Pesticide Usage In The West Bank

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Summary

This study, as the initial part of a broader project, aimed to collect background data about pesticide use in the West Bank.

In line with international norms, results have shown that pesticide usage is greater in areas of intensive and high value crop cultivation. More pesticides are used for crops grown under plastic than for those grown in open irrigation systems.

The survey reveals widespread problems in both usage and disposal of pesticides. Fourteen of the pesticides used in the West Bank are either suspended, cancelled or banned by the World Health Organization. Most of the labels continue to be in Hebrew, a language that most of the farmers don't read. There is little, if any, extension help available to farmers. Storage and disposal

of pesticides seem to be less than adequate, as is understanding of the dangers of pesticide use. Most of the farmers interviewed expressed the belief that they were developing immunity to pesticide toxicity through usage.

Encouraging signs are that the farmers interviewed were very interested in learning more about pest control. A relatively high number of farmers in Palestine said that they read and followed advice given in agricultural publications. This suggests that training, using documentation in combination with onsite demonstrations, will be possible. Furthermore, 55% of farmers interviewed recognized that there are beneficial organisms in the soil, though only just over half of this number recognized that pesticides were harmful to these organisms. This understanding of the importance of maintaining ecological balance represents a significant basis for IPM training.

Clearly, improving farmers' understanding of the ecological system with which they are working is vital. This includes improved understandings of the importance of soil organisms and of pestpredator relationships; and understanding of the concept of economic threshold. Farmers, residents in areas near to farms and consumers all need to be more aware of toxicity levels. Education is the key to coming to terms with the problems of pesticide usage in the West Bank.

Introduction

Agriculture is the backbone of the Palestinian economy, contributing 33% and 24% of the Gross National Products in the West Bank and Gaza strip respectively (ARIJ 1994). West Bank agriculture has, in the last few years, increased in sophistication, and this has had many negative sideeffects, of which the overuse of pesticides could prove to be the most serious (WRI 1994, Igbedioh 1991).

Until recently, pesticides were not considered a problem in the West Bank. On the contrary, their use was considered a sign of progress and modernization. With this attitude prevalent among the agricultural establishment, farmers' use of pesticides increased, particularly in irrigated farming. Unfortunately, this increase has not been accompanied by a full understanding of the impacts of pesticides on human health, beneficial organisms and the environment (Sansour 1991, Igbedioh 1991). This attitude has been shown elsewhere to lead into a viscious cycle of everincreasing usage and everdiminishing returns (WRI 1994).

The problem is not limited to the West Bank, of course, and has afflicted all of the neighboring countries. Pesticide usage is a major area of concern in Israeli agriculture, for instance, and much effort has recently been expended to find alternatives to pesticides. While Israel has been quite successful in using biological control in citrus orchards, they are still in the experimental phase with regard to vegetable cultivation (Hulshof 1991).

The Applied Research InstituteJerusalem (ARIJ) undertook this pilot project both in response to the issue's growing importance, and owing to an awareness that comprehensive data was missing. This report presents general information on the main features of pesticide usage in the West Bank. The results were based on the collection of information from 100 surveys conducted in a

random sampling of farmers on irrigated farms in three districts, Tulkarem, Jenin and Jericho, and information compiled from the agricultural departments in each distict of the West Bank.

Objectives

The project goals were as follows:

1. Determination of the most common crops grown in each region of the West Bank (crop distribution) and their most serious pests (designing an areacroppest calendar).
2. Study and evaluation of the different control measures, in addition to pesticides, used by farmers (status of Integrated Pest Management), including:
    - farmers' knowledge about pests andbeneficial organisms;
    - farmers' knowledge about the ecosystem (life cycles, population dynamics, etc.);
    - traditional methods of pest control.
3. Determination of the pesticides used in the West Bank regarding:
    - quantities;
    - availability of information for farmers;
    - safety precaution taken by farmers;
    - the psychology of farmers toward pesticides;
4. Evaluation of to the extent to which farmers comprehend and follow instructions on pesticide labels.

