Chapter 6

Pesticides

Pesticides are mixtures of substances used in agriculture and in urban environments to protect plants and animals from pests and diseases, to control weeds, and to protect humans from vector-borne diseases. Acute occupational or accidental exposure to high doses of certain pesticides can cause adverse health effects, including neurological disorders and death. Low-level chronic exposure to pesticides has been associated with neurological, respiratory, reproductive, and endocrine effects, as well as cancer. Evidence from toxicology and epidemiology indicates that fetuses, infants, and children are uniquely vulnerable to the effects of pesticides.

New classes of biological pesticides (containing bacteria, fungi, and viruses) as well as chemical pesticides (e.g., pyrethroids and neonicotinoids) are increasingly replacing more toxic classes (e.g., carbamates and organophosphates [OPs]). However, there is emerging evidence regarding the toxicity of these new classes of chemical pesticides[6].

Highly toxic pesticides, such as phosphine, chlorpyrifos, formaldehyde, and metam sodium, continue to be used worldwide and in Israel.

Policy and Regulations

Pesticide Registration

Four government authorities are responsible for registering pesticides in Israel:

1. The Plant Protection and Inspection Services (PPIS) unit at the Ministry of Agriculture and Rural Development (MoAg) is responsible for registering pesticides for plant protection. There are approximately 1,200 conventional pesticide formulations—in addition to 200 pesticide formulations for organic agriculture - based on 300 active ingredients registered by the PPIS. Conditions for pesticide registration and label requirements are specified in standards passed in 1994, which are currently under review.

2. The Veterinary Services unit at the MoAg is responsible for registering pesticides and disinfectants for use on animals and in farm buildings. There are approximately 150 pesticide and disinfectant formulations based on 30 active ingredients registered by the Veterinary Services. In 2016, the MoAg updated the standards requiring the registration of all veterinary pesticides and disinfectants marketed in Israel.
3. The Ministry of Environmental Protection (MoEP) is responsible for registering pesticides used for sanitation purposes, i.e., for mosquito, rodent, and other pest control in and around residences and buildings, and in open spaces. There are approximately 200 formulations based on 50 active ingredients registered by the MoEP. Conditions for registration and label requirements are specified in standards passed in 1994, which are based on the Toxic Substances Law.
4. The Ministry of Health (MoH) is responsible for registering pesticides that are applied on the human body (for example, for lice treatment or mosquito repellant for topical use).

The PPIS and Veterinary Services at the MoAg, and the MoEP have established inter-ministerial committees that include representatives from the MoH, the MoAg, the MoEP, and the Ministry of Labor, Social Affairs and Social Services (MoLSA). These committees evaluate the risks of new pesticide formulations, including imported pesticides. The MoEP and the Veterinary Services, but not the PPIS, require that all pesticides be re-evaluated and approved by the inter-ministerial committees before renewal of their registration. In recent years, several active ingredients have been phased out, following recommendations by the inter-ministerial committees (Table 1). Pesticides banned in 2012-2014 are listed in the *Environmental Health in Israel 2014* report.

Phased-Out Pesticides in Israel, 2015-2016

→ **Table 1**
Source: Israel Ministry for Environmental Protection, Israel Ministry of Agriculture and Rural Development

Active Ingredient	Responsible Government Entity	Use	Phase-Out Date
Propoxur	MoEP	Indoor spray	December 2016 (end of January 2017 for professional use)
Propoxur	Veterinary Services	Pet collars	April 2016
Chlorpyrifos	Veterinary Services	Spray for sheep	December 2016
Pirimiphos-methyl	MoEP	Outdoor spray (mosquito control)	December 2015
Temephos	MoEP	Outdoor spray (mosquito control)	December 2015
Carbaryl	Veterinary Services	Spray/powder for sheep	June 2016
Carbaryl	PPIS	Crop spray	April 2015
Benfuracarb	PPIS	Crop spray	April 2015
Carbosulfan	PPIS	Crop spray	April 2015
Flusilazole	PPIS	Crop spray	March 2015
Dicofol	PPIS	Crop spray	March 2015
Trifluralin	PPIS	Crop spray	December 2015

In addition to the registration and labeling approval of pesticide products, different government ministries are responsible for various regulations pertaining to pesticide use.

