Cut back on pesticides for healthier lives

New scientific understanding of health impacts of pesticides demands precautionary policy-making



BRIEFING

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PAN Europe

Pesticide Action Network Europe

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New scientific understanding of health impacts of pesticides demands precautionary policy-making

The current European Union Directive for authorising pesticides (Directive 91/414/EEC for the placing of plant protection products in the EU market) is totally inadequate to prevent the increasing health threats to the people in Europe, and in particular vulnerable groups such as children, women of child bearing age, pregnant women and socio-economically deprived groups. The current proposal to revise Directive 91/414/EEC and the proposal for a new Directive to address the use phase of pesticides are concrete opportunities to put human health ahead of agricultural considerations and to apply the precautionary principle.

This briefing explains our concerns and outlines policy proposals to improve this alarming situation by tackling the following issues:

Introduction

Establishing a causal link between exposure to one or several specific pesticides and health problems is difficult because human diseases and disorders are the result of many interacting influences including radiation, chemicals, genetic background, lifestyle choices and diet. Only when a chemical or a group of chemicals exert a very strong impact has it been possible to ascertain a significant association. In the case of pesticides, it is often difficult to isolate the effects of specific products because in many cases, there are simultaneous exposures to several pesticides and the type of pesticides used varies with the growing season[1].

The difficulties in assessing real risk and determining a causal link are underlined by an increasing number of scientists, in particular by the co-signatories of the Paris Appeal (2004)[2] and the co-signatories of the Prague Declaration (2005)[3].

Nevertheless, this difficulty in establishing a causal link does not mean that there is no problem. The co-signatories of both Appeal and Declaration call for overall reduction of exposure via adoption of the precautionary principle in chemicals policies.

The European Commission has adopted a revision of the pesticides authorisation Directive on 12 July 2006 (COM (2006) 388 final), in combination with a Directive addressing for the first time the use phase of pesticides (COM (2006) 373 final). Although these proposals contain some positive developments, overall they fail to introduce the strong measures needed to change the pesticide use paradigm in the EU and to respond to strong public health concerns voiced by the public, researchers and health and environmental organisations.

The co-signatories of both the Paris Appeal and Prague Declaration call for overall reduction of exposure via adoption of the precautionary principle in chemicals policies.

Why current risk assessment does not protect health

The risk assessment procedure is the basis for authorisation of each active ingredient considered individually. But **current procedures** give only a very imperfect approximation of the real risk, because they **do not take into consideration the combination of pesticides** (the use of a single substance in a crop is the exception rather than the norm) and the additive effect of pesticides which share similar mechanisms of action against a wide range of organisms.

Current risk assessment procedure takes into account toxicity and also estimated patterns of exposure to a particular pesticide but **relies solely on data from healthy adult** organisms. Current risk assessment also **lacks sufficient testing** for certain toxic properties, proper review of the scientific literature or consideration of new scientific findings. Some of these findings show higher impacts from pesticides than previously expected. The case of endocrine disrupting pesticides shows that, although knowledge of newly discovered detrimental effects of substances exists, the EC does not plan to use this information in the approval process until internationally agreed testing protocols are available. If a proper review of the scientific literature and new scientific findings were taken into consideration in the risk assessment procedure, substances of serious concern would be restricted on a precautionary basis and not allowed to accumulate in the environment to a point were the effects are irreversible.

The assessment of human exposure as part of this procedure is also very weak because pesticide usage data is patchy, multiple exposure routes are not considered and biomonitoring data (measures of concentrations in blood, urine, etc.) are lacking[4].

Why are foetuses, infants and children more vulnerable?

Because their bodies are still developing, foetuses, infants and children can be more vulnerable to toxic compounds than adults. Their diet and special behaviour patterns often result in greater exposure to pesticides. A report by the World Health Organisation and the European Environment Agency[5] highlighted how this is not adequately addressed, for example, when regulators establish limits on the amount of a specific pesticide which can be "safely" consumed

(i) each day of life (ADI-Acceptable Daily Intake*),

(ii) over a period of time (ARfD-Acute Reference Dose**) and

(iii) to calculate Maximum Residue Limits (MRLs) for pesticides in food.