Types And Properties Of Pesticides Used In The West Bank

A total of 123 pesticides currently being used in the West Bank are presented in tables 15. Among them, fourteen pesticides are internationally suspended, cancelled or banned (WHO 1993, Safi 1991, Hassoun 1991). Seven of these pesticides are members of the "dirty dozen," namely Aldicarb, Chlordan, DDT, Lindane, Paraquate, Parathion and Pentachlorophenol. Products marked with asterisks have been internationally suspended, cancelled and/or banned (PAN 1993).

Table 1. HERBICIDES.

Tradename	Active ingredient
Agreen	Pyrazosulfuron Afugan Propoxur
Albar super	* 2,4,D. Aliette Fosethyl
AlbarM	M.C.P.A. aluminum
Atranex	Atrazine
Atrazine	Atrazine
Basta	Glufosinate
Bingo	Glufosinate, Simazine
Dganol	Fluazifoppbutyl
Dukatalon	*Paraquat,Diquat & Simazole

Focus	Cycoloxydim
Goal	Oxyfluorfen
Grasp	Tralkoxydim
Hyvar X	Bromacil
Igran	Terbutryn
Katalon	*Paraquat
Linurex	Linuron
Litarol	Bromoxynil
Neburex	Neboron
Novacron	Bromoxylin,Ioxylin
Primatol	Atrazine
Ronstar	Oxadiazon
Roundup	Glyphosate
Saminyl	Simazine,Amitrol
Semeron	Desmetryn
Sencor	Metribuzin
Select	Clethondem
Sematol	Amitrol, Atrazine,Simazine
Simazine	Simazine
Simazole	Simazine,Aminotriazole
Stomp	Pendimethalin, *Pentachlorophenol
Tobacron	Metobromuron,Metalachlo
Tobic	Clodinafob,Propargyl

Table 2. FUNGICIDES.

Tradename	**Active ingredient**
Afugan	Propoxur
Aliette	Fosethyl aluminum
Antracol	Propineb
Anvil	Hexaconazele
Bayfidan	Triadimenol
Bavistin50%	Carbendazim50
Bema	Tricyclazole
Benlate	*Benomyl
Bravo	Chlorothalonil Chlorotoluron
Calixin	Tridemorph
Coprox	Copper- oxycloride 50
Daconil	Chlorothalonil Chlorotaluron
Delsene	Carbendazim
Dexon	Fenaminosulf
Dynone	Propamocarb
Folicur	Tebuconazal
Fongoren	Pyroquilon
Galben	Benalaxynil
Indar	Fenbuconazole, Carbendazim
Kocide	Copper hyroxide

Littiril	Triadimenol, Chiomethionat
Magen	Triflumizole
Mancozan blue	Mancozeb
Manebgan	* Maneb
Manzidan	Macozeb 80%
Merpan	* Captan
Moncut	Flutolanil
Morstan 25	Chinomethiona
Nechoshtan	
Ofir	Penconazole
Poliram	Metiram 80%
Prevex	Propamocarb
Remiltine	Mancozeb Cymoxanil
Resec	Carbendazim
Rodomil	Melalaxyle
Ronilan	Vinclozolin
Sandocur C	Copper- oxychloride
Saprol	Triforine
Score	Difenoconazole
Silvacur	Dichlorfluanid Tebuconazole
Systhane	Myclobutanel

Table 3.INSECTICIDES

Trade name	**Active ingredient**
Attabron	Chlorfluazuron
Baythroid	Cyfluthrin
Bescis	Decametbrine
Cotnion	Azinphosmethy
Cumbush	Cypermethrin
Dimecron	Phosphamidon
Dizictol	Diazinon
Dursban	Chlorpyrifos
Evisect	Thiocyclam hydrogen Oxalate
Folimat	Omethoate
Folidol	*Parathion
Gammacide	*Lindane
Gaucho	Imedacloprid
Gesarol	D.D.T.
Karate	Lambda cyhalothrin
Lannate	Methomyl
Lebaycid	Fenthion
Marshall	Carbosulfan
Metasystox	Oxydemetonmethy
Montopoz	Demeton I