Pest Control Professionals

A new law regulating the practice of sanitary pest control came into effect in 2016. The law established four types of licenses for pest control professionals (domestic, structures and open spaces, fumigation, and military). Among its many new requirements, the law stipulates that pest control professionals must treat pest problems in a non-chemical manner when possible, before resorting to chemical pesticides.

Pesticide Drift

The MoEP and MoAg are jointly responsible for two standards that define minimum distances from structures that must be maintained when applying pesticides from the ground or the air. Both regulations are currently under revision.

Pesticide Residues

The MoH and the MoAg are jointly responsible for regulations establishing Maximum Residue Levels (MRLs) of pesticides in agricultural produce. Updated regulations came into force in 2016. Compared to the previous standards from 1991, 285 MRLs were cancelled in the 2016 standards, reflecting the phase-out of many OP pesticides in agriculture in Israel.

The Law for Inspection of Plant Production and Marketing, enacted in 2011, requires the MoAg to formulate standards to ensure the safety and quality of locally produced fruits and vegetables.

Proposed Legislation

Several draft laws and standards related to pesticide use have been developed and circulated in recent years. The MoLSA proposed regulations that would require all pesticide applicators to receive training and certification, and to undergo regular medical tests. The proposed regulations would also prohibit the sale of pesticides to uncertified individuals, with the exception of pesticides intended for use by the general public. The MoEP proposed updating standards with stricter requirements regarding pesticide application near structures. Finally, an environmental NGO, Adam Teva V'din (Israel Union for Environmental Defense), proposed a law that would regulate the use and sale of restricted use pesticides, establish minimum distances between the application of pesticides and structures, and require development of a pesticide use database. These proposed standards and laws are in different stages of the legislative process and have yet to be approved.

Data on Pesticide Use and Exposure in Israel

Sales

Data published in 2016 by the Central Bureau of Statistics indicate a 14% decrease in sales of agricultural pesticides in 2011-2013 relative to 2008-2010[4]. There was a sharp decrease in sales of soil fumigants (-35%) and an increase in sales of herbicides (3%). Soil fumigants and fungicides account for 26% and 35% of agricultural pesticide sales, respectively. There was also a 20% decrease in the amount of active ingredient sold per area of agricultural land in Israel (2.1% in

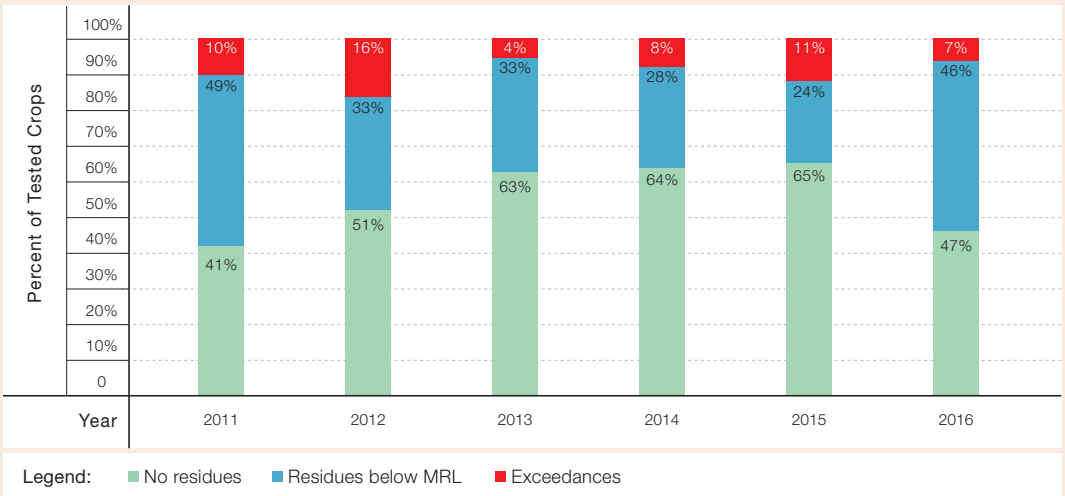
2013 compared to 2.6% in 2010). Despite this decrease, Israel continues to hold the record for the use of pesticides (tons per 1,000 m^2 of agricultural land) among selected Organization for Economic Cooperation and Development (OECD) countries. Sales of sanitation pesticides dropped by 20% between 2010 and 2013. There was an increase in the sales of pesticides for use by the general public compared to pesticides for professional use (48% in 2013, up from 34% in 2008).

Pesticide Residues

The MoH surveys pesticide residues in crop samples at the point of sale[5]. The survey strategy is based on the oversampling of products with high potential for pesticide residues. In 2016, the MoH tested pesticide residues in 920 crop samples. The primary active ingredients detected in crops were chlorpyrifos, methomyl, dimethomorph, dinotefuran, and imidacloprid.

Trends in Pesticide Residue Levels, Based on Ministry of Health Surveys, 2011-2016

→ **Figure 1**
Source: Israel Ministry of Health[5]



According to MoAg data published in 2017 on pesticide residues in crops sampled in the field in 2015 (n=642), 44% of tested crops had no residues, 44% had residues below the MRLs, and 12% had residues above the MRLs. It is important to note that 19% of tested apples and 24% of tested melons had exceedances above the MRLs[7].

Incidents and Poisonings

The MoEP collects data on incidents involving the use of agricultural pesticides in and near residences. Between January 2015 and October 2016, there were 255 public complaints in agricultural areas, which included 128 reports of adverse health symptoms.

In addition, between January 2014 and December 2015, 26 incidents involving illegal residential use of agricultural pesticides were reported. Two children died in 2014 as the result of illegal use of phosphine for domestic pest control in a residential building in Jerusalem, and another incident involving the illegal use of phosphine in a residential building was reported in Herzliya in 2015. There were 12 incidents involving the illegal use of OP pesticides (chlorpyrifos and

diazinon) in residential areas. It is worth noting that chlorpyrifos and diazinon were phased out for residential use in 2008 and for use in public parks in 2009. Diazinon for plant protection uses was phased out in 2014 and the chlorpyrifos formulation for veterinary use that was involved in numerous incidents was phased out in 2016.

Data on pesticide poisoning in Israel is not collected systematically, but there are sporadic data from several sources. According to data collected by the Israel Poison Information Center at Rambam Health Care Campus, there were 1,932 poisonings in 2014; only 27 of them resulted from occupational exposure. Most moderate or severe poisonings were attributed to exposure to OPs or carbamates. The total number of OP and carbamate poisonings in 2014 was 194. According to MoH data on emergency room visits, there were 18 visits in 2015 related to exposure to pesticides, including seven cases involving children under the age of four. The data indicate an increase in OP pesticide poisonings in 2010-2015. These data are partial and reflect underreporting by physicians.

In May 2017, two children visited the emergency room following an incident in which their drinking water was contaminated with the fumigant metam sodium. Based on a preliminary investigation of the incident, a farmer using metam sodium contaminated the public drinking water system. Tap water in the affected area was prohibited for drinking, cooking, and washing for five days.

Data on Exposure to Pesticides

Researchers from Hebrew University's Center of Excellence in Agriculture and Environmental Health and the MoH found that children have higher exposure to many pesticides compared to the general population, and that children's exposure to ten pesticides exceeded the Acceptable Daily Intake - ADI (Table 2).

