UNDP/GEF Danube Regional Project

Policies for the Control of Agricultural Point
and Non-point Sources of Pollution
&
Pilot Projects on Agricultural Pollution Reduction
(Project Outputs 1.2 and 1.3)

Inventory of Agricultural Pesticide Use in the Danube River Basin Countries

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Final Report

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Inventory of Agricultural Pesticide Use in the Danube River Basin Countries

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Preface

The UNDP-GEF Danube Regional Project supports through this Project Component the development of policies for the control of agricultural point and non-point sources of pollution and the conceptualization and implementation of pilot projects on agricultural pollution reduction in line with the requirements of the EU Water Framework Directive.

The Overall Objective of the Danube Regional Project is to complement the activities of the ICPDR required to strengthen a regional approach for solving transboundary problems in water management and pollution reduction. This includes the development of policies and legal and institutional instruments for the agricultural sector to assure reduction of nutrients and harmful substances with particular attention to the use of fertilizers and pesticides.

Following the mandate of the Project Document,

> **Objective 1** stipulates the "Creation of Sustainable Ecological Conditions for Land Use and Water Management" and under
>
> **Output 1.2,** "Reduction of nutrients and other harmful substances from agricultural point and non-point sources of pollution through agricultural policy changes",
>
> **Activity: 1.2-3** requires to "Review inventory on important agrochemicals (nutrients, etc) in terms of quantities of utilization, their misuse in application, their environmental impacts and potential for reduction"

The present document "Inventory of Agricultural Pesticide Use in the DRB" responds to this mandate in providing an analysis on the present use of pesticides, the existing mechanisms of regulation and control and proposed measures for policy reforms and their practical application in line with the requirements of the EU Directives and regulations.

The result of this study on the use of pesticides constitutes an essential contribution for the Summary Report on "Policies for the Control of Water Pollution by Agriculture in the Central and Lower Danube River Basin Countries" containing also the findings on the use of fertilizers as well as on the introduction of Best Agricultural Practices in the Danube River Basin countries

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Acronyms & Abbreviations

ai	active ingredient
BAP	Best Agricultural Practise
BPP	Best Plant Protection Practice
CAP	Common Agricultural Policy
DRB	Danube River Basin
DRP	Danube Regional Project
EAP	Environmental Action Programme
EC	European Commission
ECPA	European Crop Protection Association
EPPO	European and Mediterranean Plant Protection Organisation
EU	European Union
FAO	Food and Agriculture Organisation
GPPP	Good Plant Protection Practice
ICM	Integrated Crop Management
IPM	Integrated Pest Management
PAN	Pesticide Action Network
PIC	Prior Informed Consent
POP	Persistent Organic Pollutant
PUR	Pesticide Use Reporting
WB	World Bank
WFD	Water Framework Directive

Country Codes Used

BG	Bulgaria
BH	Bosnia and Herzegovina – consisting of 2 entities: FedBH – Federation of Bosnia and Herzegovina RS – Republic of Srpska
CZ	Czech Republic
HR	Croatia
HU	Hungary
MD	Moldova
RO	Romania
SK	Slovakia
SL	Slovenia
UA	Ukraine
YU	Serbia and Montenegro (previously the Former Republic of Yugoslavia)

Executive Summary

1. Overview

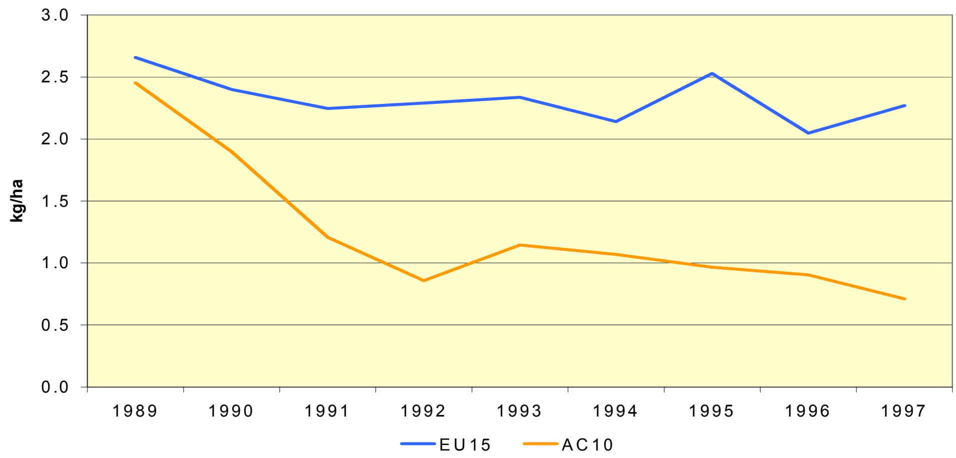
The use of pesticides has declined significantly in the countries of Central and Eastern Europe (CEE) since the political changes and sector reforms of the early 1990s disrupted the process of modernisation, specialisation and intensification of agricultural production that was characteristic of the centrally-planned economies in the region.

Reliable data on pesticide use in the CEE region are not available for the decades leading up to 1990. However, data from the FAOSTAT database show a strong decline in pesticide use in the CEE countries to about 40% of 1989 levels compared to a relatively small decrease in EU Member States during the same period (Figure 1).

There are indications, however, that the use of pesticides in the CEE region is increasing again with concerns especially that enlargement of the EU will further a trend towards the renewed intensification of crop production, particularly in the more productive regions of central Europe.

At the same time, there are many factors – including the risk of water pollution and the impact upon aquatic ecosystems – that are forcing much of European agriculture to rethink the use of pesticides, as well as many opportunities to promote new management approaches to pesticide use by farmers and policy-makers.

Summary Figure 1: Pesticide Consumption in CEE countries and the EU15[1]



Source: Data from the FAOSTAT database of the UN Food and Agriculture Organisation

2. Analysis of Priority Pesticides used in 11 DRB countries

The approach taken has been to focus upon so-called **priority pesticides** for the DRB. Studies of the water quality of the Danube River have found a number of polluting substances that regularly occur in the aquatic environment of the river. Some of these substances are of special concern for environmental and/or human health reasons and a list of "priority chemicals for the Danube River" has been prepared. According to Article 7 of the Danube River Protection Convention, which regulates

[1] The graph expresses mean consumption of pesticides (active ingredients classed as insecticides, herbicides, fungicides and others) per unit area of agricultural land.

emission limitations and water quality objectives and criteria, the discharge of hazardous substances from point and non-point sources shall be prevented or considerably reduced.

Annex II defines such hazardous substances and lists under Part 2 A (d) plant protection agents, pesticides and chemicals used for the preservation of wood, cellulose, paper, hides and textiles etc. Part 2 B of Annex II lists 40 single hazardous substances. In 2001, substances listed in Annex X of the European Water Framework Directive 2000/60/EEC were taken into account in revising the ICPDR list of priority substances. Altogether, the new list contains 41 single substances, thereof 25 chemicals which are used as pesticide **active ingredients,** and 5 chemicals which are used as **inert ingredients**.[2]

In the Danube River Basin 29 priority chemicals used in pesticide products and their regulatory status globally and in the European Union have been analyzed. Most substances, except for the inorganic compounds, are already regulated by international conventions or the European Union – including:

- **POPs Convention -** aims at the elimination or restriction of persistent organic pollutants (POPs),
- **EU Water Framework Directive No. 2000/60** - requires that measurements of dangerous priority substances aim at the phasing-out of these substances within 20 years after the adoption of measurements,
- **EU Authorisation under Directives No. 91/414 and 79/117**- only 2 of the Danube priority pesticides are fully registered in the European Union and listed in Annex I of Council Directive 91/414/EC. For three of the priority pesticides, registration will expire or has already expired and seven are still in the re-authorisation process. According to Directive 79/117, use of two of the priority pesticides is banned in the EU.

3. Regulation of Priority Pesticides

The analysis has shown that out of 25 pesticides only three priority pesticides are authorised for use in all of the DRB countries under study, while seven priority pesticides are not authorised in any of the countries. There are evidently also differences between the countries.

The Republic of Srpska authorised 15, Romania, Serbia & Montenegro and Slovakia 14 priority pesticides, while Bulgaria and Moldova authorised eight priority pesticides and the Ukraine only six.

In some countries, there are certain restrictions on specific pesticide products. For example, in Croatia, it is not allowed to apply Alachlor with a knapsack sprayer or a hand sprayer. It is also not allowed to use Alachlor on light soils after the maize has emerged. Use of Atrazine is limited to 1.5 kg ai/ha in humid and 1 kg ai/ha in arid areas. Endosulfan cannot be used in oil-seed rape and forestry. Use of Simazine is permitted only in maize monoculture. Trifluralin use is not permitted in post-harvest sown soya bean and sunflower.

4. Use of Priority Pesticides

It has **to be stated that there is** little information available about the details of the distribution and use patterns of Priority Pesticides in the DRB countries. From the 11 countries under study, only three countries maintain pesticide use/sales tracking systems based upon retail sales:

- **Hungary** - collects sales data from wholesalers and local distributors twice a year. They have to submit data on the sales in kg as well as on the monetary amounts of individual formulated pesticide products. Sales data are publicly available in an aggregated format.

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2 ‘Inert’ ingredient: These are substances which can enhance the efficiency of the active substance, make a product more degradable or easier to use.

- **Czech Republic** - all professional pesticide users have to keep spray records for 3 years. Farms larger than 10 ha are required to submit summaries to the Department of Information. Farmers report on amounts applied by formulated product, crop and geographical region. Usage data are publicly available by crop and amount of active ingredient. Data on pest and disease infestations are also published. Pesticide sales data are also collected by the Czech Crop Protection Association.
- **Slovakia** - started a pesticide sales reporting system in 1999. All traders are required to report sales data annually: manufacturer, importer, distributors and retailers. They are required to report the name and amount of formulated products for agricultural and non-agricultural pesticides. Sales data are publicly available by amounts of active ingredient, chemical class, use type and by postal code3. All farmers have to keep detailed records of their pesticide use and are required to submit summaries to the Central Control and Testing Institute of Agriculture.

National data was analyzed for 8 countries showing that the reported total use of priority pesticides is highest in Hungary and the Czech Republic - which is probably due to the fact that these two countries have comprehensive pesticide use tracking systems. In Hungary, the reported use is 10 times higher than in the Czech Republic, with copper as the most widely used pesticide. This is probably due to the fact that Hungary cultivates approximately 99,000 hectares of vineyards plus a large area with fruits and vegetables, while the Czech Republic cultivates only approximately 11,000 ha of grapes. Copper is globally used in large amounts in vineyards and orchards to control fungus and is approved as a pesticide in organic agriculture according to EU regulations.

As part of the inventory, data was also collected on the main crops that pesticides are applied to. As might be expected, it is clear from this data that a high percentage of crops in the DRB countries do not receive any pesticide applications at all. The findings can be summarized as following:

a) The priority pesticides are high-use pesticides, accounting for over 20% of total pesticide use in some countries;

b) The use of priority pesticides is associated with specific crops:
   - Atrazine is mostly used in maize;
   - Alachor is used in maize, rape seed and sunflower;
   - copper compounds in vineyards, orchards and in vegetables, including potatoes;
   - 2,4-D is mostly used in cereals;
   - the insecticides Chlorpyrifos, Malathion and Endosulfan are used in orchards, vineyards, rape seed, alfalfa and vegetables.

c) The intensity of use in treated areas can be higher than the one commonly found in western European countries.

Since many soils in the Danube catchment area, particular those closer to the river, are very good for intensified crop production, it seems likely that these observations at a national level are all directly relevant to the DRB catchment and that pesticide use on cultivated soils in the catchment will most likely be higher than national averages reported.

5. Problems Associated with Pesticide Use

Although pesticide use is currently relatively low in the DRB countries (compared, for example, to the EU Member States), it is important not to be complacent about the risks of pesticide pollution since:

1. Priority pesticides, as well as other pesticides, are frequently detected in surface and ground water in the DRB catchment area and pose a serious hazard to the environment and human health.

[3] Communication with Martin Hajas (Central Control and Testing Institute of Agriculture) and Jozef Kotleba (Ministry of Agriculture).

2. Seven priority pesticides are not authorised in the Danube countries, some of them continue to be hazardous due to old stockpiles and residues in soils and sediments.
3. The uncontrolled and illegal trade of pesticide products leading to the use of banned pesticides (e.g. DDT) by farmers is reported as a problem in many countries – although this is a sensitive issue that is difficult to verify. There is particular concern that certain countries lacking an effective pesticide control system (e.g. Ukraine) are gaining a reputation as a "dumping market" for obsolete and illegal products.
4. There are reports of high pesticide use in certain areas and on certain high value crops - this includes priority pesticides that pose a serious hazard to the environment and human health. In particular, the priority pesticides 2,4-D, Alachlor, Trifluralin, Atrazine and copper compounds are high use pesticides in most of the DRB countries. They are mostly used on cereals, rapeseed, sunflower and maize, and in orchards and vineyards.
5. Poor storage of pesticides, including old pesticide stores, continues to be a problem in many countries. In the Ukraine, there are some 20,000 tons of obsolete pesticides still in storage often under bad conditions and posing a serious threat to human health and the environment (e.g. infiltration into groundwater). In Bulgaria, 35% of the pesticide storehouses are reported to be in bad condition. In Moldova, some 6,000 tonnes of obsolete pesticides are reported to be in storage on former State and Collective farms, including single stores containing up to 4 tonnes. Several countries maintain databases containing the location, amounts and storage conditions of the pesticides, including the use of GIS-based maps in Moldova and the Ukraine.
6. Whenever farmers apply pesticides, there are many examples of "bad practice" that contribute to the risk of pesticide pollution. Those most commonly reported by the national experts were:

   - **Use of pesticides in excess of recommended rates** – in particular, the over-application of maize with the herbicide Atrazine (up to 2-3 times the recommended rate) is consistently reported as a serious problem in the DRB countries. In many cases, over-application is due to lack of knowledge/training and the tendency to apply larger amounts in the belief that this will increase the effectiveness of the pesticide products – a tendency that is made worse now by the increasing occurrence of weed resistance to Atrazine. The overuse of Atrazine is arguably one of the most significant pesticide problems in the DRB and accentuated in countries where large areas of maize are grown and/or most of the maize is routinely treated with Atrazine – for example, in Croatia it is estimated that 87-100% of the 324,000 ha of maize grown is treated with Atrazine.
   - The **unauthorised use of pesticides on crops they are not registered for** (e.g. use of Lindane on vegetables) is reported to be a common problem in most countries.
   - The **cleaning of spraying equipment and disposal of unused pesticide, pesticide containers and "spray tank washings"** nearby to (or even in!) water courses such as rivers and ponds.
   - The **drift of pesticide spray to adjacent areas** due to the old spraying equipment used (most spraying equipment used in the DRB region is now more than 15 years old), plus poor knowledge and lack of operator training (e.g. spraying in windy conditions).
   - **Lack of knowledge of and/or compliance with obligatory "buffer zones"** for surface waters and other protected areas.
   - The **poor timing of pesticide application** due to poor knowledge and lack of operator training leads to inefficient application and increased risk of pollution.