Molit	Fenchlorphos
Oplord	Buprofezin
pirimor	Pirimicarb 50%
Rogor	Dimethoate
Sefsan	Sodium Fluositicate
Sherpa	Cypermethrin
Simiron	Metamidophos
Smash	Fenpropathrin
Supracide	*Methidathion methiocarb
Sydane	Chlordan
Tamaron	Methamidophos
Temik	*Aldicarb
Thionex	*Endosulfan
Volck	Phenisobromo late
Zeidane	*D.D.T.

Table 4. ACARICIDES.

Trade name	Active ingredient
Acarin	Dicfol
Apollo	Clofenteziene
Benzoline	Ethyl 4,4Dichlorobenzilate
Lintex	Cyhexaline
Meteor	Fenpyroximate
Mitac	Amitrez
Neoron	Bromopropylate
Neoron	Bromopopylate
Omite	Propargite
Peropal	Azocyclotin
Vertemik	Abamectin

Table 5. OTHERS.

Trade name	Active ingredient
Nemacu	*Fenaminophos
Methyl Bromide	*CH3, Br

The active ingredients and their properties are shown in Annex 1 of this report. For each active ingredient, the following characteristics are listed: its type, chemical group, classification according to the World Health Organization (WHO), hazard to both fish and bees, the preharvest interval required, the necessary safety measures, longterm effect, LD50 rating and physical state.

Further information concerning the practical usages of various pesticides is presented in Annex 2. This includes details on which pests each pesticide is most effective against, and crops to which each pesticide is applied.

Extent Of Pesticide Usag In The West Bank

The total cultivated area of the West Bank is around 2 million dunums. Of this, only 100 thousand dunums are under irrigation, while 1.6 million dunums are rainfed and 300 thousand dunums are fallow lands (ARIJ 1994). It is estimated that 96.6% of irrigated land and 87.0% of rainfed land is treated with pesticide.

This survey reveals an overuse of pesticides in the West Bank, particularly in irrigated areas in Tulkarem, Jenin, and Jericho. The average seasonal consumption of pesticides was found to be around 4kg/dunum in open irrigated fields and 6.5 kg/dunum under plastic, excluding usage of methyl bromide, which is measured in liters (Table 6). Of total pesticide used, insecticides contribute 49.4%, fungicides 33.7% and herbicides 12.78%.

The total quantity of pesticide (including Methyl Bromide) used in the West Bank is estimated to be around 493.82 tons per year, of which about 200 tons are methyl bromide,72 tons are sulfur (50 tons of which are consumed in Hebron). All but 4 tons are used for agricultural purposes, the remander being used for domestic purposes such as public health. The districts show variations in the quantity of pesticide used, because of factors such as whether the area is irrigated or not, the crops that are cultivated, the farming patterns used, topography, and climate.

Table 6. The average amount of pesticide and the proportion of insecticide, fungicide, herbicide and others* used according to district and cropping type.

District	CroppingType	Kg/dunum	Insecticides %	Fungicides %	Herbicide %	Others %
Tulkarem	**Open irrig.**	1.60	51.0	32.0	10.7	6.30
	Plastic	3.3	42.2	45.5	6.50	5.80
Jenin	**Open irrig.**	2.10	48.0	26.0	25.5	0.50
	Plastic	4.00	53.0	32.8	9.0	5.20
Jericho	**Open irrig.**	2.60	55.5	32.9	9.5	2.10
	Plastic	6.00	46.5	33.2	15.5	4.80