Pesticide Intake Among Children in Excess of the Acceptable Daily Intake (based on pesticide residue data, 2006-2010)

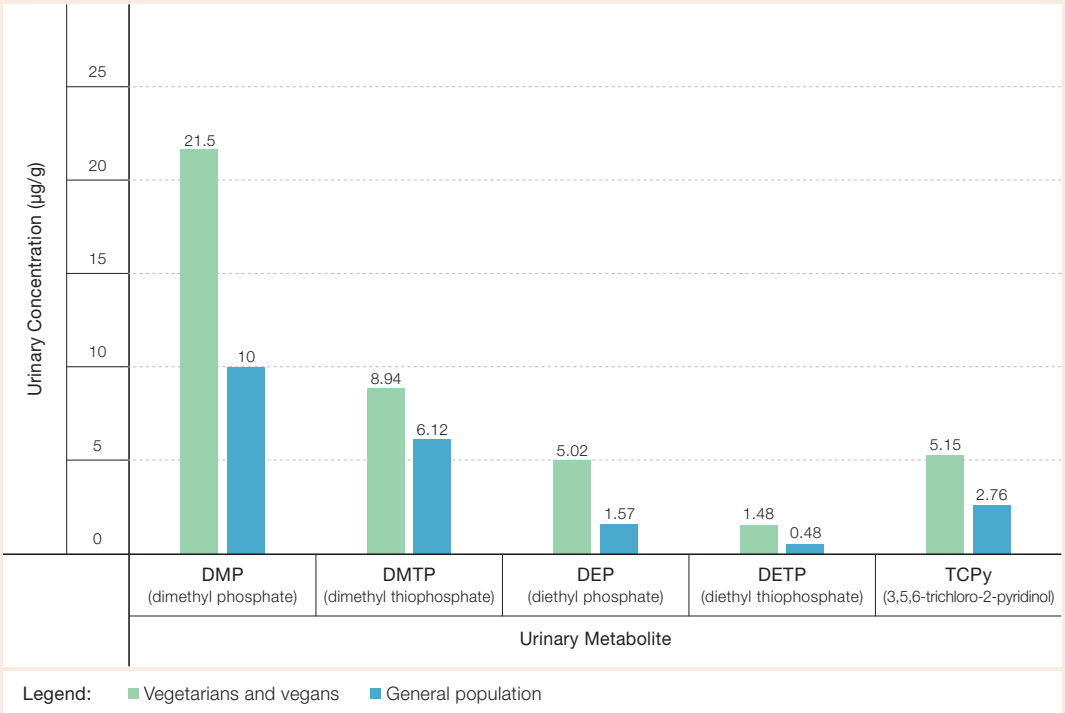
Active Ingredient	Exceedance of ADI, at Intake Percentile	Elevated Intake in Children Compared with the General Population	Use of Active Ingredient Restricted or Phased Out between 2012-2016
Cadusafos	75	+	Phased out
Carbosulfan	90		Phased out
Chlorothalonil	75		Neither phased out nor restricted
Chlorpyrifos	75		Restricted
Endosulfan	75		Phased out
Fenamiphos	50	+	Restricted
Iprodione	50		Neither phased out nor restricted
Methamidophos	25	+	Phased out
Monocrotophos	90	+	Neither phased out nor restricted
Oxydemeton-methyl	50	+	Phased out

← Table 2
Source: Freeman et al., 2016[3]

A pilot study by researchers from Tel Aviv Sourasky Medical Center and the MoH on exposure to pesticides in vegans and vegetarians in Israel indicated relatively high levels of urinary OP pesticide metabolite concentrations in residents of a vegetarian community in the Upper Galilee (Amirim) compared with the general population in Israel (Figure 2)[2].

Urinary Creatinine-Adjusted Concentrations of Organophosphate Metabolites in Vegetarians and in the General Population

→ **Figure 2**
Source: Berman et al., 2016[2]



Research on Exposure to Pesticides in Israel

Researchers from Al Quds University in East Jerusalem, the Hebrew University of Jerusalem, and the MoH found that pregnant Palestinian women have lower exposure to OP pesticides compared to pregnant Jewish women in the Jerusalem region, possibly due to lower intake of fresh fruits and vegetables or less use of pesticides in the Palestinian population[1].