Children also have a longer life expectancy in which to develop diseases with long latency periods. For example, if a 70-year-old adult and a 5-year-old child are exposed to a carcinogen with a 40-year latency period, the child has a much higher lifetime risk of developing adverse health consequences[6]. Children are also highly vulnerable to critical windows of exposure, and their systems for protecting the body from toxic chemicals are still immature. The Scientific Committee on Food that advises the European Commission on these matters took similar considerations into account when it adopted an Opinion in favour of a MRL (maximum residue limit) of 0,01 mg/kg (analytical zero) for pesticides in food intended for infants and children. The resulting baby food Directive (Directive 1999/39/EC) protects children when eating commercial baby food; however, this age group is not protected when eating currently available food.

Current pesticide risk assessment protocols allow at best for the possibility that children may be up to ten times more sensitive to pesticides then adults. This is done by introducing a factor of 10 to allow for variability within humans. Safety limits resulting from animal testing are divided by a factor of 10 to allow variation between species (for example between rodents and humans) and again divided by a factor of 10 to allow variation between humans. This factor of 10 is not really intended for children but for the adult population assuming variations in terms of gender, race and size. But recent research indicates that children may be up to 164-fold more sensitive to the effects of organophosphates, a class of pesticides commonly used in agriculture worldwide, rendering this 10 factor insufficient to protect children against commonly used pesticides[7]. Organophosphate residues in food are very common in Europe[8]. In the US, every day, 9 out of 10 children between the ages of six months and five years are exposed to a combination of 13 different organophosphate insecticides in food.

We need tests capable of evaluating the effects of exposure in key periods of development that manifest later in life. Possible adverse effects which have been neglected include neurotoxic, endocrine and immune system disorders and cancer. Unlike obvious birth defects, most developmental effects cannot be seen at birth or even later in life. Instead, brain and nervous system disturbances are expressed in terms of how an individual behaves and functions, which can vary considerably from birth through adulthood. It is estimated that **one in every six children has a developmental disability, in most cases affecting the nervous system**, the most common being learning disabilities, sensory deficits, developmental delays, and cerebral

*Average Daily Intake (ADI) expresses the pesticide dose a person can consume each day over a lifetime without harm, based on the state-of the-art science at that time.

**Acute Reference Dose (ARfD) expresses the amount of a substance in food, expressed on a body weight basis, that can be ingested over a short period of time without appreciable risk to the consumer on the basis of the data produced by appropriate studies and taking into account sensitive groups within the population (e.g. children and the unborn).

palsy. Evidence also suggests that neurodevelopmental disorders caused by chemicals have created a silent pandemic in modern society. Although many pesticides are known to be neurotoxic in adults (a strong indication of developmental neurotoxicity), we have not moved to protect children from their effects. **The absence of developmental neurotoxicity testing and the high level of proof required by the regulation arguably contribute to this pandemic**[9].

Children consume a larger intake of pesticides in their diet than adults, in relation to their body weight. Per kilogram of body weight, children might consume 6 times more fruit, 2 times more vegetables and 3 to 5 times more cereals[10]. Hand to mouth behaviour is another important exposure route. Young children spend more time crawling at ground level where pesticide residues in household air, dust, carpets and on even toys may significantly increase their exposure.

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What does new research show?

As the comprehensive review of human health effects of pesticides by the Ontario College of Family Physicians shows, children are constantly exposed to low levels of pesticides in their food and environment, yet there have been few studies on the long-term effects of these exposures. The College reviewed several **studies that found associations between pesticide exposures and cancer in children, namely**:

- ✓ An elevated risk of kidney cancer was associated with paternal pesticide exposure through agriculture, and four studies found associations with brain cancer;
- ✓ Several studies in the review implicate pesticides as a cause of haematological tumours in children, including non-Hodgkin's lymphoma and leukemia;
- ✓ Some children have overall increased risk of acute leukemia if exposed to pesticides in utero or during childhood, especially for exposure to insecticides and herbicides used on lawns, fruit trees and gardens, and for indoor control of insects.

With indoor concentration of pesticides often exceeding those outdoors, the pesticide problem is not only restricted to farmers and inhabitants in rural areas but to the entire population. Children spend comparatively more time indoors than adults and are particularly exposed. In 2000 the US Environmental Protection Agency announced a ban from home, garden and indoor uses of chlorpyrifos (a common organophosphate insecticide) after federally mandated risk assessments concluded that **children are more sensitive to the pesticide than previously estimated**[11].