** Other kinds of pesticides such as: acaricides, rodenticides,molluscicides, ..., etc are also used.*

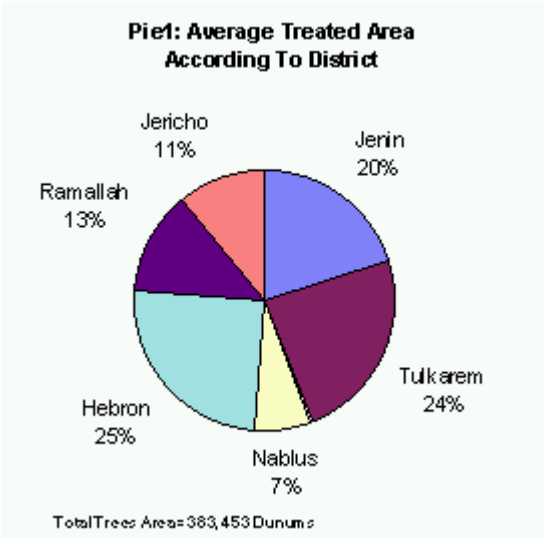
Table 7. Areas treated with pesticides in districts according to crop pattern (dunums).

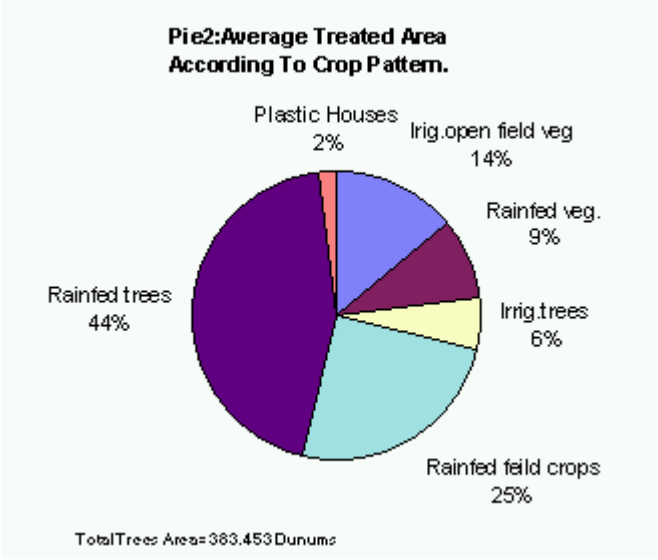
District	*Irrigated Farming*				*Rainfed Farming*		
Crop pattern	**Vegetables in Plastic Houses**	**Vegetables in Open Field**	**Trees**	**Field Crops**	**Vegetables**	**Trees**	**Field Crops**
Nablus	13	1945	1500	0	1650	5535	16450
Tulkarem	5710	8021	13000	0	12000	9260	40000
Jenin	210	12000	1740	0	12000	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*		

As is indicated by the previous table, the total area treated with pesticide is 383,453 dunums, 77% of which is under rainfed farming, and 23% of which is under irrigated farming. Still, irrigated farming accounts for about 72% of total pesticide consumption. This is due to the intensive nature of cropping methods used in irrigated farming: methyl bromide, for instance, which is not used in rainfed areas, constitutes around 56.3% of pesticide use in irrigated farming.

Pie charts 1 & 2 present the average treated area according to district and crop pattern respectively. As Pie 1 shows, 25% of the treated area is in Tulkarem, while only 7% is in Jericho. Pie 2 shows that 44% of the total treated area in the West Bank is cultivated with rainfed trees, while a mere 2% is cultivated with plastic houses.