A study published in 2017 showed that secondary drift (i.e., post-application drift) of OPs can increase the potential exposure to chlorpyrifos[10].

A study by researchers from Ben-Gurion University in 2015 found a higher incidence rate of Parkinson's disease among Jewish populations living near large cultivated fields in the Negev, based on data collected between the years 2001-2012. The researchers found that the proximity to the field and its size were associated with the risk of this disease[9].

Additional studies currently underway in Israel include: a birth cohort exploring exposure to OPs and adverse birth effects; a study on the impact of exposure to pesticides containing OPs, pyrethroids and triazines on male reproductive health; a biomonitoring study examining the exposure of Jewish and Arab school children in the Haifa Bay and in rural areas to OPs; and a study on air concentrations of pesticides in residential areas near agricultural fields. In addition, the MoH collected urine samples from 200 adults and 100 children (a subsample of participants in the National Health and Nutrition Survey 2015-2016 [Rav-MABAT]) in order to analyze OP metabolites in urine.

Progress Since 2014

In addressing the challenges raised in *Environmental Health in Israel 2014*, there has been little progress creating an integrated committee on pesticide registration, and pesticide registration continues to be based on recommendations from three separate committees. In addition, there has been little progress in establishing a comprehensive database on pesticide poisoning in Israel. There are studies underway measuring concentrations of pesticides in air near homes and schools, and urine samples from children and adults collected in 2015-2016 are being analyzed for the presence of OP metabolites. The MoAg published a list of inert ingredients prohibited in pesticide formulations.

Major Challenges

One of the major obstacles in promoting comprehensive pesticide policy in Israel is the overlap, and sometimes division, of areas of responsibility among numerous government bodies. This impedes the regulation of the sale of agricultural pesticides, the urban use of plant protection pesticides, the agricultural use of pesticides near schools; and updating of regulations aimed at reducing risk from pesticide drift. Phosphine, a fumigant that caused the death of two children in 2014, is still registered by both the MoEP and the MoAg for overlapping uses, without sufficient coordination of oversight. A number of different entities have proposed new legislation on pesticide use in Israel, but this might exacerbate the existing problem of division of responsibility. Uniform and comprehensive legislation on pesticide registration and use is required.

Another major obstacle is the lack of regulatory oversight on the sale and use of agricultural pesticides. In the field of sanitation pesticides, pesticide applicators receive training and certification, and certain formulations are registered and sold for professional use only. There is no regulatory framework for restricting the sale and use of high-risk plant protection products and veterinary preparations, and these products continue to be sold freely on the market. The high number of incidences of illegal residential use of agricultural pesticides is indicative of this problem. The 2017 State Comptroller Report highlights the fact that the MoAg does not supervise the proper use of agricultural pesticides. The report also notes that the MoAg reduced

the budget allocation for training farmers and for integrated pest management initiatives. According to the report, the MoLSA performs inspections of fewer than 1% of the workers using pesticides[8].

To date, dietary risk assessments on exposure to pesticides are performed using data on market-based diets (the amount of food sold). Dietary data on children in Israel was collected in the National Health and Nutrition Survey in 2015-2016 (Rav-MABAT), but is not yet available for risk assessment. While studies on the dietary exposure of vegetarians and children to pesticides showed that there may be subgroups with high levels of exposure, risk assessment is still conducted using average estimates of exposure.

The advisory committee on plant protection pesticides evaluates active ingredients currently registered for plant protection on an ad hoc basis. As a result, there may be delays in re-evaluation and in decision-making regarding active ingredients that have been phased out in the EU or United States. The same advisory committee is developing a work plan for the periodic re-evaluation of all active ingredients registered for plant protection at the MoAg. This is a considerable challenge considering that there are over 300 active ingredients registered for crop protection.

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