New research in France also highlights the **special vulnerability of children**. A recent study[12] concluded that the appearance of acute leukemia in children was associated with the use of various types of insecticides in the household during pregnancy and childhood. An epidemiological study conducted in the framework of the Automated Childhood Cancer Information System project by IARC (International Agency for Cancer Research) concluded that **cancer is rising rapidly among children across Europe, with up to 17% of cases resulting from modern lifestyles and changes in the environment**[13]. The study covered 77,111 cases of cancer in children diagnosed between 1978 and 1997 in 15 European countries. The results showed that the number of cases of cancer in children under 14 rose by an average of 1.1% a year. There were increases in most childhood cancers including brain tumours, testicular cancer, leukemia, kidney cancer and soft tissue sarcoma (cancer of connective tissue).

Epidemiological studies and toxicological research both demonstrate the adverse health effects of pesticides on children and recognise that children are more sensitive than adults to chemical exposure. On the other hand, studies confirm that compounds such as organophosphate pesticides accumulate in children's bodies and are easily detected in urine when children are fed a conventional diet. But if they are fed an organic diet, the concentration of the organophosphate pesticides found in their bodies decreases substantially to non-detectable levels, reducing the exposure to negligible levels[14,15]. These findings have already motivated some regulatory and legal actions but a growing number of researchers, organisations and government policies are moving to support the precautionary approach to chemicals policies.

The four key elements of the **precautionary principle** are:

- taking preventive action in the face of uncertainty;
- placing responsibility on those who create risks to study and prevent them;
- seeking alternatives to potentially harmful activities;
- increasing public participation and transparency in decision-making.

In contrast, current pesticide policies worldwide require substantial evidence of harm before regulatory action is taken, regardless of the availability of safer alternatives[16,17].

History provides numerous examples of early scientific warnings that were ignored over long periods until finally the evidence – and the costs – became overwhelming and forced governments to take action. In this respect, the example of asbestos is greatly instructive. With the first warnings coming as early as 1898 from factory inspectors, the United Kingdom took 100 years to finally ban 'white' asbestos, a decision that was echoed by the EU the following year. The current asbestos-induced death rate in the United Kingdom is about 3,000 deaths per year, and some 250,000–400,000 asbestos cancers are expected in Western Europe over the next 35 years, due to past exposures. This and other examples of late lessons from early warnings can be found in a European Environment Agency report that aims to improve the understanding of the use of the precautionary principle in policy-making[18]. The current indications of health threats arising from excessive pesticide exposure are calling for the adoption of a precautionary approach in the form of pesticide use reduction and a progressive ban and substitution of the most hazardous pesticides for safer alternatives.

Children are more sensitive to pesticide than previously estimated.

Pesticide exposure in the womb: a lethal legacy

The embryo/foetal stage is the most vulnerable stage, when the developing organs and brain are known to be subject to environmental influences with critical windows of exposure at different points. **Contact with pesticides at this stage can give rise not only to congenital malformations but also functional impairments expressed much later in life**. Mothers can be directly exposed through food, water and other drinks, occupational use, gardening and household use. Mothers can also be indirectly exposed by their partner's professional or amateur use.

Several scientific papers relate birth defects and congenital disorders with parental exposure to pesticides. The effects range from neurodevelopmental impairments detected later in life to severe cardiovascular defects. The effects are related not only with a few known hazardous substances but with different classes of pesticides, including the less toxic in acute poisoning settings[19]. A systematic review of all the evidence to date by researchers from Liverpool University[20] concludes that low levels of synthetic pesticides and organochlorines with endocrine-disrupting properties could be major factors in the development of cancers. They stress that the dangers of pesticides for children have been underestimated as chemicals can potentially cause cancer in children at parts per billion and parts per trillion levels, rather than parts per million and thousands. The current safety factors Maximum Residue Levels, Average Daily Intake and Acute Reference Dose are set using mg per kg of body weight. The threshold for pesticides concentration in water in the EU is set at 0.1 µg/l (i.e 0.1^{9} grams per litre or 0.1 parts per billion), not because it was considered to be the safe limit but because detection techniques could not go beyond that limit at the time the Drinking Water Directive was approved in 1998. At that concentration, atrazine (an endocrine disruptor pesticide banned in Europe but still one of the most widely used elsewhere) castrates adult male frogs and has irreversible effects on the reproductive capacity of larval amphibians. The effects on amphibian hormonal systems warn of similar effects in humans and may explain associations between low fertility and reproductive cancers in humans[21]. Likewise, a test showing reprotoxicity in laboratory animals is taken as a strong indication of reprotoxicity in humans.

These substances could affect the development of children before they are born and increase their likelihood of developing cancer later in life. Bioaccumulative pesticides are also present in breast milk, raising the possibility that babies are exposed while breastfeeding.

Furthermore, since the female ova are formed in the foetal stage, the next generation of children may be affected by their grandmother's exposure. In the US, research carried out for several years by scientists from the Washington State University[22,23] with vinclozolin suggests that a single exposure to this fungicide during pregnancy can cause cancer, kidney disease and other illnesses for up to four future generations. The re-approval of this pesticide in Europe was recently proposed by the European Commission in the framework of the revision of all active substances in the market under Directive 91/414/EEC because under the current risk assessment, some uses could be considered "safe" if extensive mitigation measures were to be implemented. Fortunately, pressure from some Member States forced the Commission to withdraw the proposal and the substance has been banned.

Do we have reasons to be concerned about the level of contamination?

News about the alarming level of contamination in food, water, air and human bodies by pesticide residues reach us frequently via official monitoring reports and the media. **In the EU, the monitoring results for pesticide residues in fruits and vegetables indicate a worrying trend towards the increase of residues**. The last available results indicate that almost half (42.1%) of all fruits and vegetable samples are contaminated by pesticide residues[24]. A significant percentage (5.1%) is contaminated at levels above the Maximum Residue Limits (MRLs) permitted by law. For example, analysis of the acute risk shows that, at certain levels of detected pesticide residues, a toddler might consume more than the recommended dose of methamidophos and five times the recommended dose of triazophos in sweet peppers and over 10 times the recommended dose of methomyl in table grapes. Methamidophos and triazophos are organophosphate insecticides that share a common mechanism of nerve disruption in insects. But humans share common biological mechanisms with other species which makes us vulnerable to the same substances. Methomyl is a carbamate insecticide that shares the above hazards and is also a suspected endocrine disruptor. They are all in use in agriculture in the EU and methamidophos has been recently re-approved for use.

The level of contamination in water is equally disturbing. In France, for example, a recent survey[25] by the French Environmental Institute found that 96% of surface water and 61% of groundwater samples contained residues of at least one pesticide. Almost one third of all pesticides were found in concentrations exceeding the threshold for human consumption (above 0.1µg/l). Many of the substances found have been banned due to their severe health and environmental hazards; for example

lindane, aldrin or dieldrin are organochlorine insecticides associated with cancer and endocrine disruption. These findings show that contamination persists long after the substances have been banned.

The accumulation of hazardous pesticides also occurs in the human body. Being at the top of the food chain, humans are particularly exposed to pesticides in food. Reports by the WWF analysed samples of blood from different generations and different food items and tested them for a series of chemicals including organochlorine pesticides[26,27]. Although banned (some for over two decades) they are still found in the blood and in food items. Concerns over the potential effects of long term, low level exposure to chemicals in the diet, especially on the developing foetus, infants and young children are fully justified and call for the application of the precautionary principle to reduce our exposure.

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Implications of the new scientific understanding of health effects of pesticides

We have seen how some of the old toxicological paradigms have been challenged by recent research and evidence collected from the natural world. **There is an unanswered question about the special sensitivity of children or the effects of pesticides on neurodevelopment that are only detected later in life**. On the other hand, low level exposures cause effects that disappear at higher levels and we are exposed to a combination of pesticides rather than to a single substance at a time. **Current pesticide risk assessment is vastly inadequate to address these issues and a new regulatory approach to protect human health is needed**. The scientific community is now aware of the inadequacies of current risk assessment[28,29,30] but **only a handful of progressive governments are starting to introduce changes in policy-making**. An example is the Danish Pesticide Use Reduction Programme with targets for use reduction combined with a pesticide approval scheme which has banned the use of a number of pesticides that has been recently given EU approval (i.e esfenvalerate, isoproturon, deltamethrin, iprodion, maleinhydrazid, paraquat, propineb, thiabendazol and ziram)[31].

Conceptual shifts in scientific thinking

1. OLD: High level contamination overwhelms detoxification and other defence mechanisms.
   NEW: Low level contamination takes over control of development.
2. OLD: The dose makes the poison.
   NEW: Low level exposures cause effects that disappear at higher levels.
3. OLD: Only high levels of exposure matter.
   NEW: Impacts caused at what had been assumed to be background levels.
4. OLD: Focus on adults.
   NEW: Periods of rapid growth and development (prenatal through puberty) are most sensitive to exposure.
5. OLD: A small number of bad actors.
   NEW: Many chemicals thought safe are biological active and capable of interfering with signalling systems.
6. OLD: Immediate cause and effect.
   NEW: Long latencies are common; foetal programming can lead to disease and disabilities in adult life.
7. OLD: Examine chemicals one compound at a time.
   NEW: In real life, mixtures are the rule. They can lead to effects at much lower levels than indicated by simple experiments with single chemicals.
8. OLD: Focus on traditional toxicological endpoints like mutagenesis carcinogenesis, cell death.
   NEW: Wide range of health endpoints, including immune system dysfunction (both hyper and hypo-active); neurological, cognitive and behavioural effects; reproductive dysfunctions; chronic diseases.
9. OLD: One-to-one mapping of contaminant to disease or disability.
   NEW: Same contaminant can cause many different effects, depending upon when exposure occurs during development and what signals it disrupts. Multiple contaminants can cause same endpoint [effect], if they disrupt the same developmental process.

Source: Adapted from John Peterson Myers (2002)[32]

Conclusions and policy recommendations

This briefing has highlighted the special sensitivity of children to pesticides, the high level of contamination of food, water, soil and air and the overwhelming evidence challenging the old toxicological paradigms. We therefore recommend effective application of the precautionary principle for pesticide policies, which demands:

1. Pesticide use reduction and promotion of organic farming and Integrated Crop Management in the new Directive for the Sustainable Use of Pesticides

   Member States should set clear quantitative targets and timetables for the reduction of pesticide use and for increasing land areas under organic farming. Crop specific standards of Integrated Pest Management* should be established as a standard minimum for the remaining farmland.

2. Exclusion of unacceptable active ingredients (cut-off criteria) in Article 4 and Annex II of Pesticides Regulation

   No pesticide should be approved if it causes irreversible effects – even for use by trained users. One critical step in ensuring hazardous substances do not gain authorisation is to incorporate strict maximum "cut-off" criteria for specific properties related to their biological effects in risk assessment procedures. All substances with, or suspected to be, carcinogenic, mutagenic, reprotoxic or endocrine disrupting, and substances that are persistent, bio accumulative or toxic, should not be approved. Substances on a priority list established under relevant international treaties ratified by the European Union, or on the list of priority substances for water policy annexed to the Water Framework Directive 2000/60/EEC, should not be approved for use.

3. Comparative assessment and substitution by less hazardous substances or non-chemical alternatives in Article 48 and Annex II of Pesticides Regulation

   All chemical substances should be candidates for substitution by less hazardous substances or non-chemical alternatives. If priority should be given, a list of candidates for substitution should be set on the basis of clear criteria. This list should go beyond substances already classified as dangerous by existing legislation and include substances with proved or suspected immunotoxic, neurotoxic and endocrine disrupting properties. A database containing non-chemical alternatives should be set up at the European level to assist this process. Independent experts must carry out the assessment of the alternatives

4. Protection of vulnerable groups and against combination effects of pesticides in Article 4 and Annex II of Pesticides Regulation

   Regulation should be established on the basis of protecting the most vulnerable groups affected by pesticides. In setting ADI and ARfD values, an increase in the safety level by a factor of 10 should be considered. In addition, assessment of the combination, or "cocktail", toxicity of pesticides should be carried out, and safety values should be further lowered if the toxic effect of two or more substances in use together are likely to produce a more toxic effect than when either is used alone.

5. Regular evaluation and monitoring of pesticides in Article 14 of the Pesticides Regulation

   A regular evaluation of the authorisation programme should be implemented, allowing for new scientific and monitoring information to be taken into consideration in the evaluation of active substances.

6. Inclusion of newly identified effects and review of scientific literature in Article 4 and Annex II of Pesticides Regulation

   Data requirements for a substance should include a two-generation study to identify any effects passed on to the next generation. Tests to identify toxicity (such as neurotoxicity, immunotoxicity, induced carcinogenicity) to developing organisms and the foetus should be foreseen and an extensive survey of the available literature should also be integral part of the data requirements.

*Integrated crop management is a method of crop growing, in which fertilisers and synthetic pesticides are used, but in which the environmental burden of these inputs is minimised by giving priority to preventive measures of crop growing and the use of non-chemical practices and methods.

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