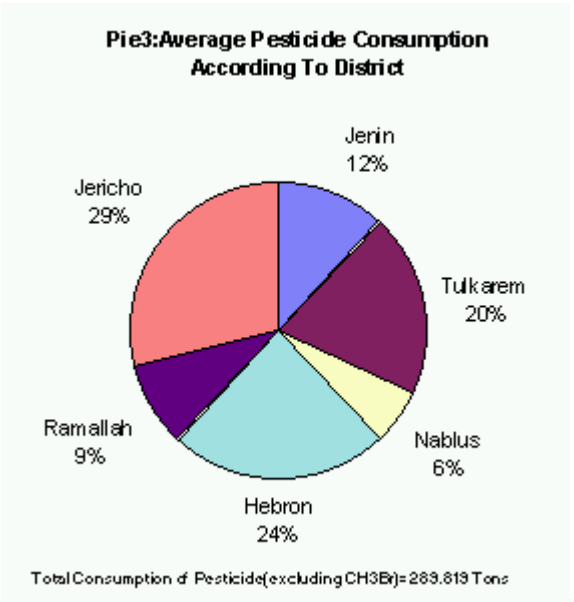
The results of information collected are illustrated in Table 8, which shows quantities of pesticide used by district and by cropping pattern. It is clear from the table that Jericho, Tulkarem and Jenin consume about 61% of the

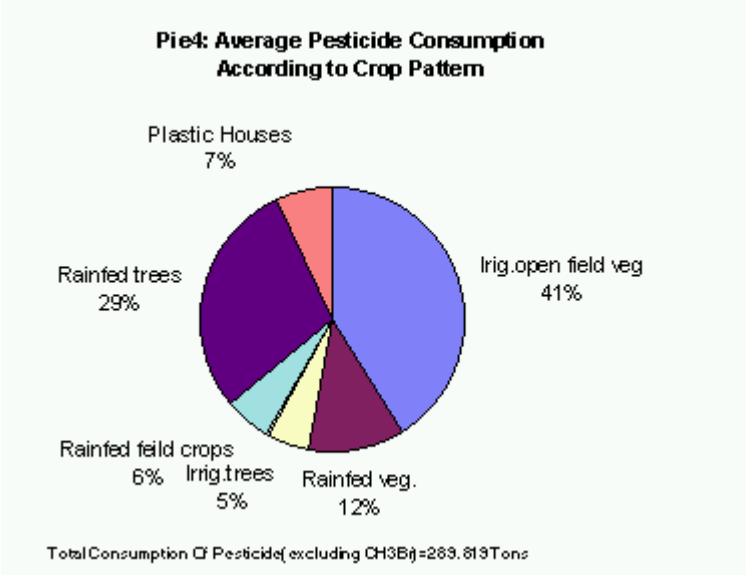
pesticides in the West Bank. Irrigated agriculture, for which pesticides are most intensively used, is concentrated in these three regions, above all in Jericho.

Table 8. Quantities of pesticides used by districts according to cropping pattern.

District / Crop Pattern	Nablus	Tulkarem	Jenin	Jericho	Ramalla	Hebron	TOTAL
Irrig. Trees	0.780	9.050	1.514	2.735	0.000	0.000	14.079
Irrig. Field Crops	0.000	0.004	.000	1.281	0.000	0.000	1.285
Vegetables in Plastic Houses	0.084	18.843	0.840	0.720	0.130	0.000	20.617
Vegetables in Open Fields	2.114	12.834	25.200	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	0.000	17.867	45.407	83.480
Rainfed Field Crops	3.420	3.670	4.000	0.000	1.445	2.740	15.275
Rainfed Vegetable	4.390	1.560	2.500	0.000	6.410	20.888	35.748
Subtotal	13.768	17.492	8.468	0.000	25.722	69.035	134.503
TOTAL	16.476	58.223	36.040	82.697	26.812	69.301	289.819

Vegetables,especially when irrigated, clearly have the highest pesticide use, probably because of their high monetary return per dunum and the high potential of there being pest damage and consequent losses. Pie charts 3 & 4 show average pesticide consumption according to district and crop pattern respectively. Pie 3 clarifies that Tulkarem consumes the largest amount of pesticide, 29% of total consumption. As pie 4 shows, irrigated open field vegetables are the most pesticide consuming crop pattern, accounting for 41% of total pesticide use.





Methyl Bromide constitutes almost 40.5% of total estimated pesticide use in the West Bank. It is used predominantly as a preplanting treatment (soil fumigant) against soil borne pests. Its negative effects on the ozone layer have been well documented and it is often criticized for killing beneficial as well as target organisms: hence it is banned in many countries. Still, some agricultural experts argue that equally effective alternatives do not yet exist (Hulshof 1991, PAN 1992, 1994).

Pesticide Marketing

The study included periodic visits to agricultural chemical merchants. This demonstrated, in line with findings documented elsewhere, that the main sources of pesticides are Israeli manufacture and distribution companies (Sansour 1991, Hassoun 1991). Pesticides are marketed via local West Bank merchants. These merchants rarely have educational backgrounds in agriculture and often obtain all their information about pesticides from the Israeli distributors. Since most pesticides are labelled in Hebrew, farmers receive their information from the salesclerks verbally. Evidence for this was a

trend of similar answers to questions about pesticides in the survey. The obvious implication is that farmers are receiving lessthanadequate information about usage, storage and disposal of pesticides.

It was also noticed that pesticide prices vary considerably between merchants. Some prices in certain parts of the West Bank were found to be below factory retail value, bringing into question the quality of merchandise being sold. Furthermore, it appears that pesticides are often sold without basic information, such as the expiry date.

Policies and laws that may be in place officially seem to be having little impact. It is not known, for instance, whether pesticides imported to the West Bank from Israel must be registered there. A merchant can seemingly sell any pesticide regardless of quality, or of health and environmental considerations. No authority exists to enforce restrictions that might be in place. While agricultural cooperatives could potentially play an important role in the distribution of certified quality and suitably priced pesticides, this role has thus far been very limited.

Farmers Practices, Knowledge, Attitude And Safety Precautions

The most common application methods are spraying with liquid formulations, dusting with powders and injection with gas. Liquid pesticides are commonly sold as concentrates to be diluted before or while loading the product into the sprayer. Measuring, mixing and loading are usually the most hazardous steps in pesticide handling. Furthermore, inaccurate dilution can reduce pesticide effectiveness or can increase residues and accelerate the development of pesticide resistance. As shown in the survey results, farmers are taking inadequate safety precautions. For example, 40% of the farmers do not measure the recommended doses accurately (Table 9), while 30% use more than the recommended dosage thinking that this will improve effectiveness. Some also think that pesticides found in the market are diluted, making it. necessary to compensate by increasing the dose (Table 10).

Table 9. Measuring the recommended dose of pesticide.

How do you measure the recommended dose?	Balance or calibrated	60%
	cylinder Spoon or container cover	30%
	Others	10%

Table 10. Following the recommended dose.

Are you restricted to the concentration on the label?	Yes	70%
	No	30%
Reason for not being restricted to concentration:	Increase according to the severity of infection	51%
	The solution is diluted	8%
	The instructionsare in Hebrew	11%
	No reason	30%

Among the farmers surveyed, 53% said that they dispose the empty containers around or inside the farm after damaging them so that they cannot be reused. The excess spray solution is in 52% of the cases buried in the soil, while 34% spray it again on the same crop. Although 69% of farmers said that they stored pesticides in special places at home or on farm, there are many cases where no special places for storing exist (Table 11). It was found that in many cases children participate in transporting, mixing and spraying.

Table 11. Disposal of the empty pesticide container.

How do you dispose of the excess spray solution?	Spray it again on the same crop	34%
	Spray it on the adjacent crop	9%
	In the soil	52%
	No response	5%
Where do you dispose the empty container?	In the farm	53%
	In the garbage	10%
	Burying it in the soil	10%
	Burning it	27%
Do you damage the pesticide container before disposal?	Yes	73%
	No	27%
Where did you store the pesticides?	In a special room	69%
	In the barn	9%
	Inside the house	1%
	In the farm	21%

On average, 70% of farmers do not wear protective clothing while spraying, and clothes contaminated with pesticides are often worn day after day even while applying other kinds of chemicals. Accouterments are washed with the family laundry. Most farmers surveyed said they do not use protective garments either because they do not have the time to dress prior to spraying, or because of the high cost of protective clothing (Table 12).

The practice of not wearing protective garments is dangerous because many pesticides are readily absorbed through the skin. However, using protective clothing improperly can be more hazardous than not using it at all. For example, clothes that are not washed and become saturated with pesticides through repeated use, or rubber gloves and boots that are contaminated on the inside, can greatly increase pesticide absorption through the skin. Proper hygiene, regular washing of both the skin and protective clothing (separately from household laundry) is a critical element of safe pesticide handling.

It was also found that farmers often use old spraying equipment because they cannot afford to replace it. Spare parts and knowledgeable technicians are often hard to find. Many cases were observed in which sprayers' backs were soaked with leaking pesticides. Many farmers know little or nothing about sprayer calibration: 70% of the farmers interviewed knew nothing about it, and performed only nonmathematical estimations of the amount of water solution needed to cover the area to be sprayed. This almost inevitably results in an excess amount of solution being used, most of which is poured into the soil,

possibly contaminating ground water. This is especially hazardous in the case of pesticides with a long residual action (Foster et al 1991, Fielding 1991).

Table 12. Wearing protective clothes.		
While spraying do you wear:	**Yes**	**No**
Overalls	30%	70%
Long boots	51%	49%
Mask	30%	70%
Glasses	8%	92%
Hat	48%	52%
Gloves	13%	87%

The following table shows the information sources on which farmers depend in making decisions about pesticide use (Table 13). It is clear from the fourth question in the following table that a large percentage of farmers would benefit from agricultural publications in Arabic or training courses regarding pest management and the safe use of pesticides. About 90% of the farmers interviewed said that they would welcome the opportunity to attend IPM training.

The lack of extension services in the West Bank is clearly a problem. 70% of farmers surveyed base decisions about pesticide use on personal experience, advice of the salesclerk, or other farmers. Only 30% of the farmers surveyed said that they consult extension agents to decide which pesticide to spray, this being due to the large number of farmers per extension agent. Even when information on pesticides is available, it focuses only on purposes of use and recommended concentrations.

Table 13. Information sources for the spraying operation.		
Is agricultural extension enough in your region?	Yes	38%
	No	62%
Taking the decision to spray a certain pesticide depends on:	extensionist	30%
	other farmers	15%
	merchants	11%
	own experience	44%
Your main source of information regarding pesticides is:	extensionist	38%
	label	9%
	merchants	31%
	other farmers	22%
Do you try to applythe agricultural advice when available from publications?	Yes	84%
	No	16%
Would you participate in a training course on pesticides?	Yes	91%
	No	9%

Table 14 demonstrates the availability of fundamental information on pesticides for farmers. On average, 62.6% of farmers interviewed said that this information, including expiry date, safety period, toxicity, and pesticide

persistence, is available. However, of those farmers who said they did have access to such data, most receive their information from other farmers and pesticide merchants, again a reflection on the poor extension system in the OPT and the fact that even if this information is included, most instruction labels are in Hebrew.

Table 14. The availability of information on pesticides for farmers.

Information	available	Sometimes not available
Expiration date	40%	60%
Safety period	44%	56%
Purpose of use	87%	13%
Concentration	89%	11%
Toxicity	53%	47%

More than half of the farmers interviewed claimed to know what is meant by the "safety period" of a pesticide (Table 14). However, 98% of them reenter their fields before the third day after spraying, implying a lack of understanding of the concept of "reentry period". They often harvested soon after this date, although most pesticides used have a relatively long preharvest waiting period, often between 3 and 6 weeks. Such pesticides should only be used in cases where waiting for the recommended period is possible. It may be that, due to the lack of available information, farmers are not made aware of the problem. Even if they are, they do not know about pest control options that would preclude the need for such a long waiting period.

Table 15. Safety and Reentry periods.

What is safety period?	Right answer	58%
	Wrong answer	42%
Reentry period?	In the same day	42%
	After the second day	56%
	after the third day	2%

Routine occupational exposure during pesticide application often causes chronic health effects. Pesticides may accumulate in body fat following incidental exposure to residues in air, water, soil and food. Chronic and incidental exposure raises the possibilities of carcinogenic, teratogenic, mutagenic and reproductive effects (WHO 1993).

Pesticide related injury cases were found in 26% of the farmers interviewed. The injuries were not restricted to the sprayers themselves, having also affected women and children, because of their participation in the spraying process. Of all the reported cases, 50% were skin injuries, a finding which reflects on the inadequate use of safety precautions, poor spraying equipment, and the unavailability or inconsistent use of protective gear (Table 16). Promisingly, however, 83% of the injured took appropriate action by consulting a doctor immediately after poisoning. It is noteworthy that the pesticides most responsible for injuries detected by the study were: Karate,

Lannate, Cotnion, Smash, Rodomil, Tamaron, Manzidan, Cumbush, Metasystox and Methylbromide.

Table 16. Farmers' health awarenes.		
Have you or any family member ever been injured due to pesticides?	Yes	26%
	No	74%
Injury was through:	Oral	23%
	Skin	50%
	Inhalation	27%
What is your action in case of injury?	Go to doctor with the container	11%
	Go to doctor or hospital	72%
	Drink milk and have a shower	11%
	Don't know	6%
While spraying do you:	Smoke	12%
	Drink	4%
	Eat	12%
	None	72%

Table 17 shows that 74% of the farmers interviewed believe themselves to be developing immunity to pesticides with time. This belief is an indication both of the frequent interaction between the farmer and pesticides, and of the level of farmer ignorance about the negative impacts of pesticide. Extension will have an important role to play in educating farmers about these impacts.

Table 17. Farmers' belief of pesticide immunity.		
As a farmer do you think that you have immunity for pesticides?	Yes	74%
	No	20%
	Don't know	6%

The fact that most farmers make uneducated decisions concerning pathogens in the soil should be a matter of concern. 83% of the interviewed farmers do not test the soil. Some of them justify this by saying that there are no soil testing laboratories nearby, or that testing is too expensive. Others are simply not convinced of the salience of testing.

Table 18 shows the extent to which farmers understand both the ecological balance and ways in which pesticides affect beneficial microorganisms in the soil. The survey shows that more than half of the farmers (55%) are aware that there are beneficial microorganisms, and that most of these (69%) understand the negative impact pesticides have on these microorganisms. This could provide an important basis for future training of farmers.

Table 18. Farmers' awareness of soil ecology.		
Are there beneficial micro-organisms in the soil?	Yes	55%

	No	19%
	Don't know	26%
Are pesticides harmful to these microorganisms?	Yes	69%
	No	7%
	Don't know	24%

Education is the key to improved pesticide use and safety. It is a highly desirable component of any pest control program. Training programs must cover safety aspects thoroughly, focusing on the dangers of pesticide absorption through skin and lungs, the short and long term effects of intoxication, the dangers of environmental contamination. Training should also stress the importance of optimizing pesticide use through integrated pest management (IPM).

Recommendations

As previously mentioned, this preliminary report aimed to give an idea about pesticide use in the West Bank. It is now important both that the issue is researched more deeply and that practical measures are instigated. The following are seen as short and medium term priorities:

- Tests on toxicity levels among farmers and individuals, especially in Jenin and Tulkarem which account for almost half of the West Bank's total pesticide use.
- Surveys to verify the croppestareapesticide matrix in rainfed areas throughout the West Bank.
- Analysis of the economic efficiency of pesticide use.
- Development of a database including a GIS computer model outlining this information for policy makers, researchers and the general public.
- Development of articles, pamphlets and workshops on safe pest control and pesticide management in the West Bank.
- Use of the database to develop public policy promoting IPM, and to develop IPM research and outreach priorities.

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