6. Potential for Pollution Control

The current low use of agricultural pesticides in the countries of the DRB presents a unique opportunity to develop and promote more sustainable agricultural systems before farmers become dependent again upon the use of agro-chemical inputs.

However, pesticide use is always related to agricultural policy. Farmers grow those crops which are economically most viable - if agricultural policy, for example, supports subsidy schemes and market policies for a small number of crops, the range of crops grown by farmers will be limited, crop rotations be simple or non-existent and, consequently, pesticide use will increase.

There is, for example, concern that with EU enlargement and the expansion of the Common Agricultural Policy (CAP) into the DRB countries joining the EU there is a risk of increasing pesticide use due to:

- increasing areas cultivated with cereals and oilseeds due to the availability of EU direct payments for farmers growing these crops in the new Member States;
- increased intensification of crop production, including the greater use of mineral fertilisers and pesticides, particularly in the more favourable areas with better growing conditions;
- a reduction in mixed cropping and an increase in large-scale cereal monocultures in some areas which are dependent upon agro-chemicals for crop protection.

There are numerous policy instruments that can be used to control pesticide pollution such as:

- Use reduction (ICM and IMP standards),
- Advice and compulsory training,
- Performance standards (cut-off criteria, eco-audit),
- Design standards,
- Permits (also transferable permits),
- Taxes and subsidies,
- Crop insurance

These control instruments provide a framework that can be elaborated and filled with more detailed measures. However, the selection of the most appropriate policy instruments for the DRB countries will depend upon the establishment of a clear policy strategy for controlling pesticide pollution, together with clear policy objectives.

According to the aims of the Danube Protection Convention, the risk of pollution should be stopped at its source – with regard to pesticide use this is generally assumed to mean[4]:

a) **withdrawing approval** for the use of those pesticides that pose the greatest threats to public health and the environment;

a) **reducing the use** of those pesticides that remained approved for use;

b) **improving the management** by farmers of those pesticides that remain approved for use.

This can be achieved through a combination of necessary policy reforms and the promotion of appropriate practical action by farmers. However, the potential to achieve these outcomes varies greatly between countries in the DRB and is above all related to the fact whether a country is currently preparing for EU accession or not.

This review of pesticide use is undertaken during a period of great change in the Danube River Basin (DRB) with Hungary, Czech Republic, Slovakia and Slovenia being in the final stages of preparation for accession to the EU in 2004, followed by Bulgaria and Romania preparing for EU accession in 2007 or later.

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4 OECD (1995). *Sustainable Agriculture: Concepts, Issues and Policies in OECD Countries*. Organisation for Economic Co-operation and Development, Paris.

The policy-making context for agricultural pollution control in the DRB is therefore undergoing significant change and preparation for joining the EU is currently a major driving force for the reform of agricultural pollution control policies in the six mentioned countries.

In the European Union, there are several Directives addressing the **regulation of pesticides**, including:

- *Directive 79/117EC on the prohibition of pesticides;*
- *Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);*
- *Directive 80/778/EEC on the quality of water intended for human consumption (the Drinking Water Directive) – to be replaced by Directive 98/83/EC from 2003;*
- *Directive 91/414/EEC concerning the placing of plant protection products on the market;*
- *Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive).*

The Directive with the highest potential for the control of water pollution by pesticides is the Water Framework Directive 2000/60/EC (WFD). Similar to the previous Dangerous Substances Directive (76/464EC), which was repealed by the WFD, pollution control is based upon chemical lists. The list of main pollutants consists of chemical classes and use types, therefore it includes priority substances and priority hazardous substances *per se*.

The EU Rural Development Regulation 1257/1999 (the "second pillar" of the CAP) makes provision for Member States to encourage more environmentally-friendly farming methods, including practices and actions that reduce the risk of agricultural pollution.

This offers an opportunity for supporting the control of pesticide reduction in those DRB countries preparing to join the EU, by allowing them to develop EU co-financed schemes that:

a) offer grant-aided investment (up to 50%) in agricultural holdings;

b) provide training in organic farming or integrated crop management practices as well as training for farming management practices with a specific environmental protection objective;

c) introduce agri-environment schemes that offer area payments to support the adoption of organic farming and ICM in orchard, vine and vegetable production, the creation of uncultivated buffer strips, conversion of arable to pasture land and the introduction of more diverse crop rotations.

Another useful tool will be the "verifiable standards of Good Farming Practice (GFP)" that all farmers receiving payments from agri-environment and less-favoured area schemes funded by the Rural Development Regulation - the so-called CAP 'Second Pillar' - must comply with across the whole of their farm[5].

Good Farming Practice (GFP) is a relatively new concept to emerge within the EU and its practical implementation is still being tested in many Member States. Obviously, the interpretation of what constitutes a "reasonable" standard of farming will vary from country to country; however, it is generally assumed that it will consistently involve farmers following relevant existing environmental legislation, and not deliberately damaging or destroying environmental assets, including the pollution of watercourses.

GFP is likely to become an even more important element of agricultural policy in future and is very relevant to promoting the better use of pesticide use by farmers, especially on those areas of the farm that are not suitable for agri-environment payments and continue to be farmed relatively intensively.

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[5] Section 9 of EC Regulation No. 1750/1999, which sets out the rules for several measures including agri-environment, states that: *"Usual good farming practice is the standard of farming which a reasonable farmer would follow in the region concerned.....Member states shall set out verifiable standards in their rural development plans. In any case, these standards shall entail compliance with general mandatory environmental requirements."*

While the four DRB countries (Czech Republic, Slovakia, Hungary and Slovenia) joining the EU in 2004 will shortly have the possibility to utilize the opportunities outlined above, the two remaining DRB countries of Romanian and Bulgaria are unlikely to join the EU before 2007. However, financial assistance is also available for these countries for developing and implementing similar measures with SAPARD co-funding - the special Pre-accession Programme for agricultural and rural development. Similarly, Croatia, Bosnia & Herzegovina and Serbia & Montenegro may use funding from the EU CARDS programme that supports implementation of measures in line with the requirements of the EU WFD.

7. Recommendations for Policy Reform

The national governments of all DRB countries should aim to effectively control pesticide pollution in order to minimise the risks presented to human health, the quality of environmental resources, and the integrity of natural ecosystems in the region.

The following objectives are recommended for all national strategies aiming to control pesticide pollution from agriculture, together with comments on policy instruments that should be adopted **where appropriate to the national context** (not all policy instruments are appropriate to all countries).

OBJECTIVE 1: Reduce the levels of harmful active substances used for crop protection by prohibiting and/or substituting the most dangerous priority pesticides with safer (including non-chemical) alternatives

1.1 **Pesticide Ban** - the use of Atrazine, Lindane, Diuron and Endosulfan needs to be banned immediately. Atrazine is the pesticide most often detected in the Danube basin, Lindane, Diuron and Endosulfan are toxic and persistent pesticides.

1.2 **Pesticide Phase-out** - the use of all other priority pesticides which are authorised should be reduced to a minimum, and the use should be phased out if possible, and substituted by less-dangerous pesticides, including non-chemical alternatives. Considering the current low levels of pesticide use and a lower dependency of farmers upon these chemicals in the DRB regions, the targets for further pesticide reduction can be ambitious.

1.3 **Cut-off Criteria** - in order to prevent the replacement of the priority pesticides which are going to be banned or phased out with other hazardous pesticides, cut-off criteria for the approval of other pesticides need to be defined. Pesticides with distribution coefficients (K_{oc}) below 300g/l (low absorption to soil, prone to leaching and run-off) and a half life greater than 20 days need to be regulated (prohibition, taxes and transferable permits are possible policy tools). Persistent pesticides should not receive authorisation.

OBJECTIVE 2: Improve controls on the use and distribution of pesticides

2.1 **Monitor Trade** - retailers, importers and distributors should be required to supply information on the amounts of all pesticide sold. Retail sellers need to keep records of their sales of pesticide products and to submit annual reports to national authorities.

2.2 **Control Trade** - all DRB countries must work towards stopping the uncontrolled and illegal trade of pesticides. The authorities at the borders should receive training on the issue of illegal pesticide trade. National legislation should enable authorities to effectively prosecute those selling illegal pesticides and to penalise them with high fines.

2.3 **Raise Awareness** – agricultural extension services and farmers should get access to information about the dangers of illegal and often unlabelled pesticides.

2.4 **Monitor Pesticide Use** – effective monitoring of pesticide use at the farm level is an essential tool for improving the control of pesticide use and distribution, as well as assessing environmental risks, developing non-chemical alternatives etc. Uniform record keeping by farming is essential for a functioning pesticide monitoring system. National regulation must require that pesticide use records are **kept** by all pesticide applicators (as in the Czech Republic and Slovakia) according to certain minimum standards and are **reported** to the relevant authorities.

2.5 **Elimination of Obsolete Pesticides** – all efforts must be made to immediately secure and remove stockpiles of obsolete pesticides.

OBJECTIVE 3: Encourage the proper use of pesticides by farmers and other operators

3.1 **Raise Farmers' Awareness** - simple and easy to understand information materials, combined with well-targeted publicity campaigns, can be very effective in raising farmers' awareness of the dangers of improper pesticide use and the importance of key issues such as the safe storage, handling, and disposal of pesticide products. Retail stores, extension services and other organisations working with farmers can serve as effective distributors of information material.

3.2 **Develop National Codes of Good Practice** – national authorities should agree upon clear and simple codes of good crop protection practice when using pesticides. There are numerous frameworks for such codes, but as a minimum they should provide guidance to farmers on:

- basic elements of crop protection;
- choice of chemicals available for crop protection, including obsolete/illegal pesticides;
- integrated crop management and non-chemical alternatives for weed, pest and disease control;
- quantity and types of pesticide product to use;
- pesticide storage;
- use of spray equipment, including cleaning equipment;
- disposal of surplus pesticides and spray mixture (diluted pesticide);
- disposal of empty pesticide containers;
- records of application;
- protective clothing and emergency procedures.

3.3 **Mandatory Farming Training** - comprehensive training is the most important instrument to prevent pesticide pollution at the farm level. All farmers and other operators (e.g. contract workers) who wish to purchase and apply pesticides should be required to have a licence confirming that they have participated in an approved training programme. As a minimum, training should highlight the possible adverse effects of pesticides and promote the National Code of Good Practice for the storage of pesticides, safe handling and application of pesticides, correct use of spraying equipment, disposal of unused pesticide and containers, and record keeping (see above).

3.4 **Develop Appropriate Extension Capacity** – agricultural extension services play a key role in raising awareness and improving the technical skills of farmers with respect to good crop protection practice, however they often require support in developing the necessary capacity to do this. National funding should be provided for the training of advisers in good practice and modern extension techniques, as well as the development of appropriate institutional frameworks for extension services (including the link to progressive and well-funded research programmes).

3.5 **Use Economic Instruments to Promote Good Practice** – where government schemes provide support to farmers, the principle of "cross-compliance" can be applied. This involves the establishment of certain conditions (e.g. compliance with verifiable standards of good agricultural practice) that farmers have to meet in order to be eligible for government support.

OBJECTIVE 4: Promote certified organic farming, together with integrated crop management (ICM) systems, as viable alternatives to conventional pesticide use

4.1 **Raise Farmers' Awareness** – viable alternatives to conventional pesticide use, such as organic farming and ICM, should be actively promoted to farmers through the preparation of simple and easy-to-understand information materials, combined with well-targeted publicity campaigns. Organic farming is the most developed of all alternative farming systems and has the highest potential for a reduction of the use of toxic pesticides (especially since the former intense use of copper compounds in organic vegetables and fruit has been controlled), plus there are a number of market opportunities available to organic farmers in the DRB countries.

4.2 **Develop Relevant Legislation** – the national legislation for the definition of organic farming systems in compliance with internationally recognised standards should be developed and implemented as a high priority (particularly those in accordance with EC legislation) in order to promote the development of domestic markets and international trade.

4.3 **Develop Appropriate Extension Capacity** – agricultural extension services and farm advisers play a fundamental role in the re-orientation of farmers towards new production systems, particularly systems such as organic farming and ICM, which require higher levels of technical knowledge and management. National funding should be provided for the development of appropriate extension capacity as 3.4 above.

4.4 **Develop On-farm "Quality Assurance Schemes"** - in addition to their growing interest in organic food and farming, the food processing and retail sectors of many European countries are developing additional "on-farm quality assurance schemes" that promote integrated crop management and the sale of food products that have been grown with reduced or minimal pesticide inputs. National authorities in the DRB should support the development of such "market-led" initiatives since they offer a potential market opportunity for DRB farmers and will contribute to reducing the risk pesticide pollution now and in the future.

4.5 **Use Economic Instruments to Promote Organic Farming and ICM** – farmers converting to organic farming and ICM techniques can incur certain additional costs associated with reductions in input, the establishment of new crop rotations, the adoption of new technologies etc. These costs can be a significant obstacle to farmers who decide to make the transition from a conventional farming system. Where national funds and/or other forms of co-financing are available, national authorities should encourage farmers to convert to organic farming and ICM by offering appropriate levels of compensatory payment.

1 Introduction

Overview

Pesticides are used to control a wide range of agricultural pests, diseases and weeds. They have become an integral part of modern European agriculture and their use is one of the most significant factors contributing to the high levels of agricultural productivity observed in many western European countries where most cultivated crops receive at least one, and usually many more, pesticide applications per year.

The development and widespread use of pesticides has largely taken place over the last 50 years with a succession of more sophisticated and effective pesticide products being introduced. Each of these pesticide products contains a number of constituents – including the **active ingredient** (ai) (or mixture of active ingredients) which is specifically intended to kill those pests, diseases or weeds that are considered noxious or unwanted in modern agricultural production.

Pesticides contribute to higher yields, improved crop quality and higher economic returns for farmers. Data on their use by farmers is, however, far from comprehensive and accurate data on their consumption is frequently missing from many European countries. This makes the assessment of trends in their use rather difficult, especially since the products used by farmers vary enormously between countries/regions according to seasonal, climatic, agronomic and geomorphological factors.

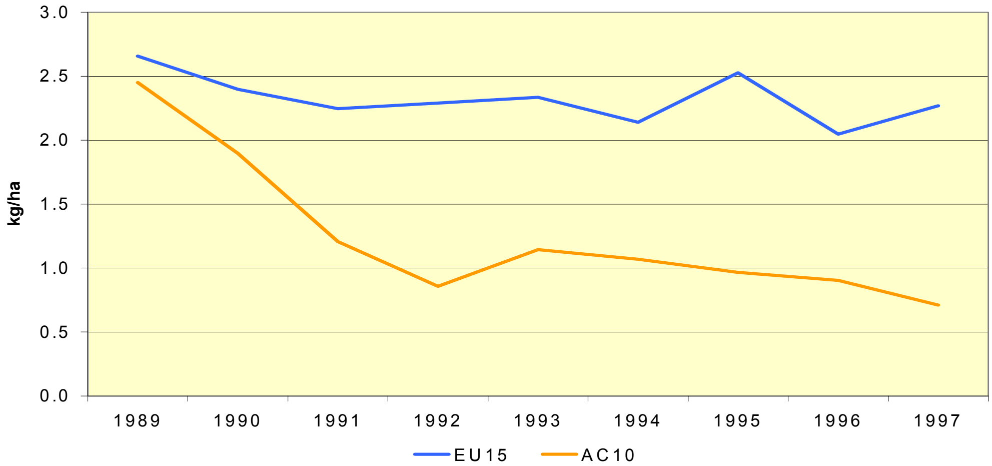
In spite of this, it is very clear that the use of pesticides has declined significantly in the countries of Central and Eastern Europe (CEE) since the political changes and sector reforms of the early 1990s disrupted the process of modernisation, specialisation and intensification of agricultural production that was characteristic of the centrally-planned economies in the region.

Reliable data on pesticide use in the CEE region are not available for the decades leading up to 1990. However, data from the FAOSTAT database show a strong decline in pesticide use in the CEE countries to about 40% of 1989 levels compared to a relatively small decrease in EU Member States during the same period (Figure 1).

There are indications, however, that the use of pesticides in the CEE region is again increasing, with concerns especially that enlargement of the EU will sustain a trend towards the renewed intensification of crop production, particularly in the more productive regions of central Europe.

At the same time it must be said that there are various factors forcing much of European agriculture to rethink pesticide use and many opportunities to promote new management approaches to pesticide use by farmers and policy-makers.

Figure 1 Pesticide Consumption in CEE countries and the EU15[6]



Source: Data from the FAOSTAT database of the UN Food and Agriculture Organisation

Aim of this Report

The aim of this report is to present an inventory of major pesticide use the Danube River Basin (DRB) countries, together with descriptions of observed misuse, potential impact upon the environment and potential for reduction.

The approach chosen has been to focus upon so-called **priority pesticides** for the DRB. Studies of the water quality of the Danube River have found a number of polluting substances that regularly occur in the aquatic environment of the river. Some of these substances are of special concern for environmental and/or human health reasons and a list of "priority chemicals for the Danube River" has been prepared.

According to Article 7 of the Danube River Protection Convention, which regulates emission limitations and water quality objectives and criteria, the discharge of hazardous substances from point and non-point sources is to be prevented or considerably reduced. Annex II defines such hazardous substances and lists under Part 2 A (d) plant protection agents, pesticides and chemicals used for the preservation of wood, cellulose, paper, hides and textiles etc. Under Part 2 B of Annex II, a number 40 single hazardous substances is listed. In 2001, substances listed in Annex X of the European Water Framework Directive 2000/60/EEC were taken into account in revising the ICPDR list of priority substances. Altogether, the new list contains 41 single substances of which 25 are chemicals which are used as pesticide **active ingredients** and 5 are chemicals which are used as **inert ingredients**.[7]

[6] The graph expresses mean consumption of pesticides (active ingredients classed as insecticides, herbicides, fungicides and others) per unit area agricultural land.

[7] 'Inert' ingredient: These are substances which can enhance the efficiency of the active substance, make a product more degradable or easier to use. 'Inerts' are mostly handled as trade secrets of the manufacturer, which means they are not labelled on the product.

Priority Pesticides in the Danube Region

				International Conventions		Status EU Water Frame Work Directive 2000/60		Status EU Directive 91/414 and 79/117
No.	**Ingredient**	**CAS Number**	**Use type**	**PIC**	**POP**	**Priority**	**Priority Dangerous**	
	Active Ingredients							
1	2.4-D	94-75-7	Herbicide					Annex I
2	Alachlor	15972-60-8	Herbicide			Yes		pending
3	Aldrin	309-00-2	Insecticide	Yes	Yes			banned
4	Atrazine	1912-24-9	Herbicide				Yes*	pending
	Copper compounds	7440-50-8	Fungicide					
5	Copper carbonate, basic	1184-64-1	Fungicide					Notified
6	Copper hydroxide	20427-59-2	Fungicide					Notified
7	Copper oxychloride	1332-40-7	Fungicide					Notified
8	Copper sulfate (basic)	1344-73-6	Fungicide, Algaecide					not listed
9	Malachite (copper equivalent 57%)	1319-53-5	Fungicide					not listed
10	Chlorfenvinphos	470-90-6	Insecticide				Yes	out 7/03
11	Chlorpyrifos	2921-88-2	Insecticide				Yes*	pending
12	DDT	50-29-3	Insecticide	Yes	Yes			banned
13	Diuron	330-54-1	Herbicide				Yes*	Dossier
14	Endosulfan	115-29-7	Insecticide				Yes*	pending
15	Endosulfan - alpha	959-98-8	Insecticide				Yes	not listed
16	Ethylene dichloride	107-06-2	Fumigant, Insecticide	Yes		Yes		not listed
	Hexachlorocyclohexanes							
17	Lindane (gamma-HCH)	58-89-9	Insecticide	Yes		Yes		out 6/02
18	delta-HCH	608-73-1	Insecticide	Yes			Yes*	not listed
19	Isoproturon	34123-59-6	Herbicide				Yes	Annex I
20	Malathion	121-75-5	Insecticide					Dossier
21	Pentachlorphenol (PCP)	87-86-5	Wood Preservative, Microbiocide,	Yes			Yes*	out 7/03
22	Simazine	122-34-9	Herbicide				Yes*	pending
23	Trifluralin	1582-09-8	Herbicide				Yes*	
	Zinc and its Compounds							
24	Zinc sulphide	7440-66-6	Herbicide					not listed
25	Zinc phosphide	1314-84-7	Rodenticide					not listed
	Inert Ingredients							
1	1,1,1-trichloroethane	71-55-6	Solvent					not listed
2	Chloroform, Trichloromethane	67-66-3	Solvent, Fumigant			Yes		not listed
3	Lead	7439-92-1	Inert				Yes	not listed
4	Methylene chloride	75-09-2	Solvent			Yes		not listed
5	Trichloro ethylene	79-01-6	Inert					not listed

* candidate priority dangerous substance

Sources: European Union (1991): Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market, Official Journal 230, Brussels, Belgium

United Nations Environmental Programme (UNEP) POPs website: www.chem.unep.ch/pops or Stockholm Convention (POPs Convention) website: www.pops.int/United Nations Environmental Programme (UNEP), website of Interim Secretariat for the Rotterdam Convention (PIC convention): www.pic.int

European Community, Official Journal L331/1, Entscheidung Nr. 2455/2001/EG Des Europäischen Parlaments und des Rates vom 20. November 2001 zur Festlegung der Liste prioritärer Stoffe im Bereich der Wasserpolitik und zur Anderung der Richtlinie 2000/60/EG, Brussels

European Council (1978): Council Directive of 21 December 1978 prohibiting the placing on the market and use of plant protection products containing certain active substances plus its amendments, Official Journals: L 33, 8.2.1979; L 296, 27. 10. 1990; L 159, 10. 6. 1989; L 212, 2. 8. 1986; L 71, 14. 3. 1987; L 212, 2. 8. 1986; L 152, 26. 5. 1986; L 91, 9. 4. 1983

U.S.Environmental Protection Agency, Inert Ingredients of Pesticide Products: http://www.epa.gov/opprd001/inerts/fr54.htm

Table 1 lists the 29 priority chemicals used in pesticide products and their regulatory status globally and in the European Union. The table shows that most substances, except for the inorganic compounds, are already regulated by international conventions or the European Union – including:

POPs Convention

The POPs convention aims at the elimination or restriction of persistent organic pollutant (POPs), while the PIC (prior informed consent) convention ensures that countries importing certain chemicals are informed prior to the import, and that information about the hazards of the particular chemicals is disseminated.

Water Framework Directive

The European Water Framework Directive 2000/60EC requires that measurements regarding dangerous priority substances aim at the phase-out of these substances within 20 years after the adoption of measurements. Regarding priority substances, a stepwise discontinuation of the pollution is required in the same timeframe.

EU Authorisation

Only two of the Danube priority pesticides are fully registered in the European Union and listed in Annex I of Council Directive 91/414/EC. For three of the priority pesticides, registration will expire or has already expired and seven are still in the re-authorisation process. According to Directive 79/117, the use of two of the priority pesticides is banned in the EU.

Table 2 shows that only three priority pesticides are authorised for use in all of the DRB countries under study, while seven priority pesticides are not authorised in any of the countries. There are also differences between the countries. The Republic of Srpska authorised 15, Romania, Serbia & Montenegro and Slovakia 14 priority pesticides, while Bulgaria and Moldova authorised eight priority pesticides and the Ukraine only six.

In some countries, there are certain restrictions upon specific pesticide products. For example, in Croatia it is not allowed to apply Alachlor with a knapsack sprayer or a hand sprayer. It is also not allowed to use Alachlor on light soils after the maize has emerged. Use of Atrazine is limited to 1.5 kg ai/ha in humid and 1 kg ai/ha in arid areas. Endosulfan cannot be used in oil-seed rape and forestry. Use of Simazine is permitted only in maize monoculture. Triflluralin use is not permitted in post-harvest sown soya bean and sunflower.

Authorisation Status of Danube Priority Pesticides in the 11 Danube Countries

	BH												
Active Ingredients	FedBH	RS	BG	HR	CZ	HU	MD	RO	YU	SK	SL	UA	No
2,4-D	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12**
Copper sulphate (basic)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12**
Trifluralin	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12**
Alachlor	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	**11**
Copper hydroxide	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	**11**
Copper oxychloride	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	**11**
Chlorpyrifos	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	**11**
Atrazine	N	Y	Y	R	Y	Y	Y	Y	Y	Y	B	N	**9**
Malathion	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	**9**
Isoproturon	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	**9**
Endosulfan	Y	Y	N	R	Y[8]	Y	N	Y	Y	Y	Y	N	**9**
Simazine	N	Y	N	R	Y[9]	N	N	Y	Y	Y	Y	N	**6**
Zinc phosphide	N	Y	N	N	Y	Y	N	N	Y	Y	Y	N	**6**
Diuron	Y	N	N	N	N	Y	N	Y	N	N	N	N	**3**
Lindane (gamma-HCH)	N	Y	N	N	N	N	N	Y	N	N	B	N	**2**
Chlorfenvinphos	Y	Y	N	N	N	N	N	N	N	N	N	N	**2**
Malachite (copper equivalent 57%)	N	N	N	N	N	N	N	N	N	Y	N	N	**1**
Copper carbonate, basic	N	N	N	N	N	N	N	N	Y	N	N	N	**1**
Aldrin	B	B	B	B	B	B	B	B	B	B	B	B	**0**
DDT	B	B	B	B	B	B	B	B	B	B	B	B	**0**
alpha-endosulfan	N	N	N	N	N	N	N	N	N	N	N	N	**0**
Ethylene dichloride	N	N	N	N	N	N	N	N	N	N	N	N	**0**
delta-HCH	N	N	N	N	N	N	N	N	N	N	B	N	**0**
PCP (pentachlorophenol)	N	N	N	N	N	N	N	N	N	N	N	N	**0**
Zinc sulphide	N	N	N	N	N	N	N	N	N	N	N	N	**0**
Number authorised	**10**	**15**	**8**	**12**	**12**	**13**	**8**	**14**	**14**	**14**	**12**	**6**	

Y= Authorised; N= Not authorised; B= Banned; R= Restricted

8 Endosulfan is authorised, but there is no registered product containing Endosulfan.
9 Simazine is authorised, but there is no registered product containing Simazine.

2 Methodology

In line with the process developed in the Inception report, the international expert team hasd developed templates and guidelines for the collection and analysis of data and information related to the use of pesticides in 11 DRB countries. Also, information from existing data sources on pesticide use available at global and EU level have been collected to compare with the situation in the DRB. Under the guidance of the international expert team,, national experts in each of the DRB countries under study have been asked to undertake a survey and to collect:

1. data available on the **amount** of pesticides applied in DRB countries and **how** they are used (e.g. what crops are they applied to, number of applications etc.);
2. information available on **bad practice** by farmers and others regarding the use of these pesticides;
3. information on legal and control mechanisms and measures for compliance.

The experts mainly submitted data based upon sales data and on recommendations included in the pesticide product registration. Actual use data by location, crop and active ingredient were generally not available and could not be submitted. Therefore the figures presented in this report relate to general estimations of national usage of the priority pesticides, except for the Czech Republic where some sub-national data has been prepared.

The results obtained are summarised by country. Detailed information on registered products and their usage by country is presented in Annexes 2 - 11.

The section on environmental impact assessment includes chemical fact sheets for selected priority pesticides. Each fact sheet comprises physical and chemical properties related to environmental behaviour, environmental fate, environmental risk associated with them and human and environmental toxicity.

Based on the analysis of data and information received in the national survey, a first set of policy recommendations for reducing pesticide usage have been outlined.

These policy recommendations shall be further developed in Phase 2 of the Project to be introduced in national legislation, assuring a harmonized approach in the use and application of pesticides in the DRB, responding to the requirements of the EU WFD and to the objectives of the Danube River Protection Convention

3 Availability of Data on Pesticide Usage

Information on the amount and identity of pesticides applied, at a particular location, on a certain date can be extremely useful in the protection of human and environmental health and in pest management. Accurate information on pesticide use can help provide better risk assessments and illuminate pest management practices that are particularly problematic so that they may be targeted for the development of alternatives.

In spite of the fact that pesticides are among the most toxic substances released into the environment, little information is available about the details of their distribution and use patterns.

The following section briefly outlines available data collected:

- by the UN Food and Agriculture Organisation (FAO);
- in the European Union; and
- in three DRB countries Hungary, Czech Republic and Slovakia, operating pesticide use/sales tracking systems.

3.1 Food and Agriculture Organisation (FAO)

The FAO has collected data on pesticide usage and consumption for more than three decades. Data are collected for major groups (insecticides, herbicides, fungicides etc.) and chemical classes such as urea herbicides, organophosphate insecticides etc. Data usually refer to quantities of active ingredients sold or used in the agricultural sector. For some countries, data about uses/ sales to the non-agricultural sector are included. Some countries provide data by formulated products. The data collected are publicly available and present the most comprehensive globally database on pesticide use.

3.2 European Union

The common way to track data on pesticide use in the EU is the collection of sales data. The most recent data published by EUROSTAT are from 1999. For some Member States, these data include non-agricultural pesticide sales. Some Member States also include sales data of sulphur, sulphuric acid and mineral oil or gases which are used as pesticides in large quantities. Table 3 presents an overview of pesticide tracking systems in EU Member States.

In 2003, Eurostat published more detailed pesticide use data. For this data collection, Eurostat contracted the pesticide industry through the European Crop Protection Association (ECPA). The members of ECPA submitted data from their annual surveys and other market research panels. The publication covers the period 1992 - 1999 and includes pesticide sales data by chemical class for a number of crops. Even sales data for some active ingredients were made available. For each Member State, a list of the five top active ingredients per crop group was presented.

Overview of Agricultural Pesticide Use Tracking Systems in the 15 EU Member States

Member State	Collection of Sales Data	Pesticide Surveys	Mandatory Record Keeping	Pesticide Use Reporting
Austria	Volume active ingredients	not regular	no	no
Belgium	Volume formulated products	3-4 crops per year	for apples, pears and glass house crops	no
Denmark	Monetary value and volume of formulated products and active ingredients	no	yes	no
Finland	Monetary value and volume of formulated products and active ingredients (obligatory reporting)	no	no	no
France	Yes	no	no	no
Germany	Volume active ingredients	no	no	no
Greece	Volume formulated products	no	no	no
Ireland	Volume active ingredients	no	no	no
Italy	Yes	no	no	no
Luxembourg	Yes	no	no	no
Portugal	Monetary value and volume of active ingredients	no	no	no
Spain	Yes	no	no	no
Sweden	Monetary value and volume of formulated products	no	yes	no
The Netherlands	Volume of formulated products and active ingredients	monthly 1 crop	yes	no
United Kingdom	Monetary value	yes	yes	for aerial applications

Source: PAN Germany 2002[10], OECD 2000[11]

3.3 Selected DRB Countries

From the 11 DRB countries under study, only three countries maintain pesticide use/sales tracking systems based upon retail sales - Hungary, the Czech Republic and Slovakia.

Hungary

Hungary collects sales data from wholesalers and local distributors twice a year. They have to submit data on the sales in kg as well as on the monetary amount on the basis of individual formulated pesticide products. Sales data are publicly available in an aggregated format.

[10] L. Neumeister (2002): Pesticide Use Reporting; Legal Framework, Data Processing and Utilisation, Full Reporting Systems in California and Oregon, Pestizid Aktions-Netzwerk e.V. (PAN Germany), Hamburg, Germany.

[11] OECD Series on Pesticides, Number 7 (1999): OECD Survey on the Collection and Use of Agricultural Pesticide Sales Data: Survey Results, Paris, France.

Czech Republic

In the Czech Republic, all professional pesticide users have to keep spray records for 3 years. Farms larger than 10 ha are required to submit summaries to the Department of Information. Farmers report on amounts applied by formulated product, crop and geographical region. Usage data are publicly available by crop and amount of active ingredient. Data on pest and disease infestations are also published.

Sales data are collected by the Czech Crop Protection Association, which is an associate member of the ECPA.

Slovakia

Slovakia started a pesticide sales reporting system in 1999. All traders are required to report sales data annually: manufacturer, importer, distributors and retailers. They are required to report the name and amount of formulated product for agricultural and non-agricultural pesticides. Sales data are publicly available by amounts of active ingredient, chemical class, use type and by postal code[12].

All farmers have to keep detailed records of their pesticide use and are required to submit summaries to the Central Control and Testing Institute of Agriculture.

[12] Communication with Martin Hajas (Central Control and Testing Institute of Agriculture) and Jozef Kotleba (Ministry of Agriculture).

4 Pesticide Usage in the 11 Danube Countries

Due to the fact that pesticide use reporting systems only exist in a few Danube countries (Hungary, the Czech Republic and Slovakia), the GFA national experts were asked to provide (where available) national usage data for the priority pesticides.

Table 4 shows the total area of the Danube countries and their share of the territory of the Danube River basin. It shows that Romania, with 28% of its territory, has the largest share of the Danube Basin, and that 97% of the country belongs to the basin. National pesticide usage/sales data are equal to usage in the Danube basin for countries which belong almost entirely (Hungary, Romania, Slovak Republic) to the basin.

Notwithstanding this, the intensity of pesticide usage varies regionally. Agricultural conditions prevailing along the Danube river are particular suitable for crop growing, and pesticide use is most likely much higher than in less suitable areas.

0 gives an overview of pesticide use in Danube countries taken from the FAO database. Data for Bosnia & Herzegovina, Bulgaria and the Ukraine are not available from this source. In some cases, the latest data are from 1993, but even the most recent data are already 5 years old.

Areas of National Territories in the Danube Basin

Country	Total Area of National Territory (km^2)	Area of National Territory in the DRB (km^2)	% of National Territory in DRB	% of DRB Occupied by National Territory
Romania	238,391	232,200	97	28.4
Hungary	93,030	93,030	100	11.4
Serbia & Montenegro	102,173	88,919	87	10.9
Slovak Republic	49,036	47,064	96	5.8
Bulgaria	110,994	46,896	42	5.7
Bosnia & Herzegovina	51,129	38,719	76	4.7
Croatia	56,542	34,404	61	4.2
Ukraine	603,700	32,350	5	4.0
Czech Republic	78,866	21,119	27	2.6
Slovenia	20,253	16,842	83	2.1
Moldova	33,700	12,025	36	1.5
TOTAL	**1,437,814**	**663,568**		**100**

Overall Pesticide Consumption in Danube Countries (tonnes)

	Croatia 1996	Czech Republic 1998	Hungary [13] 1996	Moldova 1993	Romania 1998	Slovakia 1998	Slovenia 1998	FRY 1998
Fungicides & Bactericides								
Benzimidazoles	23	67	226	15			3	
Diazines, Morpholines	2	63	21	14			6	
Dithiocarbamates	239	291	329	114			240	
Inorganics	1.114	206	1.067				377	
Mineral Oils	60	11	135	51		4		
Other Fungicides	20	156	1.625	466			106	
Total Fungicides & Bactericides	*1458*	*794*	*3.403*		*6.500*		*741*	*880*
Herbicides								
Amides	555	556	1,227	292		487	16	
Bipiridils	7	30	202					
Carbamates Herbicides	24	72	557	11		111	3	
Dinitroanilines	11	105	1,123	216		88	34	
Other Herbicides	212	971	1,567	437		688	116	
Phenoxy Hormone Products	153	545	854	197		621	41	
Sulfonyl Ureas	8	26	49					
Triazine	483	204	711	19		321	33	
Triazoles, Diazoles	14	9	710	88			9	
Uracil			11					
Urea derivates	75	124	195	6			34	
Total Herbicides	*1,528*	*2,642*	*6,496*	*1,178*	*5,400*	*2,316*	*277*	*1,748*
Insecticides								
Botanical & Biological Products	2		2			2		
Carbamates Insecticides	24	14	57			8	1	
Chlorinated Hydrocarbons	6		129	62			2	
Organo-Phosphates	92	79	1,219	295		85	27	
Other Insecticides	17	16	466	27		37	40	
Pyrethroids	7	10	208	187		38	1	
Total Insecticides	*148*	*119*	*2,081*	*571*	*2,100*	*170*	*71*	*729*
Plant Growth Regulators	35	398	11					
Rodenticides								
Anti-coagulants			126					
Other Rodenticides			1.050	4			2	
Total Rodenticides		*33*	*1176*	*4*		*152*	*2*	
Total Usage	**3,123**	**4,079**	**13,866**	**2,450**	**14,000**	**3,075**	**1,091**	**3,357**

Source: FAOSTAT Database

13 Formulated product.

0presents a summary of the national pesticide use data that was submitted by the national experts for eight countries. The table shows that the total use of priority pesticides is the highest in Hungary and the Czech Republic, which is probably due to the fact that these two countries have comprehensive pesticide use tracking systems. In Hungary, reported use is 10 times higher than in the Czech Republic, with copper as the most widely used pesticide. This is most likely due to the fact that Hungary cultivates approximately 99,000 of vineyards plus a large area with fruits and vegetables, while the Czech Republic cultivates only about 11,000 ha grapes.

Copper is generally used in large amounts in vineyards and orchards to control fungus and it is approved as a pesticide in organic agriculture according to EU regulations.

The data show that, in general, copper compounds contribute to the highest use, followed by Atrazine, 2,4-D and Trifluralin.

The pesticide usage data that were submitted are in general rather an estimation. They are based upon sales data (except for the Czech data) and often neglect trade. Uncontrolled trade into the country was reported in three countries.

The data collected present a picture of the situation at national level. An estimation of pesticide use in the Danube catchment is not possible, except for countries of which large parts are located in the catchment (Hungary, Romania, the Slovak Republic and Slovenia (83%)).

Usage of Priority Pesticides in 8 Danube Countries 2001-2002 (tonnes active ingredients, except for Slovenia – kg formulated product)

	BH										
	Fed BH	**RS**	**HR**	**CZ**	**HU**	**MD**	**YU**	**SK**	**SL***	**UA**	**Total****
	2002	**2001**	**2001**	**2002**	**2001**	**2002**	**2002**	**2002**	**2001**	**2001**	
Copper sulphate	15	4		47	10,093	1,129	7		13		11,295
Atrazine	1	73	406	145	520		115	85			1,344
Copper oxychloride		4		129	451	45	163	19	12		810
2,4-D	24	6	120	83	408	40	0	11	21	27	719
Alachlor		5	37	255	13			80			390
Trifluralin	1	2		100	111	4	96	25	3		339
Chlorpyrifos	13			111	48	8		38	2		218
Copper hydroxide	2	1		37	110	21	10	9	83		189
Malathion		3			9	5	124	0		15	155
Isoproturon				130	3			9	67		141
Endosulfan					82			0	2		82
2,4-D EHE				6				36			42
Diuron					21			0			21
Simazine							10	0	2		10
Zinc phosphide				3	2			2			7
Lindan		1						0			1
Total	**56**	**99**	**563**	**1,046**	**11,869**	**1,251**	**524**	**314**	**204**	**42**	**15,763**

* Data for Slovenia is presented as kg of formulated product

The data show that in none of the countries, 100% of the crops are treated with priority pesticides. However, the priority pesticides are high-use pesticides accounting for over 20% of the total use in some countries. Treatment data suggest that a high percentage of crops in Danube countries do not receive pesticide applications at all. However, soils in the Danube catchment and particularly those close to the river, are very good for intensified crop production. Pesticide usage in these areas is most likely higher than the national average.

The use of priority pesticides is associated with specific crops:

- Atrazine is mostly used in maize.
- Alachor is used in maize, rape seed and sunflower;
- copper compounds are used in vineyards, orchards and in vegetable production, including potatoes.
- 2,4-D is mostly used in cereals.
- The insecticides Chlorpyrifos, Malathion and Endosulfan are used in orchards, vineyards, rape seed, alfalfa and vegetables.

5 Problems Associated with Pesticide Use in the DRB

Although pesticide use is currently relatively low in the DRB countries (compared for example to the EU Member States) it is important not to be complacent about the risks of pesticide pollution since:

1. Pesticide use is reported to be high in certain areas and for certain high value crops - this includes priority pesticides that pose a serious hazard to the environment and human health.
2. Where farmers use pesticides, there are many examples of “bad practice” that contribute to the risk of pesticide pollution.
3. There is concern that with EU enlargement and the expansion of the Common Agricultural Policy (CAP) into the DRB countries joining the EU, there is a risk of:
    - increasing areas cultivated with cereals and oilseeds due to the availability of EU direct payments for farmers growing these crops in the new Member States;
    - increased intensification of crop production, including the greater use of mineral fertilisers and pesticides, particularly in the more favourable areas with better growing conditions;
    - a reduction in mixed cropping and an increase in large-scale cereal monocultures in some areas.

5.1 Bad Practice by Farmers

The national experts reported several significant problems associated with the use of pesticides:

- Wrong time of application due to poor education;
- Poor storage conditions;
- Overuse of Atrazine and Chlorpyrifos;
- Drift of pesticides to adjacent areas due to old spraying equipment and poor knowledge;
- Cleaning of spraying equipment close to surface or even in surface waters;
- Uncontrolled trade.

5.2 Environmental Impact of Pesticide Use

Pesticides can be released into the environment in many ways. After application, depending on their chemical and physical properties, they may run-off from fields and make their way into ditches, rivers, lakes. Ultimately, they reach the oceans through the water cycle. They may also leach into groundwater, which is then discharged into streams or is subsequently used for irrigation. Drift, evaporation and precipitation carry pesticides into both, nearby and far away habitats. Via the food chain, accumulated in animal tissue, persistent and bioaccumulative pesticides can travel far distances and arrive at places in which they were never applied. Figure 2 illustrates the behaviour of pesticides in the environment.

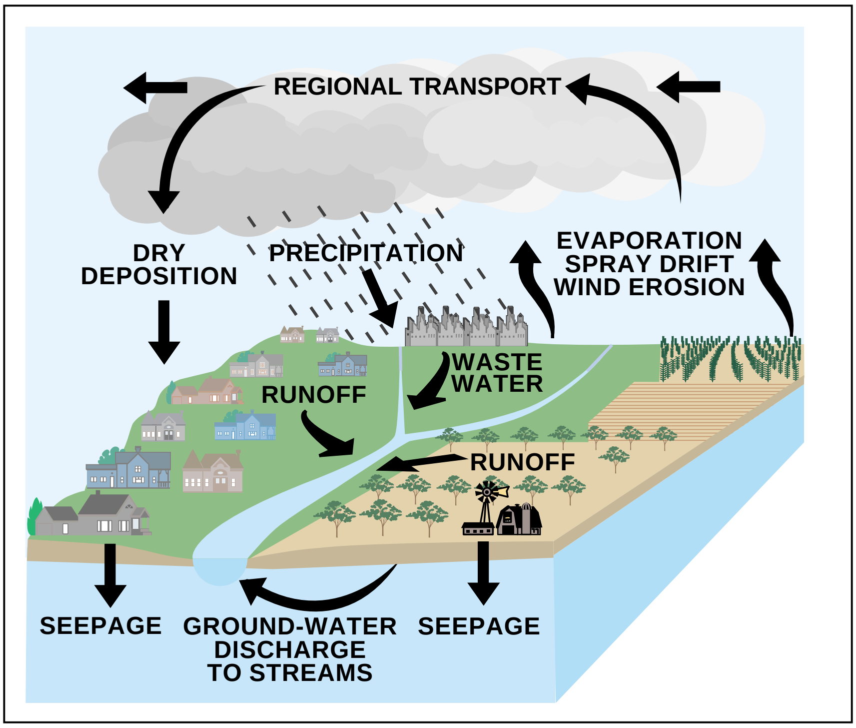


Figure 2 Environmental Fate of Pesticides[14]

In order to evaluate the environmental behaviour and possible impacts of the 25 priority active ingredients on human health and the environment in the Danube catchment area, scientific literature, the Internet and previous studies were searched. In addition, national experts in the 11 Danube countries were asked to provide information on:

- illegal use of a banned pesticides;
- poor storage of pesticides, including the problem of old pesticide stores;
- application rates that are higher than approved;
- 'spray drift' problems due to the use of old spraying equipment;
- poor disposal of containers, unused chemicals and "wash water" from spray equipment in the environment (e.g. streams and rivers).

One of the major sources was the study "*Strengthening sustainability of water quality management in the Danube Basin – Component VI, Identification of sources and amounts of pollution for substances on the EU List of Priority Chemicals (Programme No: ZZ 97 25)*[15]. This study looked into emission data, and national and international water monitoring programmes. However, the focus of the study was not limited to the EU List of Priority Chemicals.

Another valuable source was the technical report about the Joint Danube Survey conducted in August and September 2001. During this survey, a large number of water quality tests was conducted and samples of phytoplankton and zooplankton were taken and analysed[16].

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[14] "Pesticides in Surface Waters," U.S Geological Survey, Fact Sheet FS-039-97, U.S. Geological Survey, 1997.

[15] Environmental Programme for the Danube River Basin (2000): Strengthening the sustainability of water quality management in the Danube Basin – Component VI, Identification of sources and amounts of pollution for substances on the EU List of Priority Chemical, Final Report (Programme No: ZZ 97 25), WRc Medmenham, Bucks, UK.

[16] ICPDR (2002): Technical Report of the International Commission for the Protection of the Danube River, Joint Danube Survey, Vienna.

Additional scientific literature was searched using the online catalogue of Elsevier Science, Wiley InterScience and the Online Library of Springer Publications. Altogether these publishers publish over 3,000 scientific journals such as: Agricultural Water Management, Agriculture, Ecosystems & Environment, Aquatic Ecosystem Health and Management, Aquatic Toxicology, Ecological Indicators, Ecological Modelling, Ecotoxicology and Environmental Safety, Environmental Impact Assessment Review, Environmental Pollution and Journal of Contaminant Hydrology.

Articles on environmental impacts of pesticides specific to the Danube catchment were not found, except for articles repeating the results of the study *Strengthening sustainability of water quality management in the Danube Basin – Component VI, Identification of sources and amounts of pollution for substances on the EU List of Priority Chemicals (Programme No: ZZ 97 25)*.

Publications on impacts of pesticides on aquatic organisms and the ecosystem of the Danube were not found. Possible reasons are: such studies do not exist, they do not exist in English language, and/or such studies are not accessible to the public.

The conclusion of the literature search was that a number of Danube priority pesticides are frequently detected in the Danube catchment, and that drinking water guidelines and target values for aquatic organisms are often exceeded. Organochlorine pesticides such as Lindan, DDT are often detected in sediments and animal tissue. The Joint Danube Survey found that no species of macrozoobenthos at all was found in the rivers Iskar, the Arges and the Olt, and concluded that toxic effects are possible reasons. What kind of chemicals are responsible for this impact, however, was not investigated.

The results and conclusions of these studies will not be repeated in this report.

The national experts submitted information that the illegal use of a banned pesticide continues to be a problem in Ukraine and was a larger problem in Romania. Figures are, however, not available.

Poor storage of pesticides, including old pesticide stores also continues to be a problem. In the Ukraine, some 20,000 tons of obsolete pesticides are stored. Often stored under bad conditions, they seriously threaten human and environmental health (infiltration in groundwater).

In Bulgaria, 35% of the pesticide storehouses are in bad condition, and in the southern part of Moldova there is a pesticides dump site containing almost 4 metric tons of chemicals. Some 6,000 tons of obsolete pesticides are reported to be stored in Moldova. Figure 3 below shows a map of contaminated soils in Moldova. Several countries maintain databases with the location, amounts, storage conditions. In Moldova and the Ukraine, GIS-based maps are available[17].

[17] Information obtained form the 7th International HCH and Pesticides Forum in Kyiv, Ukraine, June 5th-7th 2003.

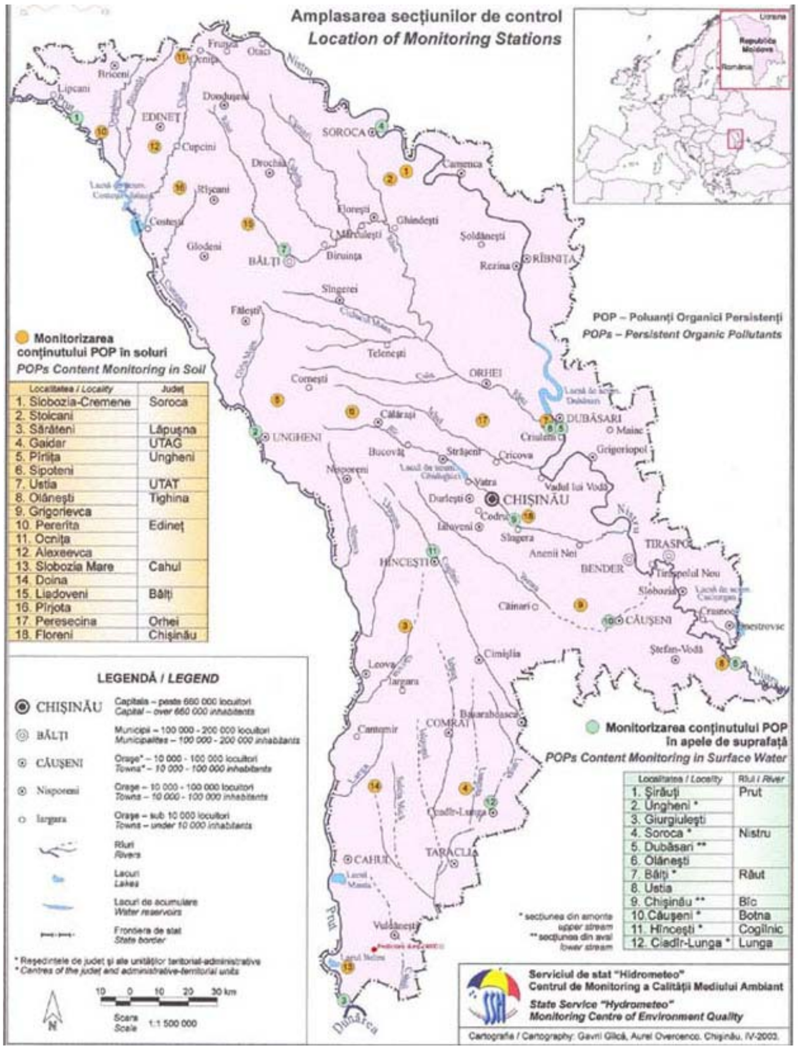

Figure 3 **Moldova: Map of Soils Contaminated with POPs Pesticides (Provided by: Andrei Isac, Ministry of Ecology Construction and Technical Development)**

National experts also often state that Atrazine is used in higher doses, sometimes up to twice the approved amount.

Spray drift and poor disposal are also mentioned to be a problem to adjacent rivers. Spraying equipment is old and often cleaned near or even in rivers and ponds.

In order to efficiently monitor and evaluate impacts of pesticides on non-target organism, usage data such as time, location and amount are very valuable. The next figure shows that pesticide use data in combination with toxicological, physical and chemical data plus geographical information can be used as input in field studies, Geographic Information Systems and environmental transport models to assess exposure and risks.

Pesticide use reporting systems exist in two Danube countries: Slovakia and the Czech Republic. However, in both countries, usage data collected are not utilised for targeted monitoring.

National sales data are not sufficient for targeted monitoring programmes. Sales data on the retail level are more useful since they allow assumptions between locations, amounts and kind of pesticides sold, provided retailers do not report anonymously.

In the absence of use data itemised by location, ingredient and amounts and the relation to sensitive areas, chemical fact sheets were developed to provide data on toxicity, physical and chemical properties.

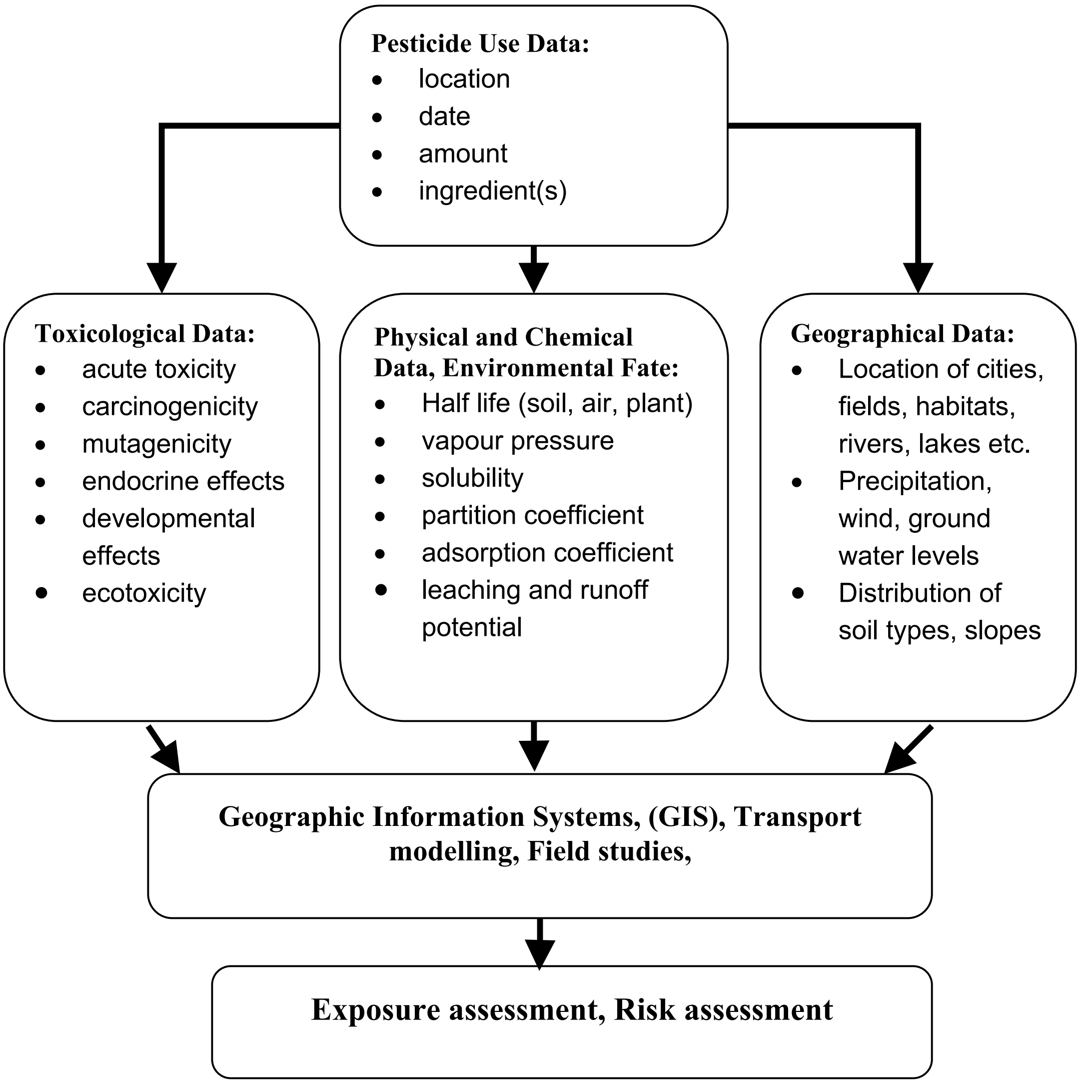

Figure 4 General Exposure Assessment Model based Upon Pesticide Usage Data[18]

In the absence of use data itemised by location, ingredient and amount, and the relation to sensitive areas, chemical fact sheets were developed to provide data on toxicity, physical and chemical properties.

0presents a summary of the environmental and human toxicity of synthetic priority pesticides which are still registered in Danube countries. Information was extracted from the chemical fact sheets. Data sources and details can be found in the chemical fact sheet (please refer to Annex 1).

The summary shows that all priority pesticides are hazardous, they are either highly acute toxic, are potential endocrine disruptors and/or are possibly carcinogenic.

[18] L. Neumeister (2002): Pesticide Use Reporting; Legal Framework, Data Processing and Utilisation, Full Reporting Systems in California and Oregon, Pestizid Aktions-Netzwerk e.V. (PAN Germany), Hamburg, Germany.

Environmental and Human Toxicity of Selected Priority Pesticides

Pesticide	Risk Symbol	Bird (HD_5 50%)	Aquatic Organisms	ED	Pers.	Acute Toxicity	EPA Cancer
2,4-D	Xn	132,9	slightly - highly	2		Moderately Hazardous	Unclassifiable, ambiguous data
Alachlor	Xn; N	330,42	moderately	1		Slightly Hazardous	
Atrazine	Xn; N	408,98	slightly	1	Pers	Unlikely to be Hazardous	C, Possible
Chlorfenvinphos	T+; N	2,73	highly –very highly			Highly Hazardous	
Chlorpyrifos	T; N	3,76	very highly			Moderately Hazardous	E, Unlikely
Diuron	Xn; N	193,04	highly - moderately	2		Unlikely to be Hazardous	Known/Likely
Endosulfan	T; N	9,53	very highly	2	Pers+	Moderately Hazardous	Not Likely
Isoproturon	Xn; N	313,4	slightly-nontoxic			Slightly Hazardous	
Lindane	T; N	10,5	highly – very highly	1	Pers	Moderately Hazardous	B2, Probable
Malathion	Xn	139,1	highly - moderately	2		Slightly Hazardous	Suggestive
Simazine	Xn; N	965,25	slightly-nontoxic	2		Unlikely to be Hazardous	C, Possible
Trifluralin	Xi; N	245,55	very highly		Pers	Unlikely to be Hazardous	C, Possible

Risk Symbol (EU 67/548EC): T = Toxic, T+ Very Toxic, Xn= harmful, N = Dangerous for the Environment, ED = Endocrine Disruption: 1= At least one study providing evidence of endocrine disruption in an intact organism. Not a formal weight of evidence approach. 2= Category 2: Potential for endocrine disruption. In vitro data indicating potential for endocrine disruption in intact organisms. Also includes effects in-vivo that may, or may not, be ED-mediated. May include structural analyses and metabolic considerations. Pers= Persistence: Pers= Persistent, Pers+= Very Persistent

Limitations of Toxicological, Chemical and Physical Data

The chemical fact sheets provided in this report will present toxicological data, chemical and physical property data and information on the environmental fate of the 25 priority active ingredients.

There are large numbers of data which vary depending on the source. Half-life of chemicals in soil and water depends on the type of soil, the exposure to sun light and oxygen etc.; exotoxicological data depend on the study type etc. For *chlorpyrifos* alone, AQUIRE, a Eco-Tox database for toxicological effects on aquatic life, maintained by the U.S. Environmental Protection Agency lists over 1,700 records, e.g. studies with different endpoints. However, even scientifically accurate toxicity studies do not necessarily reflect reality. The small number of test species and the limitation to one chemical and to mostly one (acute) endpoint (LC50) are severe limitations. Effects of multiple chemical exposure, which is reality in the Danube catchment, is not addressed by most studies.

Sublethal and chronic adverse effects such as impaired activity, endocrine disruption, cancer in fish, lower reproduction, or simply reduction in the food chain are usually not covered by these studies.

Additionally, to draw casual relationships between one particular pesticide and an adverse effect observed is rather impossible in the “chemical cocktail” of the Danube.

However, there are screening methods mimicking reality closer. For instance, in these tests, healthy water fleas (daphnia magna) are exposed to river water samples. Testing of the chemicals in water and the toxicological effects does allow to draw correlations, at least to a group of chemicals with the same mode of action such as Organophosphates[19] and N-methyl carbamates. A problem in these studies, and a general problem, are limits of detections, and the possible non-detection of toxic metabolites or other substances.

19 Kikuchi, M., Sasaki, Y., Wakabayashi, M.; (2000): Screening of Organophosphate Insecticide Pollution in Water by Using Daphnia magna, Ecotoxicology and Environmental Safety, Volume 47, Issue 3, November 2000, Pages 239-245.

6 Potential Policy Reform for Pesticide Pollution Control

The following conclusions may be drawn from the data and information on pesticide use, environmental impacts and agricultural practices collected and reviewed during the preparation of this study:

- Overall pesticide use in the Danube countries is low in amounts compared to western European countries and with a view to the area treated.
- Intensity in treated areas, however, may be higher than in western European countries and overdosing of Atrazine, probably due to weed resistance, was frequently reported.
- Seven priority pesticides are not authorised in the Danube countries, some of them continue to be hazardous due to old stockpiles and residues in soils and sediments.
- The priority pesticides 2,4-D, Alachlor, Trifluralin, Atrazine and copper compounds are high-use pesticides in most of the Danube countries. They are mostly used in cereals, rapeseed and sunflower, maize and in orchards and vineyards.
- Priority pesticides as well as other pesticides are frequently detected in surface and ground water.
- Priority pesticides pose a serious hazard to the environment and human health. Most of them have already been regulated at international and EU level.

The current low use of agricultural pesticides in the countries of the Danube River Basin (DRB) presents a unique opportunity to develop and promote more sustainable agricultural systems before farmers become dependent again upon the use of agro-chemical inputs.

However, pesticide use is always related to agricultural policy. Farmers grow those crops which are most economically viable. If, for instance, agricultural policy supports subsidy schemes and market policies for a small number of crops, the range of crops grown by farmers will be limited, crop rotations will be simple or non-existent and, as a consequence, pesticide use will rise.

There are numerous different policy instruments that can be used to control pesticide pollution. 0gives a general overview of these instruments.[20] The control instruments presented in this table provide a framework which can be elaborated and filled with more detailed measures.

However, the selection of the most appropriate policy instruments for the DRB countries will depend on the establishment of a clear policy strategy for controlling pesticide pollution, together with clear policy objectives.

[20] Falconer, K.E. (1998): Managing diffuse environmental contamination from agricultural pesticides: An economic perspective on issues and policy options, with particular reference to Europe, Agriculture, Ecosystems and Environment 69 (1998) 37-54.

Instruments Aiming at the Control of Pollution by Pesticides

Control Instrument	Target	Control Techniques	Compliance Measures
Advice	Environmentally more-sound pesticide usage; farmers using and acting according to improved information	Improved advice and extension services; more crop protection research	None (voluntary measures by farmers)
Use reduction (ICM and IPM standards) Use restriction	Mode of use/ timing/ frequency of application/ maximum dosage/restrictions on use, prohibitions in certain conditions or generally	Statutory labelling of formulations	Spot-checks, farm records, fines for non-compliance; self-regulation
Compulsory training	More socially desirable levels and types of pesticide usage (e.g. mode of application, timing)	Improve farmers' knowledge and understanding of the necessity for treatments; increase decision rationality	Prohibit use or purchase of pesticides or spraying equipment without a certificate of competence
Performance standards (cut off criteria, eco-audits)	Soil loss/ pesticide run-off or leaching	Limits on pesticide losses	Environmental simulation or field measurements
Design standards	Pesticide application	Sprayer specifications, buffer strips along water courses, field margins etc.	Farm inspections, spot-checks
Permits	Inputs, emissions, treated area, crop area	Limits on farm input use/ emissions/ crop area	Farm records and inspections; coupons for pesticide input purchases, handed in at point of sale
Taxes	Input use, emissions, treated area, numbers of applications	Increase price of materials or applications, perhaps through a percentage levy or charge per unit, to encourage reduced pesticide usage.	Distributor and/or farmer records
Subsidies to change practices	Increased use of reduced dose/ non-chemical pest controls	Compensate farmers for financial losses resulting from changed practices	Farm inspections
Transferable permits	As above	Limits on total (for example, catchment) input use, emissions, crop area.	As above
Crop insurance	Reduced pesticide usage	Reduced prophylactic treatments	None (voluntary)

Source: Falconer modified

According to the aims of the Danube Protection Convention, the risk of pollution should be stopped at its source – with regard to pesticide use this means[21]:

a) withdraw approval for the use of those pesticides that pose the greatest threats to public health and the environment;
b) reduce the use of those pesticides that remained approved for use;
c) improve the management by farmers of those pesticides that remain approved for use.

Such objectives can be achieved through a combination of necessary policy reforms and the promotion of appropriate practical action by farmers. However, the potential to achieve these objectives varies greatly between countries in the DRB and is above all related to the fact whether a country is currently preparing for EU accession or not.

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[21] OECD (1995). *Sustainable Agriculture: Concepts, Issues and Policies in OECD Countries*. Organisation for Economic Co-operation and Development, Paris.

6.1 Potential for Policy Reform in EU Context

6.1.1 Adoption of EU Pesticide Regulations

In the European Union, there are several Directives addressing the **regulation** of pesticides – see Table 9. A specific Regulation or Directive addressing the **use** of pesticides, however has not been developed.

The highest potential for the control of water pollution by pesticides is offered by the Water Framework Directive (WFD). Similar to the previous Dangerous Substances Directive (76/464EC), which was repealed by the WFD, pollution control is based on chemical lists. Three lists of substances were composed: an indicative list of main pollutants, a list of priority substances, and a list of priority hazardous substances. The list of main pollutants consists of chemical classes and use types, therefore it includes priority substances and priority hazardous substances per se.

The WFD could be a baseline for the overall water policy in the Danube basin. For **surface water,** the Directive aims at enhancing the protection and improvement of the aquatic environment, inter alias, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances.

For **groundwater,** the Directive wants to ensure the progressive reduction of pollution of groundwater and prevents its further pollution. Member States must implement the basic measure of prohibiting direct discharges of pollutants into groundwater. The European Parliament and the Council must adopt specific measures to prevent and control groundwater pollution.

The WFD is still not fully implemented. The European Commission did not come up with concrete measures and many of the priority hazardous substances are still defined as candidates. There is also a compliance issue between the WFD and the Directive 91/414. The herbicide Isoproturon is a candidate for being a priority hazardous substance, nevertheless it is listed on the positive list of Annex 1 of 91/414EC.

Legislation addressing pesticides in the European Union (except that regarding food safety)

Title of Legislation	Obligation(s) Arising from Legislation
Directive 79/117EC on the prohibition of pesticides	• The Directive was enforced in 1981 by the Member States and prohibits the placing on the market and use of plant protection products containing certain active substances. • The first pesticides prohibited were pesticides such as DDT and Aldrin, today known as POPs pesticides, but also mercury compounds. • Back then, Member States were allowed to authorize pesticides containing such ingredients in some cases. By 1990, these exceptions expired or were deleted, and a number of pesticides were added. The last pesticides were added in 1990. Currently, some 25 pesticides are prohibited. The production and export to third countries is not prohibited.
Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive)	• The Groundwater Directive establishes a framework for the protection of EU groundwater by prohibiting discharge to ground water of the most detrimental substances including pesticides. • It is intended to reduce the amount of pesticides reaching drinking water and thus is not primarily environmental legislation. However, insofar as the intention is to limit or largely exclude pesticides from water, this Directive contributes to meeting environmental objectives by reducing the environmental burden of pesticides. • The Directive places mandatory obligations on farmers relating to disposal of pesticide waste (including washing water), implemented in legislation described below. There are no other mandatory obligations on farmers, rather the obligation is on member states' to introduce sufficiently precautionary legislation to exclude pesticides from water. • By 2013, the Groundwater Directive will be repealed by the Water Framework Directive 2000/60.

Title of Legislation	Obligation(s) Arising from Legislation
Directive 80/778/EEC on the quality of water intended for human consumption (the Drinking Water Directive) – to be replaced by Directive 98/83/EC from 2003	• The Drinking Water Directive (80/778) lays down standards for the quality of water intended for drinking or for use in food and drink manufacture in order to protect human health. • The Directive does not impact upon farmers directly, but sets a maximum admissible pesticide residue level (0.1 parts per billion for individual pesticide Active Ingredients and 0.5ppb for all pesticide Active Ingredients) in drinking water that water suppliers must comply with. This requires the use of water treatment in some areas to ensure that the drinking water supplied is acceptable.
Directive 91/414/EEC concerning the placing of plant protection products on the market	• Directive 91/414 - the 'Authorisation Directive' - introduces a Community system to harmonise the authorisation and placing on the market of plant protection products, i.e. pesticides, to protect human health and the environment. • The Directive includes an EU wide common positive list of permitted Active Ingredients. However, the process of review to place substances on this list is not proceeding as planned, and interim measures in Member States result in different substances permitted in the Community. Thus producers in one Member State (and elsewhere) may be able to use products containing substances which are prohibited in another Member State (these may pose either more or less risk to the environment). There is a risk of illegal import of banned products. • The Directive places no mandatory obligations on farmers. The obligation is on the regulatory system to only approve products that pose an acceptable risk to human health and the environment. Detailed criteria and protocols have been devised. • This legislation provides the framework for the authorisation of pesticide Active Ingredients, which can only be included in the list if they meet certain conditions, particularly concerning the likely effects on human health and the environment. Only products containing active ingredients on the EC positive list can be authorised, initially for a maximum period of ten years. This process has recently been accelerated by Commission Regulation No. 2266/2000 which lays down the detailed rules for the necessary review procedures. • Directive 91/414 applies primarily to synthetic pesticides. However, at a late stage in negotiations, its scope was extended to cover authorisations of the marketing of pesticides containing or composed of GMOs. • The legislation also requires Member States to prescribe that pesticides '… must be used properly. Proper use will include compliance with any conditions attached to the product and specified on the label and the application of the 'principles of good plant protection practice, as well as, whenever possible, the principles of integrated control'.
Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive)	• The Directive has the overall environmental objective of achieving 'good water status' throughout the EU by 2010 and for it to be maintained thereafter. It sets out to establish a Community framework for the protection of surface and ground waters across the EU through a common approach, objectives, principals and basic measures. It establishes the river basin as the primary administrative unit for the purposes of water management. The Directive will have widespread and significant impacts. It brings together much of the existing water legislation into an overall framework establishing broad ecological objectives for water and provides an administrative framework to achieve these. • The Commission (via the OSPAR Convention agreement) has proposed a priority list of substances, which will be targeted with the aim of improving water quality. The pesticides in this list have been selected according to the risk they pose to aquatic life and to human health from polluted waters – this includes alachlor, atrazine, chlorfenvinphos, diuron, endosulfan, lindane, simazine and trifluralin. • This Directive places no direct obligation on farmers, but they influence the standards they must meet.

6.1.2 EU Environmental Action Programme (EAP)

In addition to legislation, the European Union addressed pesticide issues in the 5th and 6th Environmental Action Programme (EAP).

In 1993, the European Union acknowledged in its 5th Environmental Action Programme that the Common Agricultural Policy (CAP) has led to negative side effects, which include consequential over-intensification. It was recognised that the systematic use of plant protection products led to a relative resistance in parasites, increasing the subsequent frequency and costs of treatment and causing additional soil and water pollution problems.

Proposed objectives were:

- a significant reduction of pesticide use per unit of cultivated land until 2000; and
- farmers' conversion to methods of integrated pest control, at least in areas of importance for nature conservation.

Proposed actions were:

- registration and control of pesticides sales and use;
- promotion of integrated pest control and bioagriculture[22].

A significant reduction in pesticide use per unit of land was not achieved by 2000, and the European Union, in 2001, realises that the pesticide contamination problem is serious and growing.[23]

The 6th Environmental Action Programme, which was established in 2001, aims eventually at a legislation regarding the sustainable use of pesticides and, in its actions, suggests a Community Thematic Strategy on this issue.

Proposed actions regarding pesticides in the 6th EAP are:

- Development of a Code of Good Practice on pesticide use;
- Revision of Directive 91/414 on the authorisation of pesticides;
- Development of a Community Thematic Strategy on the sustainable use of pesticides that may include elements to:
  - a) minimise the risk from the use of pesticides, which is principally linked to the toxicity of the substances, and monitoring progress; better control of the use and distribution of pesticides;
  - b) substitute the most dangerous active substances with safer ones, including non-chemical alternatives;
  - c) raise awareness of, and train users;
  - d) encourage the uptake of low input or pesticide free agriculture and the use of Integrated Pest Management (IPM) techniques;
  - e) encourage the introduction of fiscal incentives to reduce the use of the most dangerous pesticides such as a pesticides tax;
  - f) link the award of Rural Development Funds to the uptake of the Code of Good Practice on pesticide use.
- Ratification of the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade;

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22 European Union (1993): Towards Sustainability, A European Community Programme of policy and action in relation to the environment and sustainable development, Official Journal of the European Communities C138/5, 17.05.1993.

23 European Commission (2001): Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on the sixth environment action programme of the European Community,'Environment 2010: Our future, Our choice' - The Sixth Environment Action Programme - Proposal for a Decision of the European Parliament and of the Council Laying Down, The Community Environment Action Programme 2001- 2010.

- Amendment of Community Regulation (2455/92) concerning the import and export of dangerous chemicals to bring it into line with the Rotterdam Convention, to improve some of its procedural mechanisms and to improve information to developing countries;
- Development / full implementation of Community programmes to improve chemicals and pesticides management in developing and accession countries, including for the elimination of stocks of obsolete pesticides;
- Support for research efforts aimed at the reduction and sustainable use of pesticides.

All of the proposed actions have the potential to reduce environmental contamination. The 6th Environmental Action Programme, however, ends in 2010 and so far no concrete and legally binding policy instruments have been introduced.

6.1.3 Financial Incentives for Pollution Control

The EU Rural Development Regulation No. 1257/1999 makes provision for co-financing to encourage more environmentally-friendly farming by:

- training farmers for the *"...application of production practices compatible with the maintenance and enhancement of the landscape and the protection of the environment"* ;
- offering grant-aided investment in agricultural holdings that helps to *"...preserve and improve the natural environment"* ;
- introducing agri-environment schemes that offer area payments to support *"...agricultural production methods designed to protect the environment and to maintain the countryside";* and
- other complementary actions under Article 33 concerned with *"...protection of the environment in connection with agriculture, forestry and landscape".*

EU Member States began implementing the first so-called "agri-environment programmes" in the 1980s and 1990s, and today such programmes cover over 20% of all agricultural land in the EU. These programmes pay farmers to modify their farming practices in order to benefit the environment.

Extensive monitoring of agri-environment programmes in EU Member States shows that they lead to significant benefits for the conservation of valuable semi-natural habitats, biodiversity, landscape, water and soil resources. The potential for agri-environment schemes to contribute to a wide range of rural development objectives, including environmental protection, is recognised by the fact that they are now the **only** compulsory measures for EU Member States to introduce under Regulation 1257/1999.

It will therefore be obligatory upon accession for all new Member States to introduce an EU co-financed agri-environment scheme that offers payments to farmers who change their methods of farming in ways *"...which are compatible with the protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic diversity"* – this includes support for a range of actions contributing to the control of pesticide pollution, including the adoption of organic farming.

While the four DRB countries (Czech Republic, Slovakia, Hungary and Slovenia) joining the EU in 2004 will shortly be implementing national agri-environment programmes, two DRB countries (Romania and Bulgaria) are unlikely to join the EU until at least 2007. In these latter countries, financial assistance is also available for developing and implementing "pilot" agri-environment measures with SAPARD co-funding – the Special Pre-accession Programme for Agriculture and Rural Development.

According to the SAPARD Implementing Regulation No. 1268/1999, EU co-financing support may be provided for all the agri-environment actions described in the Rural Development Regulation No. 1257/1999.

6.1.4 On-farm Quality Assurance Schemes

There is increasing interest shown by farmers, the food industry and food retailers in EU Member States to establish "on-farm quality assurance schemes" that offer consumers the assurance of food products having been grown with reduced or minimal pesticide inputs.

The most developed example is organic farming as defined by EC Regulation 2092/91. Organic farming has the highest potential for reducing the use of toxic pesticides. Many organic crops are grown without the use of any pesticide, and the former intense use of copper in organic fruits and vineyards is now regulated.

In addition, a number of other quality assurance schemes are being developed which are based upon "integrated crop management". For example, the Euro-Retailer Produce Working Group (EUREP) has developed a set of standards and procedures for inspecting and certifying farmers who follow so-called "good agricultural practice" (GAP).

The EUREP-GAP initiative[24] is a set of normative documents suitable to be accredited to international certification laws. Representatives from around the globe and all stages of the food chain have been involved in the development of these documents and a very robust, very challenging protocol has been produced which focuses the producer on the key issues that need to be addressed during the pre-farm gate stage.

0The next table summarises the mandatory requirements relating to pesticides for farmers and growers complying with EUREP-GAP Fresh Produce Protocol.

[24] EUREP website: www.eurep.org/sites/index_e.html.

Mandatory requirements relating to pesticides in the EUREP-GAP Fresh Produce Protocol

Basic Elements of Crop Protection

- Protection of crops against pests, diseases and weeds must be achieved with the appropriate minimum pesticide input and with the minimum adverse environmental impact (volume/type of active ingredients) and with the appropriate employment of non-chemical methods (biological and cultural/mechanical).
- Wherever possible, growers must apply recognised IPM techniques on a curative basis. Non-chemical pest treatments are preferred to chemical treatment.

Choice of Chemicals

- The crop protection product utilised must be appropriate for the control required.
- Growers must only use chemicals that are officially registered in the country of use and are registered for use on the crop that is to be protected. A current list of all products that are used and approved for use on crops being grown must be kept. This list must take account of any changes in pesticide legislation. Chemicals that are banned in the European Union must not be used on crops destined for sale in the European Union. In addition, growers must be aware of restrictions on certain chemicals in individual countries.

Advice on Quantity and Type of Pesticide

- Recommendations for application of pesticides must be given by competent, qualified advisers holding a recognised national certificate.
- Where such advisers are unavailable, growers must be able to demonstrate their competence and knowledge (e.g. through adequate training in pesticide usage and application).

Records of Application

- All applications of pesticides must be recorded in a crop diary or equivalent. Records must include: crop, location, date of application, reason for application, technical authorisation, trade name, quantity of pesticide used, application machinery used, name of operator and pre-harvest interval.

Safety, Training and Instructions

- Workers who handle and apply pesticides must be trained and able to demonstrate appropriate competence and knowledge.

Protective Clothing/Equipment

- Workers must be equipped with suitable protective clothing in accordance with label instructions and appropriate to the posed health and safety risks.
- Growers must be able to demonstrate that they follow label instructions with regard to protective clothing and equipment.
- Protective clothing and equipment must be stored separately from pesticides.

Pre-harvest Interval

- Pre-harvest intervals must be observed and under no circumstances should the recommended pre-harvest interval be ignored.
- For crops that are continuously harvested over an extended period of time, there must be a plan for crop protection that does not compromise pre-harvest intervals.

Spray Equipment

- Spray equipment must be suitable for use on the land in question and be kept in good condition, with annual calibration to ensure accurate delivery of the required quantity of spray.
- When mixing chemicals, the correct handling and filling procedures, as stated on label instructions, must be followed. The correct quantity of spray mix for the crop to be treated and the proposed treatment type must be calculated, accurately prepared and recorded.

Disposal of Surplus Spray Mix

- The quantity of spray mix must be calculated before mixing. This calculation must consider: velocity of application, surface area to be covered, pressure of application system.

Pesticide Residue Analysis

- Growers and/or suppliers must be able to provide evidence of residue testing by laboratories accredited by a competent national authority

Pesticide Storage
• Pesticides must be stored in accordance with local regulations and include the following minimum standards. • Pesticides must be stored in sound, secure, frost resistant, fire-resistant, well ventilated (in case of walk-in storage) and a well lit location which is sited away from other materials. • The pesticide store must be able to retain spillage (e.g. to prevent contamination of watercourses). • There must be adequate facilities for measuring and mixing pesticides. • There must be emergency facilities (e.g. eyewash, plenty of clean water, a bucket of sand) to deal with operator contamination and accidental spillage. • Keys and access to the store must be limited to workers with adequate training in the handling of pesticides. • An accident procedure, a list of contact telephone numbers and the location of the nearest telephone must be available within the immediate vicinity of the store and next to the nearest telephone. • Inventory, stock control and stock rotation documentation must be kept and readily available. • All pesticides must be stored in their original package. • Only chemicals approved for use on the crops produced in the crop rotation must be stored on the farm. • Powders must be stored on shelves above liquids. • Signs warning potential dangers must be placed on access doors.
Empty Pesticide Containers
• Empty pesticide containers must not be re-used and disposal of empty pesticide containers must be in a manner that avoids exposure to humans, and contamination of the environment. • Empty containers must be rinsed via the use of an integrated pressure rinsing device on the sprayer, or at least three times with water, and the rinsate (wash water) returned to the spray tank. • When rinsed, containers must be crushed or pierced to prevent re-use, or adequately labelled according to the rules of a collection system. • Empty containers must be kept secure until disposal is possible. • All local regulations regarding disposal or destruction of containers must be observed.
Obsolete Pesticides
• Obsolete pesticides must only be disposed of through a certified or approved chemical waste contractor or supplying company, however equipment achieving similarly environmentally sound disposal may be used.

6.2 Potential Policy Reform in Wider DRB Context

6.2.1 Pesticide Use Reduction

Research and Implementation of Integrated Crop Management (ICM) and Integrated Pest Management Standards - National Governments shall support research in order to define ICM and IPM standards for all major crops especially maize, wheat, vine, fruit and vegetables to promote a minimum use of pesticides. Such measures need to include detailed schemes of integrated crop management for each crop and crop rotation system (example in Annex 12).

National experts and authorities should define crop rotation systems prone to extreme pest, weed or disease development. Prohibition or financial incentives are possible instruments to stop crop rotation systems which are 'bad agricultural practices.'

Once the ICM and IPM standards are developed, they need to be disseminated to farmers. ICM and IPM standards should be legally binding – and a condition for agricultural subsidies.

6.2.2 Compulsory Training

Farmers' licence - farmers who apply pesticides need to have a licence. In order to obtain and hold a licence, farmers must attend a comprehensive training on:

- ICM and IPM (see above);
- non-chemical alternatives;
- the safe handling of plant protection products and spraying equipment (cleaning, safety distances);
- disposal of unused pesticide and containers;
- record keeping and use reporting.

The licences should be valid for 3 years. If farmers can proof that they attended a total of 48 hours training on ICM, preventive measures and non-chemical alternatives over the last 3 years, the licence will be prolonged.

Purchase of pesticides without a licence should not be possible.

Farm Adviser Licence – similar to the farmers, farm advisers should be required to possess a licence limited to 3 years. In addition to training on the safe handling of pesticide products and handling and adjusting application equipment, advisers should attend special training on ICM/IPM and practical measures to prevent and reduce pesticide use to obtain the licence. Farm advisers must be required to up-date their knowledge regularly, in order to prolong the licence.

6.2.3 Performance Standards & Cut-off-Criteria

Pesticide ban – the use of Atrazine, Lindane, Diuron and Endosulfan needs to be banned immediately. Atrazine is the pesticide most often detected in the Danube basin, Lindane, Diuron and Endosulfan are toxic and persistent pesticides.

Pesticides phase out – uses of all other priority substances need to be phased out in a time frame to be defined. The EU WFD sets a 20-year target in the EU. Considering the lower use of pesticide and a lower dependency on these chemicals in the Danube region, targets should be more ambitious.

Cut off criteria - in order to prevent the replacement of dangerous pesticides, which are going to be banned or phased out with other hazardous pesticides, cut off criteria for pesticides need to be defined. Pesticides with distribution coefficients (K_{oc}) below 300g/l (low absorption to soil, prone to leaching and run-off) and a half-life of more than 20 days need to be regulated (prohibition, taxes and transferable permits are possible policy tools).
Persistent pesticides should not receive authorisation.

Licensing of spraying equipment – all spraying equipment should be inspected every two years. Accurate spraying equipment should get a licence for two years.

6.2.4 Eco-Audit

Mandatory uniform record keeping is essential for a functioning pesticide monitoring system. National regulations must require that pesticide use records are kept by all pesticide applicators (as in the Czech Republic and Slovakia). The records must include, at the minimum, the following information about the applications:

- name and address of the applicator;
- community name/code, postal code or other identification of the treated field/site location;
- name and registration number (for the pesticide product(s) used;
- quantity of the pesticide product(s) applied;
- application method;
- date of the application;
- size of the field/site treated;
- acreage planted and treated;
- name/ code of the crop treated.

Based on mandatory record keeping, a flexible and expandable pesticide use reporting system can be developed. If all pesticide applicators have to keep the same type of record, the regulation concerning pesticide use reporting can differentiate what person is required to report what set of data in what frequency. In this way, all possible options are thinkable: full reporting, e.g. submitting all application record data, as well as the submission of summaries extracted from the records.

Pesticide use reporting should be required from all farmers using pesticide. National authorities must decide, what farmers have to report what information. (quarterly summaries, annual summaries by all farmers, by all farmer with farms larger 5 or 10 ha).

Sales reporting – Retailers, importers and distributors should be required to supply information on the amount of pesticides sold. In order to identify individual products, the bar codes could be used in the future. Retail sellers need to keep records of their sales of pesticide products and submit annual reports.

6.2.5 Subsidies to Change Practices

Defining water protection zones and sensitive areas – efforts should be made to define water protection zones and vulnerable areas. In these areas, no pesticide use should be allowed. Farmers in these areas need special training and must receive compensation for yield losses.

Spraying distances - to water courses and habitats often vary from pesticide to pesticide depending on the toxicity. Farmers often do not pay attention to the requirements. Pesticide use close to sensitive water bodies should be phased out. Fixed margins of a minimum of 10 m for arable crops, a minimum of 5 m for vegetables and a minimum of 50m for orchards and vineyards should be set.[25] The phase out and plantation of buffer stripes could be part of an agri-environment programme.

Disposal of old spraying equipment – old and unsafe spraying equipment needs to be replaced by environmentally friendly new spraying equipment. Funds should be allocated to support a fast technology change.

Disposal system for pesticide and containers – distributors and retailers should have the legal obligation to take back unused pesticides and empty containers. Unused pesticides and empty containers should be recycled in an environmentally friendly manner. The responsibility of the industry needs to be strengthened.

6.2.6 Other Instruments

Data improvement - countries with existing pesticides use reporting systems need to improve data quality and data evaluation. Collected pesticide use data are of enormous value if used in a appropriate way.

Targeted monitoring – monitoring of environmental impacts of pesticide in the Danube region needs to be intensified. Sampling should correlate with the time of the application. Toxicity of organophospates such as Chlorpyrifos and Diazinon to aquatic organisms should be observed more closely.

Elimination of obsolete pesticides – every effort must be made to immediately secure and remove stockpiles of obsolete pesticides.

[25] Based upon drift tables by the Federal Biological Research Centre for Agriculture and Forestry.

7 Proposed Practical Action for Pesticide Pollution Control

1. Choice of Site and Crop Rotation

The cropping site should be used so that it meets crop requirements on soil quality and climate. This allows optimum plant growth and reduces the risk of infestation with harmful organisms. Unsuitable or unsuitably shared sites weaken the vigour, resistance and competitiveness of the plant. Narrow crop rotations may lead to an accumulation of harmful organisms, which may have a negative impact on further cropping.

Growers must try to extend crop rotation by catch-crops and the integration of the areas set-aside.

A number of crops require the observance of crop-free periods to avoid accumulation of harmful organisms. For instance, sugar beet and potatoes require crop-free periods to contain or avoid infestation with nematodes. Recommendations regarding crop-free periods must be followed.

2. Soil Tillage

Soil tillage must fit the site and situation, and should be organised so as not to further infestation with harmful organisms.

Tillage has a great influence on the weediness of crop stands and infection of cereals with stem base diseases. Appropriate tillage may, for instance, reduce infestation with couch grass. No-plough soil tillage lessens erosion, but often entails more expenses for plant protection.

3. Choice of Cultivars and Origin

Resistance is an important criterion for the choice of cultivars, apart from yield potential, regional and specific suitability, and market demand.

Cultivars and origins which are resistant or have at least a certain tolerance of important site-specific harmful organisms and/or which are able to suppress weeds must be the preferred choice for cropping.

With harmful organisms being able to overcome resistances, the state of health of crops must also be carefully watched when resistant varieties are grown, so that any protection measures, should they become necessary, can be taken in time.

4. Hygienic Measures

The farmer must follow all hygienic measures in agriculture and horticulture to reduce the potential of harmful organisms and to prevent, or delay as much as possible, the first infection with harmful organisms. This is done by preventing the introduction and spread of harmful organisms, such as nematodes, Rizomania on sugar beet and ring rot on potato, by seed and planting stock, and the introduction via contaminated soil, substrates, propagation containers, tools, or diseased plants.

The most important hygienic measure to be taken by the farmer is to use healthy seed and planting material. This means regular purchase of certified seeds and planting stocks and confining replanting to seed and planting material from healthy and vigorous stocks.

If several farms share agricultural tools and machinery, these must be carefully cleaned to remove soil. Agricultural tools and machinery must also be cleaned after tillaging a disease or nematode infested field.

Combine harvesters may contribute to spreading weeds, such as oat-grass. They must be cleaned before entering a new field.

5. Planting and Sowing Time

Sowing and planting times must be chosen so as not to promote infestation with harmful organisms. The occurrence of certain harmful organisms can be influenced by the choice of the planting time.

Finding the best possible specific sowing and planting time for a site and a farm is an important condition for healthy and vigorous growth of the crops.

6. Supply of Nutrients

The supply of nutrients, including fertilisation, must be arranged so that it is balanced and meets the needs of the crops. Nutrient supply by fertilisation should not further any infestation with harmful organisms.

It must be noted that both want of nutrients and unbalanced supply of single substances is to the detriment of the crop, enhances its susceptibility to pests and pathogens and weakens its competitiveness with weeds.

Observation

Personnel involved in decision-making must be trained in the recognition of pests, diseases, weeds and beneficial insects: Routine monitoring is an essential element in the best agricultural practice. Retraining will be required to maintain knowledge levels and cover any pests, diseases or weeds which, because of changing circumstances, become more problematic.

Crops must be monitored for their development and health status. To examine the need for control, infestation with harmful organisms has to be assessed and classified as infestation which does not require control measures or infestation requiring control measures.

Assessment of the state of development and health of crops requires special knowledge, in particular about patterns of infestation and damage of the most important harmful organism. Special knowledge is also needed to know which infestation requires control measures.

In assessing crop health and the need for control of harmful organisms, growers must apply control thresholds, if available. To do this, farmers must first quantify the extent of the infestation by sampling or counting harmful organisms in the field.

For some harmful organisms, there are indirect methods of infestation assessment, such as

- yellow traps for pests of rape (cabbage stem flea beetle and stem weevils);
- glued colour traps in orchards and glasshouses;
- pheromone traps for noxious butterflies (turnip moth, gamma moth, pea moth, codling moth, fruit tortrix moth, grape-berry moth, nun moth, pine noctuid, etc.) and bark beetles; and
- electronic warning systems for apple scab and Peronospora in vineyards.

Some diseases, such as foot-rot of wheat, potato late blight, and fire blight of pome fruit do not allow any early visual recognition and assessment of the need for control. Advice must be obtained from official extension services which make infestation prognoses with the help of computer models and other indirect methods.

The farmer must keep a protocol of the observations. This protocol must include the:

- date;
- name/number of the site;
- crop and variety;
- quantity of each pest, weed, disease observed;
- previous weather conditions.

Experience and Decision Aids

In assessing the need for a particular control measure, growers must use their experience and observations from previous years, consider advice by official extension services and use other decision aids.

7. Non-Chemical Measure of Prevention and Control

Non-chemical measures of prevention and control, which have no adverse effects on the environment, they have to be preferred to others.

The decision to use a non-chemical plant protection measure depends on the site, situation and crop and is made upon consideration of its effectiveness, environmental compatibility, risk and costs. A consideration of occupational safety and health protection is also important. In making such decision, all available knowledge and decision aids such as information leaflets, information by warning services, meetings and information by the plant protection services have to be used.

Application of Non-chemical Measures of Plant Protection

Non-chemical measure of plant protection have to be preferred to chemical measures.

Mechanical weeding by hoeing and harrowing and other techniques are at the centre of non-chemical plant protection measures in agriculture and horticulture. The efficiency of mechanical weed control depends on the condition of the soil, the development of the crop stands and the degree of infestation with weeds as well as on the weather. In cereals, it may be between 30 and 70 % weed elimination, while it may be even higher in maize and potatoes.

Mechanical methods are also suitable to control noxious soil insects in farming.

Environmentally compatible preparations (Bacillilus thuringensis, granulose viruses, insect-pathogenic bacteria etc.) have to be preferred to others. A biological method which has proven to be effective in farming, is the use of Trichogramma egg parasites against the European corn borer. There are also Bacillus thuringiensis preparations against potato beetles, European corn borer, nun moth and other harmful organisms.

8. Use of Suitable Plant Protection Products

If there are no other practicable methods to prevent damage, the use of a suitable chemical plant protection product must be taken into account. Only plant protection products, which are registered for use in the country of the farmer are allowed to be used.

When selecting a pesticide, consideration must always be given to the effect the product will have on predators. Products such as those based on Bacillus thuringiensis are examples of products least likely to harm predators. The substitution principle must apply - the least toxic and least environmental hazardous product must be chosen.

Label directions must be read carefully and followed. This concerns for example safety precautions to protect users, specific use conditions or information about possible damage to beneficial organisms and earthworms. