 ηg/toy post application, with concentrations increasing throughout the 2-weeks period, demonstrating a cumulative adsorption/absorption process indoors. The daily amount of chlorpyrifos estimated to be absorbed by the CPPAES children post application ranged from 0.04 to 4.8 µg/kg/day. During the 2-weeks period after the crack-and-crevice application, there was no significant increase in the amount of chlorpyrifos absorbed by the CPPAES children.

Lu C., (2004) suggested different exposure pathways for children living in agricultural and nonagricultural regions. He found that environmental measurements of OP pesticides were conducted in the homes of 13 children, who lived either in the Seattle metropolitan area or in the agricultural region of Washington State, to ascertain exposure through multiple pathways. Each home was sampled for two 24-hours periods during two seasons, summer and fall. Samples included 24-hours indoor air, drinking water, soil, house dust, and hand and toy wipes and 24-hours duplicate diets. At least one OP pesticide (chlorpyrifos one of them) was found in each of the matrices sampled except for drinking water. Half of the indoor air samples contained detectable levels of chlorpyrifos or diazinon. Quantifiable chlorpyrifos and azinphosmethyl were found on either agricultural children's hands or their toys.

Yassin M., *et al.*, (2002) assessed knowledge, attitude, practice, and toxicity symptoms associated with pesticide use and exposure among 189 farmers in the Gaza Strip. A cross section of agricultural farmers in the Gaza Strip were asked to fill on a questionnaire on knowledge, attitudes, practice towards pesticide use, and associated toxicity symptoms. Farmers reported high levels of knowledge on the health impact of pesticides

(97.9%). Moderate to high levels of knowledge were recorded on toxicity symptoms related to pesticides. Most farmers were aware of the protective measures to be used during applying pesticides. Burning sensation in eyes/face was the commonest symptom (64.3%). The prevalence of self reported toxicity symptoms was dependent on mixing and use of high concentrations of pesticides. The highest percentage of self reported toxicity symptoms was found among the farmers who returned to sprayed fields within one hour of applying pesticides.

Salameh, (2004) used a standardized questionnaire, a knowledge, attitude, and practice study was performed in two Lebanese regions, in which a group of agricultural workers was compared to workers of the general population and a third group of pesticide distributors. Agricultural workers were exposed to pesticides during cropping, mixing, loading, and application (100%). They had low pesticide knowledge scales compared to pesticide distributors and to the general population workers. The preventive measures they took were low, and the lower their knowledge was, the lower were the preventive measures applied. Pesticide safety education is necessary in order to induce protective behavior among agricultural workers. The general population may also benefit from increasing their awareness regarding pesticides.

Rojas M. *et al*., **(**1998) indicated that a public health problem is associated with pesticide use. This study was designed and performed to test methodology and analyze preliminary data on demographics, pesticide usage, health, environment and lifestyles in a representative farming community in Venezuela to determine if pesticide misuse may be contributing to public health problems. A questionnaire was administered in the village selected and a geographic information system was utilized to investigate spatial aspects of the data obtained. Additionally, the geographic analysis showed a cluster of farmers with symptoms on the east side of the village which coincided with reported foul air odor and proximity to farms using pesticides.

In 2003, the Centers for Disease Control and Prevention (CDCP) published a national survey of human exposure to environmental chemicals based on laboratory analysis of blood and urine specimens obtained in 1999–2000. The report provided reference ranges for 116 chemicals, including selected pesticides, measured in a randomly selected sub sample of participants in the National Health and Nutrition Examination Survey. Urine levels of dimethylthiophosphate (a major metabolite of many organophosphate pesticides) were approximately twice as high in children from 6 years old to 11 years of age as in adults 20 to 59 years of age. This finding suggests that children in the United State have had higher levels of exposure to organophosphates than adults.

Mourad TA., (2005) assessed biomarkers in farmers who used OP insecticides to evaluate the health impact of insecticides on Palestinian farmers in the Gaza Strip. Serum cholinesterase and complete blood count were determined before and after spraying of OP insecticides. Burning sensations in eyes/face (62.5%), itching/skin irritation (37.5%), and chest symptoms (29.2%) were reported. Serum Butyl cholinesterase (SBuChE) was significantly decreased at the end of the work day. Burning sensations in eyes/face and skin rash were significantly associated with inhibition of SBuChE activity ($p < 0.05$). Younger workers were more affected. Leukocyte and platelet counts were increased and hemoglobin decreased significantly, reflecting acute poisoning. Monitoring of SBuChE and hematologic parameters of farmers could be useful to predict and prevent health hazards of pesticides.

Cerrillo.I *et al.,* (2005) investigated the presence of endosulfan metabolites in fatty and non-fatty tissues and fluids from women of reproductive age and children in Southern Spain. The highest concentration of commercial endosulfan was found in adipose tissue, with a value of 17.72 ng/g lipids, followed by human milk, with a value of 11.38 ng/mL milk. These findings support the lipophilicity of these chemicals and their elimination by milk secretion. The concentration in the placenta homogenate was similar to that in the blood from the umbilical cord (7.74 and 6.11 ng/mL, respectively) and reflected their lower fat content. Endosulfan diol and endosulfan sulfate were more frequently found in placenta homogenate, with a mean concentration of 12.56 and 3.57 ng/mL, respectively, and in blood from umbilical cord, at 13.23 and 2.82 ng/mL, respectively. Therefore, women of reproductive age in Southern Spain appear to be currently exposed to endosulfans. Because these chemicals can be mobilized during pregnancy and lactation, further research is warranted to investigate the health consequence in children resulting from exposure to chemicals suspected of immunotoxic, neurotoxic, or endocrine-disrupting effects (Cerrillo.I *et al.,* 2005).

Meuling *et al.,* (2004) found that daily occupational exposure to chlorpyrifos may result in accumulation of it and/or its metabolites, possibly resulting in adverse effects. They described the study on the dermal absorption of chlorpyrifos in humans established via urinary excretion of the metabolite 3, 5, 6-trichloro-2-pyridinol. Two dermal, single, doses of chlorpyrifos were applied in two study groups (A and B) each comprising three apparently healthy male volunteers who gave their written informed consent. The latter indicates that an increase in the dermal dose at a fixed area does not increase absorption, which suggests that the percutaneous penetration rate was constant. Further, it was observed that the clearance of chlorpyrifos by the body was not completed within 120 h, suggesting that chlorpyrifos or its metabolites was retained by the skin and/or accumulated in the body. A mean elimination half-life of 41 h was established.

Human health studies by Stoppelli and Crestana (2005) reports an environmental health study on risk identification. It discusses risk factors linked to rural work and pesticide contact in a restricted geographic area and shows the necessity of improving farmer's health in the central part of Sao Poulo State. They focused on environmental problems engendered by modern agriculture that may have human health repercussions such as cancer, as indicated by hard statistical association on an extended cause effect time scale. The study indicated an almost two times higher probability of cancer development among farmers, with a calculated relative risk between those exposed farmers and the none exposed (other occupations) of 1.6. No patterns of geographical distribution of cancer in that time period were recorded among rural workers of Bariri.

Soliman and Smith *et al.*, (1997) examined serum organochlorine levels among 31 Egyptian colorectal patients and 17 controls who were healthy friends of other cancer patients. Controls were deliberately chosen from different but similar geographic areas than cases to avoid sampling controls that had been exposed to the same dose of pesticides in the same locale as cases. This appears to introduce the possibility of significant selection bias into the study. High levels and large inter-individual variability of organochlorine levels were found among most subjects, especially those from rural areas. Farming and aging were each associated positively with high serum organochlorines. While the paper reports colorectal cancer patients having higher serum organochlorines levels than controls, this was not significant. In addition, the presence of cancer may have altered the body state of cases that were on average lighter than controls. This may in turn have had an influence on organochlorine storage and blood levels.

Webster, (2002) reported that Organophosphate-based pesticides have been associated with pathology and chromosomal damage in humans. There are also epidemiologic links with cancer. The few screening tests for low-level occupational exposure are of doubtful sensitivity; this investigation evaluated four methods. Blood samples were studied from 10 farmers before and after occupational exposure to organophosphate-based pesticides and five unexposed controls. The standard cholinesterase test was insensitive to the exposure. Cytogenetic studies on routine and aphidicolin-induced blood cultures revealed that following OP exposure the total number of gaps and breaks on human chromosomes was significantly increased. Nuclear damage resulting from low-level occupational exposure to OP, such nuclear damage could be implicated in carcinogenesis. The development of bladder cancer is one such example (Webster, 2002).

Daniels and Olshan *et al*., (1997) conducted an epidemiologic studies which were published between 1970 and 1996 examined the possible association between pesticides and the risk of childhood cancers, the review found thirty-one relevant studies. In general, the reported relative risk estimates were modest and appeared to be stronger when pesticide exposure was measured in more detail. Frequent occupational exposure to pesticides or home pesticide use was more strongly associated with both childhood leukemia and brain cancer than either professional exterminations or the use of garden pesticides. Occupational pesticide exposure has also been associated with increased risk of Wilms' tumor, Ewing's sarcoma, and germ cell tumors.

Salvi *et al*., (2003) reported that long-term exposure to low levels of OP pesticides may produce neuropsychiatric symptoms. They performed clinical, neuropsychiatric, and laboratory evaluations of 37 workers involved in family agriculture of tobacco from southern Brazil who had been exposed to OP for 3 months, and in 25 of these workers, after 3 months without exposure to OP. Clinically significant extra pyramidal symptoms were present in 12 of 25 subjects, which is unexpected in such a population. There was a significant reduction of extra pyramidal symptoms after 3 months without exposure to OP, but 10 subjects still had significant Parkinsonism.

It is widely reported that most pesticide related deaths involve acute poisonings rather than chronic exposure (WHO, 2004). In the US, a descriptive analysis of national mortality data, National Hospital Discharge

Survey data, and American Association of Poison Control Centers (AAPCC) national data from 1985 to 1990 found 341 fatalities from agricultural chemicals over the 6-year period, of which 64% were suicides, 28% were unintentional, and 8% were of undetermined intent (Schwartz k., and Smith G., 1997).

Recena M. *et al*., (2004) found that exposure to pesticides has been the source of many acute and chronic health problems in the rural population, mainly in developing countries. The objective of this study was to characterize the poisonings from acute exposure to agricultural pesticides used in the state of Mato Grosso do Sul, Brazil. Insecticides were involved in 75.7% of the poisoning cases, followed by herbicides, with 12.2% of the cases. The anticholinestherase insecticides methamidophos, carbofuran and monochrotophos were the primary pesticides involved in the poisonings.

Kristensen and Irgens *et al.,* (1997) compared the prenatal health of 192,417 children born to parents identified by agricultural census as farm holders, with 61,351 births to non-farmers in agricultural municipalities. Subjects were matched with the Medical Birth Registry of Norway, which comprises all births with more than 16 weeks of gestation. Prenatal mortality between the two groups was similar, but the proportion of late-term abortions (gestational weeks 16-27) was higher among farmers' births. The increase in late-term abortion among the farmers could to some extent be attributed to an excess of mid-pregnancy deliveries among grain farmers.

Some of the publications concentrated on the effect of the pesticides mobility by dust from the farmers to the houses of the farmers and effect of this mobility of the health situation of children

They found the concentrations of pesticides in blood and in urine and try to found the influence of using high concentration of these pesticides on the health of the human. On the other hand part of the studies developed a relation between the health situation of farmer and their families and the wearing of protective cloth during the spraying pesticides.

Most of the studies were done on agricultural communities and the obtain result are compared with the results obtained on the non agricultural communities.

Our literature survey revealed that no work has been done on the influence of the health of farmers and their families in Palestine. The aim of the present work is to study the effect of using excessive amount of pesticides on the health of the farmers and their families in agricultural area in eastern of Nablus and try to estimate the influence of exposure to pesticides on the health of the farmers and their families through a questionnaire investigative the filled by investigator after an interview with the farmers, to investigate the take-home path-way of pesticide exposure among agricultural families and to establish a baseline of exposure in communities in Palestine

1.6 Pesticides utilization in Palestine

The total cultivated area in Palestine is 89.6% which around 1861 thousand donums in 1997-1998 (PCBS, 2006), In West Bank it is around 2 million dunums. Of this, only one hundred thousand dunums are under irrigation, while 1.6 million dunums are fallow lands (ARIJ, 1995). It is estimated that 96.6 % of irrigated land and 87.0% of rain fed land is treated with pesticides.

In west Bank as is indicated in Table (1), the total area treated with pesticide is 383.453 dunums, 77% of which under rain fed farming and 23% of which is under irrigated farming. Still, irrigated farming accounts of about 72% of total pesticides consumption. This is due to the intensive nature of cropping methods used in irrigated farming (saleh *et. al*, 1995). The quantities of pesticide used by district and by cropping pattern shows in Table (2).

The average seasonal consumption of pesticides was found to be around 4 kg/dunum in open irrigated fields and 6.5 kg/dunum under plastic houses in areas Tulkarm, Jenin, and Jerico areas (ARIJ, 1995).

A total of 123 pesticides currently being used in West Bank. Among them, fourteen pesticides are internationally suspended, cancelled or banned (Saleh *et.al*, 1995).

West Bank agriculture has in the last few year, increased in sophistication, and this has had many negative side effects, of which the over use of pesticides could prove to be the most serious problem facing the Palestinian agriculture (Saleh *et.al*,1995).

The lack of mechanisms, institutions and laws which control and monitor the sale and proper application of pesticides has left pesticide use in Palestine virtually unrelated. In general, farmers in Palestine are unaware of the risks associated with the use of agrochemicals of all kinds of pesticides, and their source of information is limited to their own experience, word of mouth, extension agents and pesticide-selling agents (ARIJ, 1995).

Palestine face problems in excessive and misuse of pesticides lead to insect resistance, high residue level in crops, environmental pollution, and increasing in the cost of production (ARIJ, 1995).

Table (1): Areas treated with pesticides in districts according to crop patterns (dunum)

District	IRRIGATRD FARMING				RAINFED FARMING		
Crop patterns	**Vegetables in Plastic Houses**	**Veg. in Open Field**	**Trees**	**Field Crops**	**Vegetables**	**Trees**	**Field Crops**
Nablus	**13**	**1945**	**1500**	**0**	**1650**	**5535**	**16450**
Tulkarem	**5710**	**8021**	**13000**	**0**	**12000**	**9260**	**40000**
Jenin	**210**	**12000**	**1740**	**0**	**12000**	**9260**	**40000**
Jericho	**120**	**29985**	**6411**	**6120**	**0**	**0**	**22**
Ramalla	**20**	**1131**	**0**	**0**	**4100**	**37560**	**7000**
Hebron	**0**	**526**	**0**	**0**	**9630**	**74744**	**12800**
Subtotal	**6073**	**53608**	**22651**	**6120**	**33510**	**168719**	**92772**
Total	**88452**				**295001**		

(Saleh *et al*., 1995)

Table (2): quantities of pesticide (tons per year) used by district and by cropping pattern.

DISTRICT / CROP PATTERNS	Nablus	Tulkarem	Jenin	Jericho	Ramalla	Hebron	TOTAL
Irrigatrd Trees	0.078	9.050	1.514	2.735	0	0	14.079
Irrig. Field Crops	0	0.004	0	1.281	0	0	1.285
Irrig. Veg. in Plastic Houses	0.084	18.843	0.840	0.720	130.	0	20.617
Irrig.Veg. in Open Field	2.114	12.834	25.20	77.961	0.960	0.288	119.335
Subtotal	2.978	40.731	27.554	82.697	1.090	0.266	155.316
Rainfed Trees	5.958	12.262	1.986	0	17.867	45.407	83.480
Rainfed Field Crops	3.420	3.670	4.00	0	1.445	2.740	15.275
Rainfed Vegetables	4.390	1.560	2.50	0	6.410	20.888	35.748
Subtotal	13.768	17.492	8.468	0	25.722	69.035	134.503
TOTAL	16.476	58.223	36.04	82.697	26.812	69.301	289.819

(Saleh *et al*., 1995).

1.7 Study Area Location

Wadi Al-Fara'a is located in Al-Fara'a catchment which is located in the northeastern part of the West Bank and extends from the ridges of Nablus Mountains down the eastern slopes to the Jordan River and the Dead Sea. Al-Fara'a catchment overlies three districts of the West Bank. Those are: Nablus, Tubas, and Jericho district and have area of about 334 km^2 which accounts for about 6% of the total area of the West Bank (5600 km^2).

Al-Fara'a wadi (Al-Bathan, Talluza, Al-Fara'a, Al-Aqrabaniyya, Beit-Hassan, Ein Shibli, Froush Beit Dajan, An-Nassariyya, and then lower part of the catchment east to reach Al-Jiftlik agricultural area (237m elevation). Nablus is the upper part of the catchment (570m elevation).

Within Al-Fara'a catchment there exist 13 fresh water springs and 70 ground water wells. The fertile alluvial soils, the availability of water through a number of springs and the meteorological conditions of the catchment made it one of the most important irrigated agricultural areas in the West Bank. The population of Wadi Fara'a is distributed mainly in small villages; the rural population of the area is estimated at 20.261 people living in poor economic and environmental conditions.

Agriculture is the most common economic activity in the area. In addition to agriculture, there are few small industrial and commercial activities in the area. The upper area has few touristic activities and touristic facilities. However, these activities were highly impacted by the closure of roads and the restrictions on travel.

Agricultural patterns in the area include rainfed and irrigated agriculture. Rainfed agriculture includes rainfed vegetables, field crops and rainfed trees. Rainfed agriculture is mainly in the upper areas as it is not feasible in the lower areas because of the small amounts of rainfall there. The most common rainfed crops are olive trees especially in the upper areas of Talluza and Al-Bathan where olives cover more than 10,000 dunums. Field crops cover approximately 5,000 dunums mainly in Al-Fara'a and An-Nassariyya. Rainfed vegetables cover less than 1,000 dunums which are also in the upper parts of the Wadi. The economic returns of rainfed agriculture are much lower than irrigated agriculture.

Irrigated agriculture is the most important economic activity in the Wadi. Irrigated agriculture includes open field vegetables, greenhouses and irrigated trees. Open field vegetables cover more than 20,000 dunums. The climate allows production of vegetables all year in the Wadi which made a very important area in the West Bank for the production of vegetables. Greenhouses usually have much higher returns than open field vegetables as the productivity under greenhouses is much more than that for open field crops. However, greenhouses require more investments. For irrigated trees, the most common irrigated trees in the Wadi are citrus trees which cover about 3,000 dunums. However, due to the high prices of water and the salinity of water especially in the lower areas, farmers are uprooting citrus trees to replace them by vegetables, grapes or palm dates.

Table (3) presents a summary of agricultural pattern in Wadi Al-Fara'a.

Irrigated agricultural sector is considered the backbone of Palestinian economy in the area, in the area of Wadi Al-Fara'a, irrigated agriculture forms 90% of the total current agriculture, Annual production is generally affected by the dominant climatic conditions, reflecting substantial variation between the various years. The traditional irrigated cropping systems include vegetables and trees.

Table (3): summary of agricultural pattern in Wadi Al-Fara'a

Agricultural areas of Wadi Al-Fara'a	Total area for irrigated vegetables	Total area for non-irrigated vegetables	Total area for irrigated trees.	Total area for non-irrigated trees.	Total area for rain fed field crops	Total area for irrigated field crops
Bathan and Talluza	**39**	**54**	**245**	**9 943**	**120**	**5**
Ras Al-Fara'a	**4 346**	**210**	**478**	**540**	**950**	**150**
An-Nassariyya	**3156**	**811**	**1 342**	**2**	**4 550**	**557**
Froush Beit Dajan	**132**	**0**	**1298**	**0**	**361**	**5**
Al-Jiftlik	**13 315**	**0**	**307**	**0**	**0**	**1 325**
Total	**20 997**	**1075**	**3670**	**10485**	**5981**	**2042**

(EQA, 2006).

Environmental degradation includes problems related to agricultural sector such as inefficient irrigation, intensive use of agrochemicals and improper management of agricultural waste. These problems are considered quite significant taking into account the importance of the agricultural sector to economy and tradition.

The pollution caused by industry, energy utilization as well as transportation is also affecting the environment in terms of industrial and hazardous waste generation and air emissions from fixed and mobile sources.

The fact that Al-Fara'a area is a major agricultural area in Palestine with both rural and urban centers, which are producing a load of pollution to the surrounding environment, justifies the high importance given to the area.

1.8 Research Objectives

There is limited data about the use of pesticides in Palestine. Therefore, the aim of the present work is to study the effect of using excessive amount of pesticides on the health of the farmers and their families in agricultural area in eastern of Nablus, and try to obtain data about the utilization and handling of pesticides in the agricultural community, and to estimate the influence of exposure to pesticides on the health of the farmers and their families through a questionnaire investigator after an interview with the farmers, to investigate the take-home path-way of pesticide exposure among agricultural families and to establish a baseline of exposure in communities in Palestine.

Samples were obtained and analyzed from Wadi Al-Fara'a mainly for chlorpyrifos, methamedophos, endosulfan, penconazole, and triadimenol, which were chosen because of their frequent use, presence in multiple environmental media, expected population exposures, and associated toxicity as mentioned by the farmers in the questionnaire.

As expected by Dr. Hakam Ershade after an interview in medical clinic of An-Nassariyya that the farmers and their children have many adverse health due to pesticides exposure and their were six farmers (cancer patients) in the year 2006 died in An-Nassariyya area. So the expected out put is to establish a relation between the health situation of the farmers and their families and the misuse of the pesticides in the studied areas in Wadi Al-Fara'a.

Chapter two

Materials and Methods

2.1 Equipment used in this study

All chemicals and solvents used in the present work are of analytical grade.

2.1.1 Field equipments

1- A metal spatula used for collection of soil samples.

2- Polyethylene bags.

3- Sieve (U.S standard, 2mm stainless steel).

2.1.2 Laboratory equipments

Soxhlet extraction apparatus, consist of 125-ml round bottom flask, siphon100-ml capacity (33×80mm thimble), and a regulated heating mantle.

2.2 Preparation of pesticides standard solutions:

2.2.1 Chlorpyrifos standard solution

A stock 1000 ppm solution of chlorpyrifos was prepared by transferring exactly 0.22ml of (450g/L) solution of chlorpyrifos (Dursban®) (Dow Agro Sciences, Israeli) into a 100-ml volumetric flask. The volume was completed to the mark with hexane.

2.2.2 Triademanol standard solution:

A stock 1000 ppm solution of triademanol was prepared by transferring exactly 0.4 ml of (250g/L) solution of triademanol (Payfidan®) into a 100-ml volumetric flask. The volume was completed to the mark with hexane.

2.2.3 Endosulfan standard solution:

A stock 1000 ppm solution of endosulfan was prepared by transferring exactly 0.285 ml of (350g/L) solution of endosulfan (Thionex®) into a 100-ml volumetric flask. The volume was completed to the mark with hexane.

2.2.4 Penconazol standard solution:

A stock 500 ppm solution was prepared by dissolving exactly 50 mg of penconazol in 100 ml of hexane.

2.2.5 Methamidophos standard solution:

A stock 500 ppm solution was prepared by dissolving exactly 0.083 ml of (600g/L) solution of methamidophos (Tamaron®) into a 100-ml volumetric flask. The volume was completed to the mark with hexane.

2.2.6 Internal standard solution:

A stock solution of 1000 ppm Methyl tricosonoate as internal standard solution was prepared by dissolving 50 mg in 50 ml hexane. The working solution of 25 ppm was prepared by diluting 2.5 ml of the stock solution to 100 ml with hexane.

2.2.7 Mixed pesticides standard solution:

A solution containing 25 ppm of each of the pesticides and the internal standard was prepared from the standard stock solutions. Exactly 1.25 ml of each of the stock solutions of chlorpyrifos, triademanol, endosulfan, and 2.5 ml each of the stock solutions of penconazol and methamidophos were transferred into a 50-ml volumetric flask. Exactly 1.25 ml of the internal standard stock solution was added and the volume was completed with hexane.

2.3 Quantitative determination of pesticides in environmental samples

The collected samples were:

- Soil from inside the greenhouses.

- Soil in the open field farms.

-Dust collected from in front of the farmer's houses.

-Dust collected from the vehicles used by farmers for transportation between their houses and farms.

Dust collected from the farmer's private pesticide stores.

Five pesticides (chlorpyrifos, methamedophos, endosulfan, penconazole, and triadimenol) were targeted for analysis in the samples. These five pesticides represent the major pesticides applied in the agricultural areas

2.4 Sampling and analysis used.

2.4.1 Soil sampling:

Soil samples were collected from different locations in eastern of Nablus district agricultural area in Al-Fara'a, Al-Bathan, and An-Nassariyya, from open field and closed field (inside the greenhouse).

The locations from which the soil samples were collected are situated in agricultural area (cultivated with different types of crops: cucumber, tomato, potato, green pepper, cauliflower and peas).

Forty three soil samples were collected as follows:

- 22 soil samples were collected from closed agricultural area (inside greenhouses).
- 21 soil samples were collected from open field agricultural area.

A composite soil samples, consisting of approximately 150 g were collected from five different locations within this area using a metal spatula one meter between each sample and other one in the same field, at depth level from 0 to 10 cm because this layer is indirect contact with the farmers and their children when they do their activities in the agricultural area that place them at greater risk for exposure to pesticide. Each sample was grinned and sieved. About 100 g of each sieved soil sample was kept in polyethylene bag and then stored in the refrigerator at 2-5°C, till analysis for pesticides residues were performed.

2.4.2 Extraction of pesticides from the soil samples

The pesticides residues from the collected samples were extracted using soxhlet extraction: About 10 grams of each sample were weighed out accurately, then placed in a filter paper and inserted into the extraction thimble after folding. Thimble was placed in soxhlet, supporting with spiral condenser.

About 100 ml acetone was transferred into the round-bottom flask and few anti bumping chips were added to the flask.

The sample was refluxed for five hours (welfare and sport, 1996). The heat was adjusted so that extractor siphons approximately thirty times per hour. The solution was filtered and evaporated to dryness using water bath (70 ºC), then the residue was diluted with 2 ml of working internal standard solution, transferred into a 2-ml vial and stored at -30 ºC until the GC/MS analysis.

2.4.3 Dust sampling

Dust samples were collected from different locations in the same area from where the soil samples were collected. (Al-Bathan, Al-Fara'a and An-Nassariyya agricultural areas).

These samples were taken as follows:

Nine dust samples were collected from the location:

- Four dust samples were collected from areas around the house where the parents had identified as common play areas for their children.

The average distance between the houses and the farms was in the range 200-500 meter.

- Three dust samples were collected from the vehicles used by the farmers to go to and come back from work.

- Two dust samples were collected from the farmer's private pesticide stores, (because only two farmers have real stores).

Dust samples were collected mixed and sieved. About 50 gm was kept in a polyethylene bag and then stored in the refrigerator at 2-5°C till analysis for pesticides residues were performed.

2.4.4 Extraction of pesticides from the dust samples:

The pesticides were extracted from the dust samples following the procedure used in section 2.4.2 for soil samples.

2.5 Questionnaire:

A questionnaire was prepared to be filled by the farmer after an interview to obtain data about the utilization and handling of pesticides in an agricultural community, and to estimate the influence of exposure to pesticides on the health of the farmers and their families. To investigate the take-home path-way of pesticide exposure among agricultural families and to establish a baseline of exposure in communities in Palestine. It includes questions and information related to environmental impact of pesticides on health of farmers and their families.

The target group was agricultural farmers and their families in three agricultural areas in the eastern of Nablus district Al-Fara'a, An-

Nassariyya, and Al-Bathan. The farmers were asked to fill out the questionnaire, which includes questions and information related to environmental impact of the pesticides on the health of the farmers and their families, and to the knowledge, attitude, practice towards pesticide use, and associated toxicity symptoms.

The questionnaire was designed for this study and it is composed of three sections. The first section included questions related to: Social information, for example, area, age, education, and marital status of the farmer; if his children or wife works with him; kind of the field open or closed field (greenhouse); Information from questions relevant to pesticide exposure pathways have been incorporated into this analysis. The second section included practice questions such as: wearing protective clothes; If the clothes were cleaned in the same laundry with other family cloths; following label instructions and agronomist guiding; re-entry period in the farm after applying pesticides; whether the farmer smoke, eat, drink, or chewing gum during application of pesticides; having a water bath or not after application; and whether they complied with the safety period and concentration recommended, either by the agronomist or by the pesticide label. The third section contained questions related to the health impact of exposure to pesticides (self reported toxicity symptoms associated with pesticides use); knowledge of the acute and chronic toxicity of pesticides, prohibited pesticides, effect of pesticides on human health, other alternatives to pesticides, the route of pesticide entry into the human body, and names of pesticides used; and attitudes regarding the use of pesticides and protective equipment or clothes during preparation and application of pesticides. The farmers were selected randomly from different locations in each Al-Fara'a, Al-Bathan, and An-Nassariyya.

The questionnaire was filled after an interview with the farmers, Appendix (A). The questionnaire was based on United States Environmental Protection Agency questions, WHO questions, and on that used in similar studies with some modifications (Yassin M. *et al*., 2002). Statistical analysis was performed using statistical package for social sciences (SPSS).

A relation between the results of questionnaire, the health condition of the people in the agricultural community and the degree of contamination of the samples analyzed will be discussed in chapter 3.

2.6 Gas chromatographic/ mass spectrometric conditions

The GC/MS technical are widely used for the analysis of pesticides due to its sensitivity and selectivity.

The soil and dust extracts containing pesticides were analyzed using GC/MS in the selected ion monitoring mode. The obtained results were compared with the results obtained for standards analyzed under the same conditions.

The GC/ MS apparatus (QP 5000, SHIMADZU, Japan) was used in the selected ion monitoring mode. It was supported with auto injector

(AOC-17) Class 5000 software and capillary column DB-SMS (5% phenyl Methylelopolysiloxane) of 0.25μm film thickness, 30 meters length and 0.25mm I.D (J. and W. Scientific).

Chromatographic analysis was performed under the following conditions: injector temperature was set up at 250°C, GC/MS interface was adjusted at 280°C, and helium carrier gas with 6.2 ml/min as a total flow rate at 25°C was adjusted at 1.2 ml/min flow rate. The sample quantity of 2 μL was used in the split less injection mode. The oven temperature was programmed as follows: 100 °C for 1 min, then raised, ramp at 5 °C/min to 320 °C then hold 10 min.

This program of temperature used is effective in spite of being long

(Total time at 55 min) since this duration is required for removing the other components in the lack of an additional step of cleaning-up.

Analysis of the final extract of each sample was done using gas GC/MS with selected ion monitoring mode.

The obtained results were compared with those obtained from the mixed pesticides standard solution analyzed under the same conditions. The retention times of the standard pesticides and the relative retention times are presented in Table 4.

2.7 Retention time of the pesticides used in the study:

The identification of the five pesticides was realized by measuring the retention times obtained when standard solution was injected into the gas chromatograph. The absolute retention times and the relative retention times to Methyl tricosonoate (as internal standard) for the five pesticides (Methamidophos, Chlorpyrifos, Penconazol, Triademanol, and Endosulfan) are presented in Table 3.

Typical chromatograms of mixed standards of real soil sample analyzed using ion-monitoring mode are presented in Fig.1 and 2.

Table (4): retention times of standard pesticides analyzed following the recommended procedure.

Standard pesticides	Retention time(min)	Relative retention time(min)
Methamedophos (Tamaron®)	**4.287**	**0.27**
Chlorpyrifos (Dursban®)	**9.102**	**0.57**
Penconazol (Ofir®)	**9.84**	**0.61**
Triademanol (Payfidan®)	**10.148**	**0.63**
Endosulfan (Thionex®)	**10.67**	**0.66**
Methyl tricosonoate	**16.1**	**1**

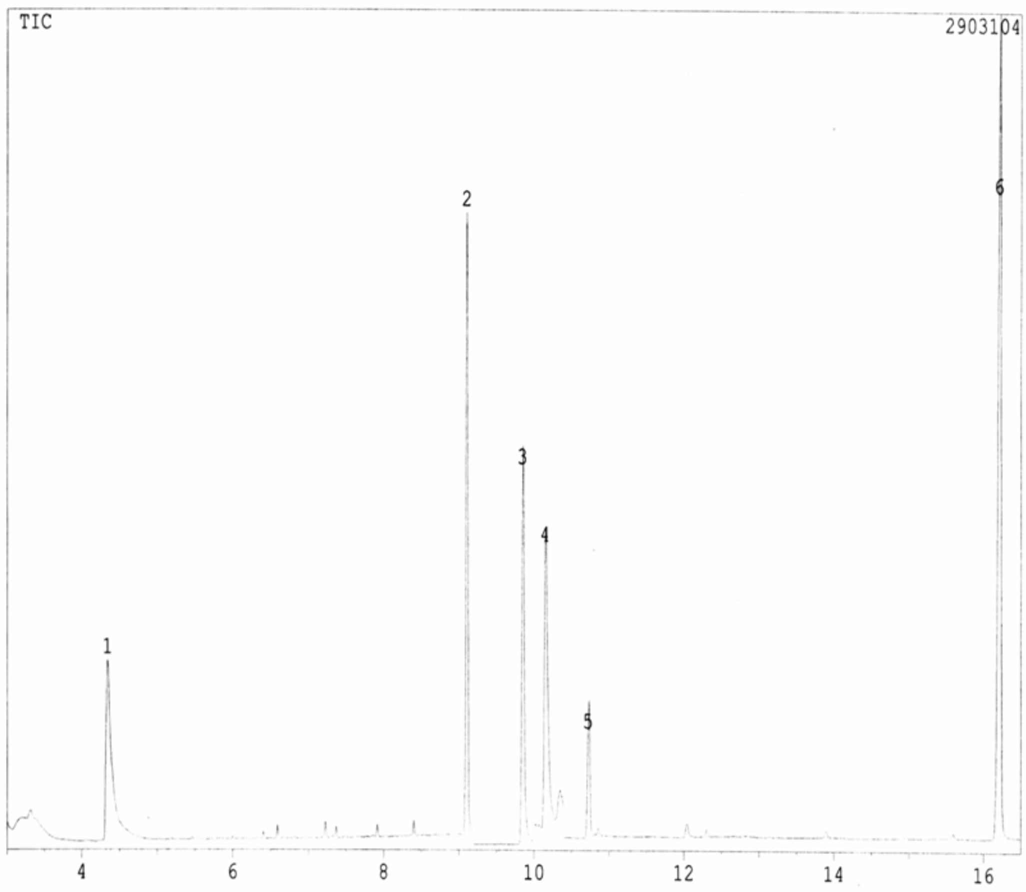


Figure (1):Typical GC/MS chromatogram of a mixture of standards containing Methamidophos (4.287min), Chlorpyrifos (9.102 min), Penconazol (9.84 min), Triademanol (10.148 min), Endosulfan (10.67 min), and Methyl tricosoate (16.1 min) as internal standard (25ppm each), using the selected ion-monitoring mode.

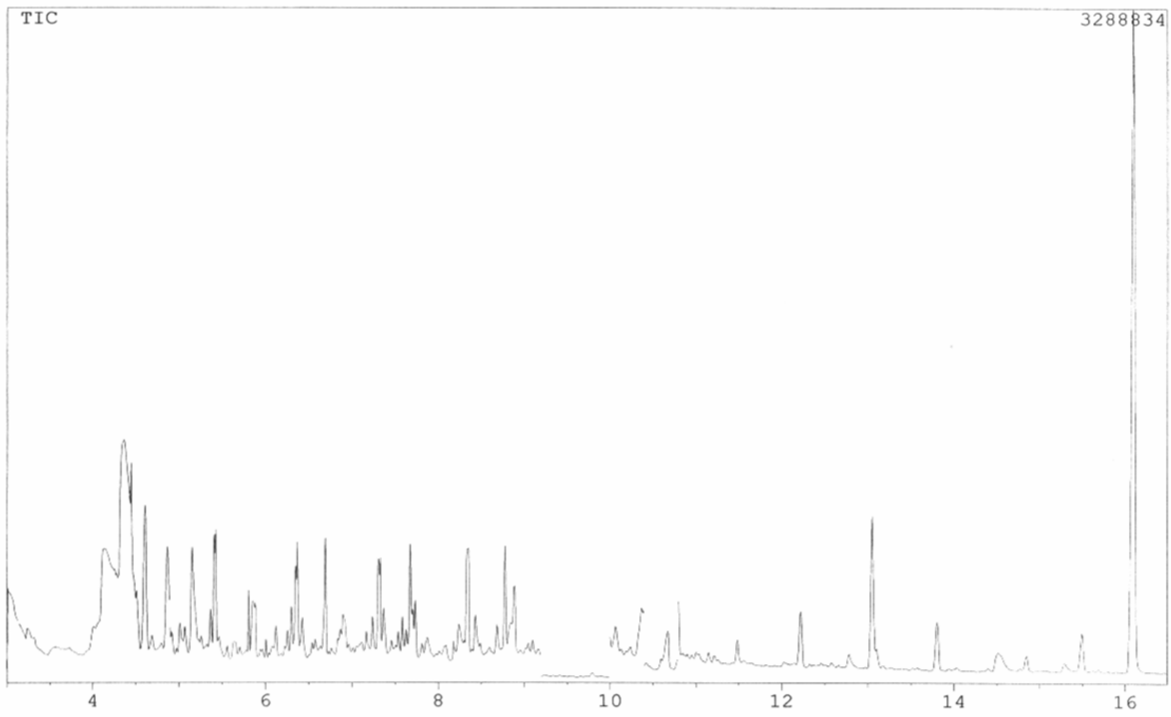


Fig. 2: Typical chromatogram of real soil sample analyzed using the ion-monitoring mode.

Chapter three

Results and Discussion

The present work was carried out in the eastern of Nablus district in West Bank, which has several environmental problems, including effects of pesticide related activities in the agricultural sector (Saleh A. *et,al*., 1995). Pesticide problems have been identified as a major environmental health problem in West Bank (Saleh A. *et, al*., 1995); (Sansur R.M., 1992); (Yassin M. *et al*, 2002).

Increased attention has been directed at wife and children of agricultural workers. The US National Institute for Occupational Safety and Health (NIOSH) has prepared a review of children's exposures to environmental health hazards, including pesticides associated with parental occupation (NIOSH, 1995).

Pesticides were commonly found in the children's residential environments and in their diets. While exposure to pesticides is common among children, the exposure pathways among different groups of children may be different (Lu C., 2004).

The pesticide measurements reported were of value in the assessment of aggregate exposure of pesticides. The use of pesticides in agriculture for crop protection pest control has been associated with environmental contamination and human health problems world wide (Celina *et al.,* 2006).

3.1-Quantitative determination of pesticide residues:

Soil is the principle reservoir of environmental pesticides, thus representing a source from which residues can be released to the atmosphere, ground water, and living organisms (Goncalves and Alpendurada 2005).

The concentrations of five pesticides (Tamaron®, Dursban®, Ofir®, Payfidan®, and Thionex®) in soil and dust samples collected from three locations in the eastern of Nablus district were determined using the recommended procedure described in chapter 2.

3.1.1 Pesticide residues in the soil inside the green houses:

Twenty two samples of soil collected from the green houses were analyzed for pesticide residues. The obtained results are presented in Table 5. The results of analysis of ten samples collected from Al-Bathan showed that the median concentrations of Tamaron® in Al-Bathan was 0.613 ppm with a highest concentration of 6.8ppm. Dursban® median concentration was 0.138 ppm with a highest concentration of 0.272 ppm. Ofir® in Al-Bathan was 0.08 ppm with a highest concentration of 1.5 ppm, Payfidan® in Al-Bathan was 0.676 ppm with a highest concentration of 4.25 ppm, and Thionex® in Al-Badan was 0.179 ppm with a highest concentration of 1.24 ppm.

Similar analyses were conducted on another ten samples collected from Al-Fara'a and two samples collected from An-Nassariyya. The obtained results (Table 5) showed that the median concentration of Tamaron® in Al-Fara'a was (1.12 ppm) with a highest concentration of (8.59 ppm). Dursban® median concentration was (0.228 ppm) with a highest concentration of (0.448 ppm). Ofir® in Al-Fara'a was (0.088 ppm) with a highest concentration of (1.95 ppm), Payfidan® in Al-Fara'a was (0.734 ppm) with a highest concentration of (2.21 ppm), and Thionex® in Al-Fara'a was (1.04 ppm) with a highest concentration of (4.45 ppm).

The results collected from An-Nassariyya showed that the median concentration of Tamaron® in An-Nassariyya was (0.635 ppm) with a highest concentration of (0.755 ppm). Dursban® median concentration was (0.119 ppm) with a highest concentration of (0.135 ppm). Ofir® in An-

Nassariyya was not detectable, Payfidan® in An-Nassariyya was (0.343 ppm) with a highest concentration of (0.488 ppm), and Thionex® in Al-Fara'a was (0.193 ppm) with a highest concentration of (0.385 ppm). In An-Nassariyya also Tamaron® has the highest concentration (0.635 ppm) followed by Payfidan® (0.343 ppm), Thionex® (0.385 ppm), and Dursban® (0.119 ppm).

The median residues of the five pesticides in the soil of the three areas were almost in the same range, except An-Nassariyya soil, in which the pesticide Ofir® has not been detected.

Table (5): Pesticide residues in soil samples inside the green house.

Location	Pesticide residue (ppm)				
	Tamaron Methamedophos	Dursban® Chlorpyriphos	Ofir® Penconazol	Payfidan® Triademanol	Thionex® Endosulfan
Al-Bathan	3.98	0.272	0.035	4.25	1.24
	0.410	0.243	1.5	1.08	0.529
	0.323	0.107	0.127	0.542	0.163
	4.44	0.175	0.049	0.81	0.202
	6.8	0.149	0.049	0.556	0.241
	3.75	0.0073	0.719	0.075	0.023
	0.094	0.011	0.084	0.155	0.104
	0.61	0.0399	0	0.057	0.052
	0.61	0.18	0.076	0.021	0.194
	0.651	0.126	0.095	0.015	0.111
Median	**0.631**	**0.138**	**0.08**	**0.676**	**0.179**
Al-Fara'a	0	0.393	1.04	2.21	1.67
	7.55	0.366	1.95	1.36	1.32
	7.44	0.266	0.47	0.582	1.26
	8.59	0.26	0	2.76	0.816
	1.3	0.178	0.121	1.70	0.311
	0.214	0.448	0.067	0.834	4.45
	0.050	0.176	0.108	0.634	1.48
	0.232	0.0041	0.016	0.304	0.398
	1.48	0.196	0.028	0.046	0.164
	0.931	0.103	0	0.074	0.12
Median	**1.12**	**0.228**	**0.088**	**0.734**	**1.04**
AlNasarya	0.755	0.135	0	0.488	0
	0.515	0.103	0	0.198	0.385
Median	**0.635**	**0.119**	**0**	**0.343**	**0.193**

3.1.2 Pesticide residues in soil of open fields:

Twenty one samples of soil from the open field in Al-Bathan, Al-Fara'a, and An-Nassariyya were collected and analyzed for the quantitative determination of the five pesticides under investigation. The obtained results are presented in Table 6.

It can be seen in (Table 6) that Ofir® not been detected in eight samples (out of twenty one), the median concentration of it in the soil of Al-Fara'a was (0.057 ppm) higher than in An-Nassariyya (0 ppm) and in Al-Bathan (0.034 ppm). On the other hand, the median of Tamaron® concentration in the soil of Al-Fara'a was (5.25 ppm) higher than the concentration in the soil of Al-Bathan (3.56 ppm) and An-Nassariyya (0.601 ppm).

Durspan® concentration in the soil of Al-Fara'a was (0.358 ppm) higher than in the concentration in the soil of Al-Bathan (0.179 ppm) and in An-Nassariyya (0.062 ppm). The median concentration of Payfidan® in the soil of Al- Fara'a (0.65 ppm) was higher than the concentration of soil in Al-Bathan (0.511 ppm) and in An-Nassariyya (0.274 ppm). Thionex® concentration in Al-Bathan was (0.935 ppm) higher than the concentration of the soil in Al-Fara'a (0.25 ppm) and in An-Nassariyya (0.097 ppm).

Table (6): Pesticide residues in soil samples in open field

Pesticide residues (ppm)					
Pesticide	**Tamaron® Methamedophos**	**Dursban® Chlorpyriphos**	**Ofir® Penconazol**	**Payfidan® Triademanol**	**Thionex Endosulfan**
Al-Bathan	**0**	**0**	**0.115**	**0.463**	**1.68**
	0	**0.271**	**0.044**	**6.74**	**1.12**
	4.75	**0.129**	**0.024**	**0.559**	**0.141**
	2.37	**0.228**	**0**	**0.295**	**0.749**
Median	3.56	0.179	0.034	0.511	0.935
Al-Fara'a	**6.76**	**1.25**	**0.055**	**0**	**0**
	6.87	**0.358**	**0.132**	**0.731**	**0.854**
	6.6	**0.094**	**0**	**0.25**	**0.88**
	5.25	**0.46**	**0.382**	**0.97**	**2.25**
	2.18	**0.198**	**0.057**	**0.65**	**0.25**
	0.494	**0.048**	**0.04**	**0.37**	**0.115**
	0.872	**0.675**	**2.6**	**0.66**	**0.071**
Median	**5.25**	**0.358**	**0.057**	**0.65**	**0.25**
An-Nassariyya	**0.395**	**0.126**	**0**	**0.36**	**0.117**
	0.77	**0. 022**	**0**	**0**	**0.059**
	0.627	**0.156**	**0**	**0.023**	**0.083**
	0.192	**0.133**	**0.012**	**0.306**	**0.22**
	0	**0**	**0**	**0.372**	**0.11**
	3.53	**0.123**	**0.120**	**0.357**	**2.41**
	0.754	**0.026**	**1.43**	**0.369**	**0**
	0	**0.00563**	**0.063**	**0.241**	**0.065**
	1.12	**0.026**	**0**	**0**	**0.211**
	0. 575	**0**	**0**	**0.02**	**0.083**
Median	**0.601**	**0.062**	**0**	**0.274**	**0.097**

3.1.3 Comparison of the total pesticide residues in the soil inside the green houses and open fields:

The degree of soil contamination with pesticides is affected by many factors such as the temperature, humidity, half life of the pesticide, type of soil ventilation, amount of applied formulations, and the intervals between the application rates of the pesticides. It is almost impossible to obtain a correlation between all of the above mentioned factors and the degree of contamination of the soil in the studied locations.

Comparison of the total pesticide residues in the soil of the three locations (Al-Bathan, Al-Fara'a, and An-Nassariyya) is presented in Table 7 Fig 3. It can be seen that Al-Fara'a showed the highest total residue in the soil inside the green houses and in the open fields, followed by Al-Bathan and An-Nassariyya. The difference in the concentrations could be attributed to the use of uncontrolled concentrations of the pesticides during spraying or to the number of times of spraying of the pesticides.

Table (7): Total of median of pesticides residues in soil samples inside the green house and in the open field.

Area	Total pesticide residues (ppm)*	
	Inside the green houses	In the open field
Al-Bathan	1.704	5.22
Al-Fara'a	3.21	6.315
An-Nassariyya	1.29	1.034

***the sum of Tamaron®, Dursban®, Ofir®, Pyfidan®, and Thionex®.**

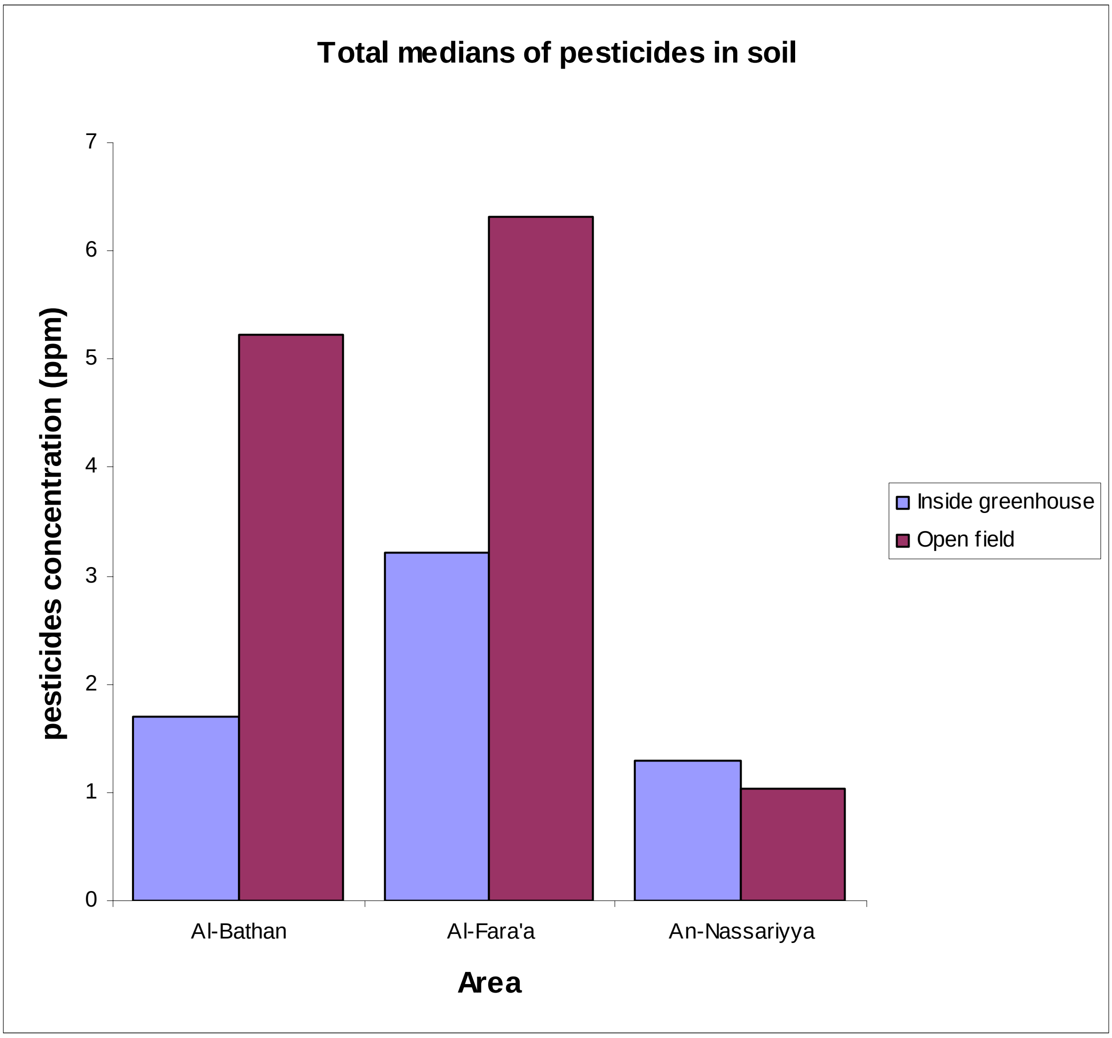


Fig (3): Total pesticide of median residues in soil samples inside the greenhouse and in open field.

3.1.4 Pesticide residues in the dust of the studied area:

Nine samples of dust from the houses, vehicles, and stores of the farmers were collected for pesticide residue determination. Four dust samples were collected from the houses; three samples were collected from the dust of vehicles while two dust samples were collected from the stores of the pesticides of the farmers. All the samples were analyzed as described in the general procedure. The obtained results are presented in Table 8 Fig 4.

Table (8): Median residue of pesticides in the dust of the studied area.

Pesticide residues (ppm)					
Pesticide	**Tamaron® Methamedophos**	**Dursban® Chlorpyriphos**	**Ofir® Penconazol**	**Payfidan® Triademanol**	**Thionex® Endosulfan**
Home dust	1.39	0.135	0.098	0.377	0.262
	5.647	0.331	0.023	1.22	0.838
	0.269	0.044	0.155	0.999	2.8
	0.307	0.009	0	3.118	1.37
Median	**0.849**	**0.090**	**0.061**	**1.11**	**1.104**
Vehicle dust	13.77	1.55	0.128	8.68	1.59
	0.036	0.45	0.073	1.03	2.6
	0.705	0	0	0334	0.7
Median	**0.705**	**0.45**	**0.073**	**1.03**	**1.59**
Store dust	0.77	0.33	0	0.884	2.43
	6.47	2.04	0	3.73	1.85
Median	**3.62**	**2.37**	**0**	**2.31**	**2.14**

All of the collected samples showed detectable concentrations of pesticides. Ofir® was found to be no detectable, while Tamaron® was the highest in most samples. This is attributed to the use of excessive amount of Tamaron® by farmers since it is the preferable pesticide in the area. The small number of dust samples in each location limits interpretation of these results.

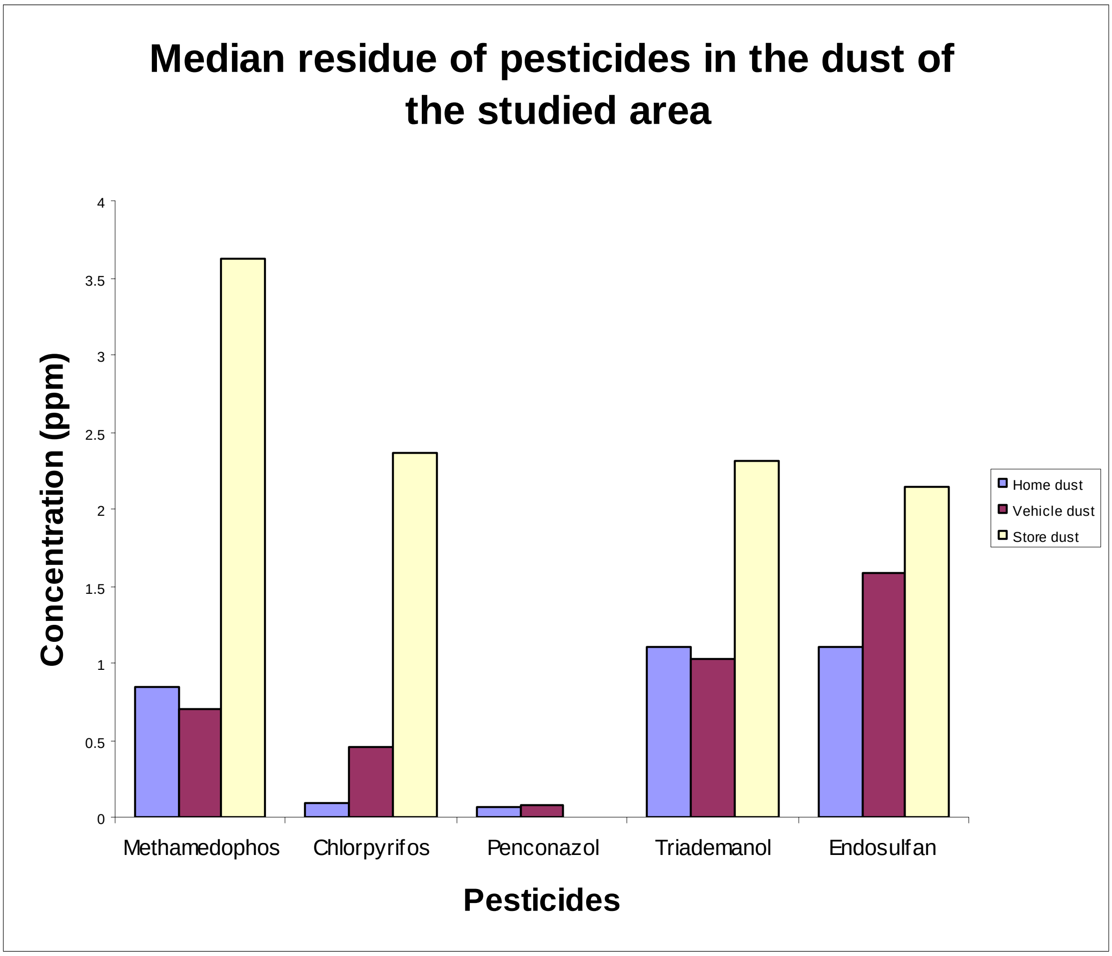


Fig. (4): Median residue of pesticides in the dust of the studied area.

The obtained results (Table 8) confirm that houses, vehicles and farmer stores are main sources of contamination with pesticides. On the other hand, the agricultural families' daily exposure to the pesticides may be the main source of transmission of pesticides to the bodies of the human beings, animals and food.

The vehicles used for travel to and from work are vectors for pesticides transmission, and that the pesticide residues found in the vehicles is markers of contamination on worker clothing or skin. It is also possible that workers may have brought pesticides to their houses for preparation or due to the unavailability of special stores, and that both houses and vehicles were thereby contaminated.

These results concur with previous work in Washington State, which found that concentrations of pesticides in the house dust of agricultural workers were much higher than concentrations of these pesticides in the house dust of nonagricultural workers, regardless of residential proximity to farmland (Lu *et al*., 2000). The study also reported that residues of agricultural pesticides were detected on the work boots, steering wheels, and children's hands of many of the agricultural families.

As expected, significantly high levels of methamidophos were found in houses of agricultural families. Much higher levels were found in vehicles and house's dust, where chemicals are not degraded or dispersed by environmental factors such as rain, sun and soil microbial activity. These results consistent with other reports of the persistence of pesticides in indoor environments (Lewis, 1994; simcox *et al*., 1995).

The three pesticides (Methamidophos, Triademanol and Endosulfan) that were detected in the house's dust samples were readily available for agricultural use at the time when the samples were collected. The relatively high concentration of pesticides in dust samples is not surprising since air transfer the pesticides to the houses close to the agricultural area. Penconazol in house's dust and vehicle's dust samples had the lowest concentration across the targeted pesticides in this study, and none of the two store's dust samples collected from the farmer agricultural stores in Al-Fara'a and An-Nassariyya had detectable penconazol levels, while other pesticides were detected with high concentration. This could be due to the large use of these pesticides to control of pests and diseases.

These results are in agreement with the results reported by Simcox *et al.,* (1995); who studied household dust and soils samples that collected in children's play area from 59 residences in eastern Washington State. It was found that pesticide concentrations in household dust were significantly higher than in soil for all groups of OP studied. The highest pesticide concentration found in dust sample was 17 ppm (phosmet) OP pesticide, and the greatest total OP concentration measured in dust was 21.5 ppm.

3.2 Questionnaire results:

3.2.1 Knowledge, attitudes, and practices with regard to the use of pesticides:

The present work was carried out in agricultural areas in eastern Nablus. In these areas from which the soil and dust samples were collected, several environmental problems are wide spread in a way that causes severe health problems to the people. Pesticide problems have been identified as a major environmental health problem in Palestine (UNRWA, 1993; Yassin M. *et al*, 2002). The present study describes the knowledge, attitude, practice, and toxicity symptoms related to pesticide use among farmers in agricultural areas in eastern of Nablus**.**

The questionnaire contained many questions related to the practices of the farmers in the studied area, the total number of questionnaires that were filled out was fifty and all the farmers respond.

3.2.1.1 Education & Social status:

Analysis of the educational status of the respondent farmers (n = 50) showed that 24% had university degrees, 38% had finished secondary school, 22% had finished preparatory school, 10% had passed primary school, and 6% were illiterate. A low level of illiteracy was recorded among the respondent farmers, reflecting a well educated community. This may give the impression that the high rate of educated farmers not getting another job is the unemployment crisis in Palestine (Yassin M. *et al*, 2002). A total of 82% were married; only 40% had children and wife work in the farm. In addition, 78% were smokers.

3.2.1.2 Types of agricultural field:

The questions related to the type of agricultural field and planted crops illustrated that 48% of the farmers grow their crops in open fields, 28% in closed fields, and 24% grow their crops in both open and closed fields. It was found that most farmers in the studied area grow Vegetables.

In addition, 40% of the farmers reported that the agronomists were visiting their farms periodically. Those agronomists came from the Ministry of Agriculture and the Palestinian Agricultural Relief Committee.

3.2.1.3 Knowledge of farmers about pesticides:

Table (9) illustrates the knowledge of the respondent farmers (n = 50) regarding the identity, health effects, biological and natural controls, route of pesticide entry into the body, and the fate of pesticide residues. A total (88%) farmer had knowledge about the adverse health effects of pesticides on human health. When those farmers were questioned further about the degree of health impact of pesticides, a total of (74%) knew that not all pesticides have the same adverse health effects, (90%) knew that the pesticides enter with respiratory system, (84%) knew that pesticides could enter the body through dermal exposure. It was also found that (68%) knew the name of the pesticides they were using. A total of (40%) knew biological and natural control methods as alternatives to pesticides for pest control that to use kind of virus or bacteria that prevent the pest to grow or use alternative methods as cultivated the weed before making seeds.

Knowledge of the respondent farmers in the agricultural areas about the effects of pesticides on human health was high. Knowledge of the names of pesticides used was also high, whereas knowledge concerning biological and natural control was low. This necessitates the launch of educational extension programmes about pesticide alternatives among farmers in the area.

3.2.1.4 Pesticide residues:

Analysis of farmers responses indicated that the routes of exposure to pesticides according to farmers perception were mainly inhalation (90%) followed by dermal (84%) and then oral route (54%) table 9.

In terms of knowledge regarding the fate of pesticide residues, the majority of respondents (74%) reported that pesticide residues may be detected in the soil, whereas a smaller number of respondents (52%) reported that pesticide residues may be detected in the fruits and tree leaves.

Table (9): Knowledge of farmers about pesticides, positive responses regarding the knowledge were included in the table

Items assessing the knowledge	(%) *
Name of pesticides used	**(68)**
Adverse health effects of pesticides on human health.	**(88)**
Degree of health impact of pesticides knowing that not all pesticides have the same adverse health effects	**(74)**
Pesticides enter with respiratory system	**(90)**
Pesticides enter from dermal.	**(84)**
Pesticides enter from mouth into the body	**(54)**
Fate of pesticide residues in the soil.	**(74)**
Fate of pesticide residues in the fruits and tree leaves.	**(52)**
Fate of pesticide residues in air	**(58)**
Fate of pesticide residues in Groundwater	**(54)**

***The percent of farmers with positive response.**

3.2.1.5 Toxicity symptoms:

Knowledge of toxicity symptoms among farmers in the agricultural community in eastern of Nablus is reported in Table (10). Analysis of the responses of 50 farmers indicated that the most frequent symptoms reported were breathlessness (80%), followed by skin irritation, headache, sweating and coughing (76%), nausea (74%), dizziness (72%), burning sensation in the eyes/face (66%), chest pain, itching (64%), diarrhea, vomit (60%), fatigue (52%). Less than half of the agricultural workers reported; leg cramps (42%), high temperature (40%), and forgetfulness (32%).

When the respondent farmers were questioned about their knowledge regarding pesticide-associated toxicity symptoms, most knowledge was of a burning sensation in the eyes/face, lacrimation, breathlessness, itching/skin irritation, headache, and dizziness. Most of these symptoms are consistent with the common manifestations of acetylcholinesterase inhibition (Mourad TA., 2005).

Table(10): Adverse or toxic effected reported by farmers (n=50)

Symptoms	**(%)**
Breathlessness	(80)
burning sensation in the eyes/face	(66)
Chest pain	(64)
Itching	(64)
Skin irritation	(76)
Headache	(76)
Sweating	(76)
Coughing	(76)
Dizziness	(72)
Forgetfulness	(32)
Fatigue	(52)
Diarrhea	(60)
Nausea	(74)
Vomit	(60)
High temperature	(40)
Leg cramps	(42)

Regarding toxicity symptoms associated with pesticides, results showed that common self reported toxicity symptoms among farmers were common manifestations of AChE inhibition as was previously stated regarding Organophosphates (Yassin M. *et al*, 2002; ATSDR 1993). These findings require urgent prevention, intervention, and farmers' protection by the Ministry of Health and other non-governmental organizations.

The result that a high proportion of farmers were more aware of inhalation and dermal absorption of pesticides than other routes of exposure agrees with other studies which had found that most occupational exposure to pesticides occur from skin absorption and through inhalation.(WHO,1993; Iorizzo *et al*.,1996).

The present investigation showed a moderate to low awareness among farmers towards the fate of pesticide residues in soil, in air, on plants, and in groundwater. This level of knowledge could put farmers at risk when handling pesticides or being exposed to pesticide residues (Yassin *et al*., 2002).

3.2.1.6 Protective clothes:

Table (11) Fig. 5 illustrated the knowledge of farmers (n = 50) about protective gear that protect the farmer from adverse health effects. A total of (80%) farmers had information that gloves and goggles can protect the skin of the hands and the eyes from the adverse health effects of pesticides, while a total of (64%) believed that wearing a wide hat can protect the head from pesticides and a total of (68%) believed that wearing a special boots can protect the feet from pesticides. A total of (80%) responded that wearing an oral–nasal mask can prevent entrance of the pesticide drifts through the mouth or nose into the human body. A total of (98%) reported that wearing protective gear as overalls can protect the whole body. The interaction between use of protective measures and awareness of farmers towards these measures showed that most farmers were aware of the protective measures to be used during application of pesticides, but no one took precautions although they knew about the measures (Yassin M. *et al*, 2002).

Table (11): Believes of farmers (n = 50) about protective clothes.

Protective measures in use	(%)
Wear gloves	
Yes	(80)
No	(16)
I don't know	(4)
Wear goggles	
Yes	(80)
No	(14)
I don't know	(6)
Wear wide hat	
Yes	(64)
No	(32)
I don't know	(4)
Wear nasal mask	
Yes	(80)
No	(16)
I don't know	(4)
Wear special boots	
Yes	(68)
No	(26)
I don't know	(6)
Wear overalls	
Yes	(98)
No	(2)

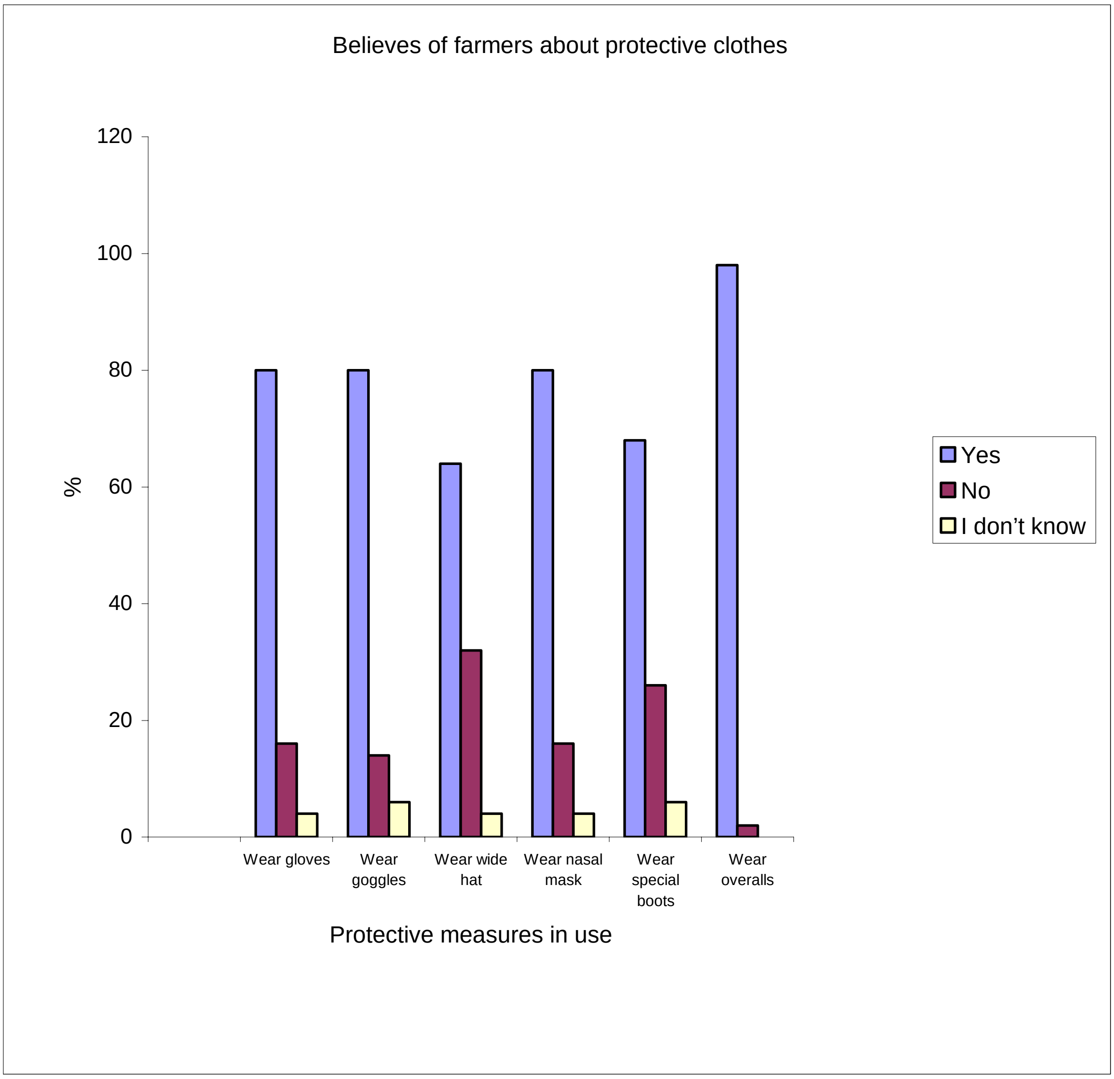


Fig.(5). Believes of farmers about protective clothes

3.2.1.7 Attitudes of farmers towards pesticides:

Only (32%) farmers were against the use of pesticides for pest control even though they still use them. They justified the use of pesticides by the absence of other successful alternatives for pest control. On the other hand, a total of (68%) reported that use of pesticides is the best and most efficient way for pest control. This is not in agreement with the results of Yassin *et al.*, 2002, who reported that the percentage of the interviewed farmers in Gaza strip who were against the use of pesticides was higher than those who supported with pesticide use. Lack of knowledge of the other alternatives for pest control was the justification for the continuous use of pesticides.

In term of body susceptibility to pesticides, a total of (40%) farmers (n = 50) believed that their bodies has developed resistance to pesticides, whereas (34%) had the opposite opinion. In addition, a high percentage of the interviewed farmers believed that their bodies could develop resistance against pesticides. This with time attitude of farmers in our study was similar to the attitude of farmers Jenin, Jericoh, and Talkarm in the West Bank (Saleh *et al.*, 1995), and Gaza Strip (Yassin M. *et al*, 2002). Such attitudes may further encourage farmers to be careless towards the use of protective measures.

3.2.1.8 Practices towards pesticides:

The majority (96%) of farmers used pesticides; and (68%) knew the names of the pesticides used. The most common pesticides used by the farmers were organophosphates, carbamates, pyrethroids, and organochlorines. Other types of agricultural pesticides used included fungicides and fumigants.

Almost all farmers (96%) had an extra space as a store in the farm, and only (12%) stored pesticides in the houses. In most cases, the farmers disposed the empty pesticide containers within the farm, while (74%) burned them, or left it in the field, many farmers reutilize the containers for other purposes (e.g., for water storage (8%), or pesticide storage (14%). On some farms, the empty containers were taken to the local waste containers (62%), or threw it along the street.

Although a low percentage of the interviewed farmers store pesticides in the house (12%), this practice still puts children and adults at risk. In addition, the high percentage of interviewed farmers who dispose the empty containers on the garbage site or along the street could put the general population at risk. Such practice was considered to be one of the main problems associated with pesticide use and its management in developing countries (Wesseling *et al*., 1997).

Table (12) lists the practice of safety procedures used by farmers (n = 50) during application of pesticides. A highest percent of respondents (64%) wear hand gloves then wear oral–nasal masks (62%) a lower percent (44%) wear goggles during preparation and application of pesticides. The number of farmers who mentioned not smoking, avoided drinking, avoided eating, and not chewing gum during application of pesticides were (66%), (80%), (88%), and (92%), respectively. Respondents who showered after application of pesticides were (76 %). The activities of farmers with potential for exposure to pesticides showed that a total of (80%) used the recommended concentration of pesticides; only (10%) did not use specific concentrations.

Only (4%) farmers used more than the recommended concentration, but (8%) farmers used less than the recommended concentration. A total of (72%) farmers reported that they mixed two or more pesticides before they applied them.

The prevalence of mixing two or more pesticides was high among the interviewed farmers and correlated with the prevalence of self reported toxicity symptoms associated with pesticides, and the synergistic effect of chemicals may contribute to this result (Yassin M. *et al*, 2002) Also, the use of different concentrations of pesticides was positively associated with the prevalence of self reported toxicity symptoms among farmers in the area. Use of high concentrations of pesticides is common among farmers in Palestine as reported by (Yassin M. *et al*, 2002)

Table (12): practice of safety procedures used by farmers (n = 50) during application of pesticides.

Protective measures used by respondents	**(%)**
hand gloves	(64)
oral–nasal masks	(62)
wide hat	(56)
special boot	(50)
Goggles	(44)
Avoided eating during application	(88)
not smoking during application	(66)
Avoided not drinking	(80)
Avoided chewing gum	(92)
Observed the wind direction	(76)
Showered after application.	(76)

3.2.2 Comparison between the results of An-Nassariyya, Al-Fara'a, and Al-Bathan:

A total of 50 farmers from different areas of eastern of Nablus participated in the present study. In Table 13 The highest response for wearing protective clothes; as wearing hands gloves was recorded in the Al-Fara'a out of 12 farmers (75%) and the lowest in An-Nassariyya out of 19 farmers (57.9%) but in Al-Bathan out of 19 farmers response for wearing hand gloves was (63.2%), also in other wearing as oral-nasal masks, wide hat, special boot, and wearing goggles. This may be attributed to the employment of most farmers in greenhouse work in Al-Fara'a during the work period, whereas most of those in An-Nassariyya work in open fields. As concluded by the farmers, the reason for not using protective clothes could be attributed to carelessness, discomfort, cost, or unavailability of protective devices.

The present finding is inconsistent with the study from Sri Lanka and the USA (Sivayoganatha C. *et al.*, 1995; Perry MJ. *et al.*, 2000). In our study we did not explore why awareness does not necessarily translate into action, but this point needs further investigation and could be the subject of further research.

About 84.2% of the farmers in An-Nassariyya were smokers while in Al-Fara'a only 50% smoke. Smoking during spraying pesticides was found to be popular in the area. About 36.8% of An-Nassariyya farmers not smoke during spraying, while in Al-Fara'a a 75% do it. Smoking while spraying could increase the risk of adverse health of respiratory system and risk of lung cancer.

These results are in agreement with the results reported by Avnon *et al.*,1998 that showed pipe and cigarette smoking during of agricultural work were also associated with increased hematological cancer (i.e., leukemia and lymphoma)($p<0.08$) incidence.

Table (13): Comparison of An-Nassariyya, Al-Fara'a, and Al-Bathan in practice of safety procedures used by farmers during application of pesticides.

Protective measures in use	**Al-Fara'a Farmers (n=12) %**	**An-Nassariyya Farmers (n=19) %**	**Al-Bathan Farmers (n=19) %**
Wear hand gloves	75.0	57.9	63.2
Wear oral–nasal masks	66.7	57.9	63.2
Wear wide hat	58.3	52.6	57.9
Wear special boot	66.7	47.4	42.1
Wear goggles	50	42.1	42.1
Not eating during application	100	89.5	78.9
Not smoking during application	75.0	36.8	31.6
Avoid drinking	91.7	26.3	21.1
Avoid chewing gum	100	94.7	84.2
Observe the wind direction	83.3	84.2	63.2
Shower after application.	83.3	84.2	63.2

3.2.3 Prevalence of toxicity symptoms

Table (14) summarizes the prevalence of toxicity symptoms associated with pesticides. In An-Nassariyya we found the highest percent of farmers who reported symptoms potentially associated with exposures to pesticides followed by Al-Bathan and Al-Fara'a. Respiratory symptoms, including cold, chest pain, coughing, and difficulty breathing were reported other symptoms headache, other symptoms reported were sweating, burning sensations in eyes/face, and itching and skin irritation, were also prevalent.

In all the cases, ignorance of the farmers to the regulations associated with correct pesticide practices were the main reasons for spreading of the toxicity symptoms among the farmers and their families.

(Table 14): Toxicity symptoms among farmers.

Symptoms	**Al-Fara'a (n=12) (%)**	**An-Nassariyya (n=19) (%)**	**Al-Bathan (n=19) (%)**
Breathlessness	(83.3)	(89.5)	(68.4)
burning sensation in the eyes/face	(58.3)	(73.7)	(63.2)
Chest pain	(41.7)	(78.9)	(63.2)
Itching	(75.0)	(63.2)	(57.9)
Skin irritation	(66.7)	(78.9)	(78.9)
Headache	(58.3)	(84.2)	(78.9)
Sweating	(66.7)	(84.2)	(73.7)
Coughing	(66.7)	(94.7)	(63.2)
Dizziness	(58.3)	(68.4)	(84.2)
Forgetfulness	(16.7)	(42.1)	(31.6)
Fatigue	(33.3)	(63.2)	(52.6)
Diarrhea	(58.3)	(68.4)	(52.6)
Nausea	(66.7)	(63.2)	(89.5)
Vomit	(58.3)	(57.9)	(63.2)
High temperature	(33.3)	(47.4)	(36.8)
Leg cramps	(25.0)	(47.4)	(47.4)

In Nablus, Alwatany Hospital, Oncology Part received the patients who had cancers in the agricultural area especially in An-Nassariyya and in Al-Fara'a there were cancers in the agricultural farmers as show in Table (15) from 2003-2006, a social worker Salah Abbas in the hospital said that all patients from this areas were work in the agriculture, Dr. Yousuf Horani recommended that it should be more studies in this areas to approve that the excessive use of pesticides caused cancers more research in comparison in agricultural and non agricultural patients.

Table (15): Cancers patients in the studied areas in years 2003-2006.

Year	Area	No. of cancers patients	Type of cancers
2003	Al-Fara'a	1	1 Prostate cancer.
2004	Al-Fara'a	4	1 Lung ca. 1 Stomach ca. 1Bladder ca. 1Breast ca.
	An-Nassariyya	3	1Brain tumour. 2Lung cancer
2005	An-Nassariyya		1Esophagus ca.
2006	Al-Fara'a	2	1 Breast ca. 1Prostate ca
	An-Nassariyya	1	1 Bladder ca.

(Alwatany Hospital, 2006).

Chapter four

Conclusions and Recommendations

Agricultural workers were exposed to pesticides during cropping, mixing, loading, and application. Pesticide safety education is necessary in order to induce protective behavior among agricultural workers (Salameh, 2004).

Farmers in an agricultural area in West Bank used pesticides extensively (ARIJ, 1995). Despite their knowledge about the adverse health impact of the pesticides, the use of protective measures was poor. Most had self reported toxicity symptoms, particularly the younger workers (Yassin M. *et al*, 2002). Although the small sample size of this study (50 farmers) limits generalization of our results to a greater population, several findings are worth noting.

Regardless of residential or occupational use of pesticides, some of these chemicals will eventually be brought into the house or become available for exposure to the residents. The presence of pesticides on children's hands and toys is of particular concern, since the likelihood of ingestion through hand-to-mouth contact is great among preschool children.

The results of our study are consistent with the theory of a para-occupational or take-home exposure pathway; agricultural pesticides move from the workplace to residential environments through the activities of farmers.

These results demonstrate that children of agricultural families have a higher potential for exposure to pesticides than children of nonfarm families in this region. Children's total and cumulative exposure to pesticides from household dust, soil, and other sources warrants further investigation.

There is an ongoing need to obtain baseline data on children's exposure to

Organophosphate pesticides and many other hazardous environmental chemicals.

A number of long persistent organochlorines and highly toxic organophosphates, which have been banned or severely restricted, are still marketed and used in many developing countries. In West Bank, among 123 pesticides currently being used, fourteen pesticides are internationally suspended, cancelled or banned, Endosulfan one of them (Saleh *et al.*, 1995). Also Gaza Strip more than 100 metric tons of formulated pesticides (about 75 pesticides) are used annually, it was found that 19 of these pesticides, that have been used, are internationally suspended, cancelled or banned pesticides (Safi JM. *et al.*, 1993). In Sri lanka eight pesticides de-registered for example (Methamidophos, Parathion, Propanil) in 1995 because of their dangers to humans and the environment were still being used in 1996 (Wilson, 1998). The misuse of pesticides by concerned individuals, in addition to lack of or weak national controlling plans is behind the outbreak of adverse effects in Palestine and in other developing countries (Mansour, 2004).

Steps should to be taken to reduce the use of pesticides in the farms of agricultural areas, and to encourage alternative measures:

- Biological control: Bet Armywarm (scientific name: *Spodoptera exigua*) are a widespread pest found in tomato fields every year. Larvae feed on leaves and fruit caused damage, creating single or closely grouped circular or irregular holes. Naturally sometimes it kept under control by natural enemies and polyhydrosis virus. So the biological control by a nuclear polyhedrosis virus often reduces populations in fall and winter, *Hyposoter exiguae* is the most important parasite of bet armyworm (Zalom *et.al,* 2003).

- Integrated pest management: as integrated weed management that plants on the orchard floor can influence other pests such as insects, mites, nematodes, and diseases. A weed management program should start before trees are planted because the more difficult to control weeds (particularly perennials) are easier to manage before planting, that is to cultivate, then irrigate to germinate new weeds, and shallowly cultivate again to destroy seedling weeds. Soil solarization is nonpesticidal method of controlling soil borne pests by placing clear plastic sheets on moist soil during period of high ambient temperature. Weeds are commonly controlled either chemically or mechanically. Alternatively, organic mulches (that prevent the growth of weed seedlings by blocking light and preventing it from reaching the soil surface), subsurface irrigation, and flamers can be used. Often several weed management techniques are combined (Elmore *et.al*, 2004).

Further investigation is needed to assess the impact of pesticides on human health. Implementations of a primary prevention program would include health education regarding the use of protective gear and monitoring the health status of workers exposed to pesticides.

The National Institute for Occupational Safety and Health (NIOSH) recommends educating workers and their families about the risks of take-home exposure and about ways by which they can minimize their risks (NIOSH, 1995).

Unsafe pesticide concentrations in crop spraying are causing a wide range of health problems. Immediate symptoms that the farmers have reported include respiratory problems, such as asthma attacks; skin rashes; eye irritation; and headaches. Potential longer term disorders identified include neurological symptoms, such as parkinsonian tremor; liver disease; and disorders of the immune system, such as Goodpasture's syndrome. In some cases, pesticide exposure has been blamed for exaggerating existing health problems (Smallwood, 2005).

Health risks associated with pesticides may be underestimated because current toxicological testing does not assess all the conditions that members of the farmers have attributed to pesticide exposure, the study claims. Better access to this information would allow the public to make informed choices about the potential health risks.

More precautionary approach most taken about passive exposure to agricultural pesticides, noting the possibility that it contributes to both acute and chronic ill health. It should collect more extensive data on pesticides to allow a more conclusive examination of the potential hazards and provide an accessible database for this information. Pesticide exposure should be reduced as much as possible while further evidence is collected.

It would be useful to minimize the use of pesticides and encourage alternative measures. Prevention and intervention programs regarding the use of protective measures and monitoring the health status of farmers should be implemented.

Pesticide safety education is necessary in order to induce protective behavior among the farmers. The general population may also benefit from increasing their awareness regarding pesticides.

Our results indicated that special educational programs, legislation promoting the use of safer pesticides, and implementations of personal protective measures are necessary to decrease the pesticide exposure of farmers.

Some measures can be taken to reduce the risk situation:

- Use of personal safety equipment
- Financial support of research on alternative techniques such as organic farming, strategies such as integrated pest management.
- Education in schools, universities, communities, among rural workers.
- Governmental support in restructuring the production system with respect to environmental health risks, enforcing better training for public health workers, enforcing current legislation and, when necessary modifying laws to ensure effective oversight and monitoring.
- Improvement in products inspection; control of importationquality, and selling of pesticides.
- Restriction on media advertising of pesticides as non-risk products.

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Appendix A

إستبيان أثر المبيدات على الوضع الصحي للمزارعين:

1- خصائص اجتماعية: 1)المنطقة : 1- الفارعة 2- النصارية 3- الباذان

2)الاسم (اذا رغبت) ________________

3)الجنس 1- ذكر 2- انثى

4)العمر 1- أقل من 18 سنة 2 - 19-40 3- 41-60

5)التعليم 1- أمي 2- ابتدائي 3- اعدادي 4- ثانوي 5- جامعي

6)الحالة الاجتماعية : 1-متزوج 2- عزابي 3- ارمل 4- مطلق

(1-هل لديك أولاد: 1- نعم 2- لا) (2-عدد الاولاد--------)

7)مدخن 1- نعم 2- لا

8)المزرعة 1- مفتوحة 2- مغلقة 3- 1+2

9)المحصول -خضروات للتسويق 1-نعم 2-لا

2-مدى معرفة المزارع بأسس استخدام المبيدات

10)هل يوجد مرشد زراعي يزور مزرعتك كل فترة . 1-نعم 2-لا

11)هل تستخدم المبيدات؟ 1-نعم 2-لا

12)منذ متى وأنت تستخدم المبيدات (الفترة الزمنية).__________

13)هل تتبع تعاليم العبوة ؟ 1-نعم 2-لا

14)هل ترش نوعان أو أكثر من المبيدات المخلوطة؟ 1-نعم 2-لا

15)تركيز المبيدات التي تستخدم هي 1_ الموصى بها 2-أكثر من الموصى بها.

3- أقل من الموصى بها 4- غير ملتزم بتركيز محدد.

3- معرفة المزارعين لاجراءات الصحة والسلامة اثناء استخدام المبيدات:

16)أين تخزن المبيدات والعلب؟

1 - في مخزم خاص بالمزرعة 1-نعم 2-لا

2 - في المنزل 1- نعم 2-لا

17)ماذا تفعل بالعلب الفارغة من المبيدات ؟

- للاستخدام البيتي (لتخزين الماء) 1-نعم 2-لا
- للاستخدام البيتي (لتخزين أكل) 1-نعم 2-لا
- لتخزين نوع آخر من المبيد 1-نعم 2-لا
- رميها في مكب الزبالةأو موقع في المزرعة للزبالة 1-نعم 2-لا
- حرقها 1-نعم 2-لا

18) ماذا تلبس من الآتي عندما تجهز أو ترش المبيد ؟

1 - كفوف 1-نعم 2-لا

2- طاقية عريضة 1-نعم 2- لا

3- قناع 1-نعم 2-لا

4- بوت خاص 1-نعم 2-لا

5-نظارات واقية 1-نعم 2- لا

19) خلال الرش هل تقوم بالآتي:1

1 - التدخين 1-نعم 2-لا

2-الشرب 1-نعم 2-لا

3-الأكل 1-نعم 2-لا

4-مضغ اللبان 1-نعم 2-لا

5- مراعاة اتجاه الريح 1-نعم 2-لا

20) هل تعرضت لملامسة المبيد مباشرة؟لأي جزء من جسمك؟___________________

21)هل تستحم بعد الرش؟ 1- نعم 2-لا

-اذا كان الجواب (نعم) هل تستحم مباشرة بعد الرش 1- نعم 2-لا

-إذا كان الجواب (لا) أرجوك حدد المدة الزمنية التي تبقى فيها بدون حمام بعد الرش؟

22) كم الفترة الزمنية التي تترك فيها العمل بعد الرش ثم تعود للعمل في الحقل؟

23) هل تتدربت في كورس عملي أو ورشة عمل على الآثار السلبية للمبيدات وكيف تقلل من استخدام المبيدات؟ 1- نعم 2- لا

24) هل تعرف فترة الأمان ؟(الفترة ما بين آخر رش وفترة الحصاد 1- نعم 2-لا

25) هل تعرف اسم المبيد الذي تستخدمه؟ 1-نعم 2- لا

-إذا كان الجواب (نعم) اذكر بعض اسماء المبيدات التي تستخدمها _ _ _ _ _ _ _ _

26) هل تعرف طريقة آخرى للسيطرة على الآفة غير المبيدات ؟ 1-نعم 2-لا

27) هل المبيدات لها تأثير ضار على صحة الأنسان؟

1-نعم 2-لا 3-لا أعرف

28) حسب معرفتك هل كل المبيدات لها نفس التأثير العكسي على صحة الأنسان؟

1-نعم 2-لا 3-لا أعرف

29) هل المبيدات تدخل لجسم الأنسان عن طريق؟

التنفس 1-نعم 2-لا 3-لا أدري

الجلد 1-نعم 2-لا 3-لا أدري

الهضم 1-نعم 2-لا 3-لا أدري

30) أي من الأمراض التالية تعاني منها نتيجة استخدامك للمبيد؟ (ضع دائرة أو أكثر): 1صـداع،2التعـرق،3 قحـة،4آلام صـدر،5ضـيق تـنفس،6ضـعف عـام،7حـرق الوجـه والعيـون،8التهـاب الجلد،9حكة،10غثيان،11دوخة،12مراجعة،13اسهال،14حمى،15ارتفاع حرارة،16نسيان،17رجة الأرجل.

31)-أعراض أخرى اذكرها_____________.

32)هل تعرف أن بواقي المبيدات ممكن أن تكون في

الهواء	1-نعم	2-لا	3-لا أدري
التربة	1-نعم	2-لا	3-لاأدري
مياه جوفية	1-نعم	2-لا	3-لاأدري
ثمار واوراق الشجر	1-نعم	2-لا	3-لا أدري

33) هل تعرف انه يوجد معلومات عالمية لمنع بعض المبيدات؟

1-نعم 2-لا 3-لا أدري

34) هل انت مع استخدام المبيدات ؟ 1-نعم 2-لا

-حسب جواب 34 سواء نعم اولا حدد لماذا تستخدم المبيدات؟___________

35)أي من الآتي تعتقد انه يمكن حماية المزارع في المزرعة من التأثير السلبي؟

1- لبس الكفوف	1-نعم	2-لا	3-لاادري
2- استخدام نظارات واقية	1-نعم	2-لا	3-لاادري
3- لبس طاقية عريضة	1- نعم	2-لا	3-لاادري
4-وضع كمامة أنف	1-نعم	2-لا	3-لاادري
5- لبس حذاء خاص	1-نعم	2-لا	3-لاادري
6- لباس واقي كامل	1-نعم	2-لا	3-لاادري

36) بما انك مزارع هل تعتقد ان جسمك كون مناعةضد المبيدات؟

1- نعم 2-لا 3-لاادري

37) هل شاهدت حالة تسمم بالمبيدات أو لديك معلومات عن ذلك؟

1-نعم 2-لا 3-لادري

38) هل لديك مركز علاجي طبي أو مركز سموم في منطقتك يقوم بالخدمات الطبية للمزارع؟

1-نعم 2-لا 3-لاادري

جامعة النجاح الوطنية
كلية الدراسات العليا

تعرض المزارعين وعائلاتهم إلى المبيدات في المجتمعات الزراعية

إعداد
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إشراف
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قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في العلوم البيئية بكليــة الدراســات العليا في جامعة النجاح الوطنية في نابلس، فلسطين

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الملخص

الاستخدام المستمر للمواد الكيماوية مثل المبيدات له تأثيرات ضارة على البيئة و يسبب الأمراض للانسان وكذلك له تأثيرات سلبية على إستدامة الانتاج الزراعي، فالمزارعون وعائلاتهم يتعرضون إلى المواد الكيماوية الزراعية حتى مع عدم العمل في نشاطات المزرعة ففرصهم للتعرض إلى المبيدات عالية بشكل مباشرة أو غير مباشر.

تم في هذا البحث جمع عينات من التربة و الغبار من ثلاث مناطق زراعية تقع في المنطقة الشرقية من محافظة نابلس وهي الفارعة والباذان والنصارية. تم تحليل العينات باستعمال جهاز تحليل الكروماتوغرافي الغازي. دلت النتائج على وجود المبيدات التالية: تمارون (ميثاميدافوز) ودورسبان (كلوربيريفوز) وثيونيكس (اندوسلفان) وأوفير (بينكانازول) وبايفيدان (ترايديمانول).

تم إجراء التحليل لثلاث وأربعون عينة من التربة تم أخذها من الحقول المكشوفة ومن داخل البيوت البلاستيكية، وتسع عينات من الغبار تم جمعها من داخل البيوت ومخازن المبيدات والسيارات التي تستخدم من قبل المزارعين. معظم العينات التي تم فحصها بينت وجود كميات كبيرة من متبقيات المبيدات الخمسة المذكورة أعلاه.

كما تم في هذا البحث تعبئة إستبيان من قبل خمسون مزارع من المنطقة الزراعية التي تم دراستها ويتضمن أسئلة تصف درجة الوعي والشعور وطريقة الإستعمال للمبيدات من قبل المزارعين وكذلك الأعراض السمية المصاحبة لاستعمال المبيدات. وقد تم تحليل نتائج الإستبيان وربطها بنتائج التحليل لعينات التربة والغبار التي تم تحليلها.

وقد انتهت النتائج إلى أن معظم المزارعين وعائلاتهم يعانون من أعراض التسمم بسبب الاستعمال الخاطىء لهذه المبيدات على الرغم من معرفتهم عن الآثار العكسية لهذه المبيدات.

وقد بينت نتائج الاستبيان أن النسبة العالية جدا من المزارعين الذين يعانون من أعراض التسمم بالمبيدات سببها الرئيسي عدم إستعمال الملابس الواقية أثناء إستعمال المبيدات.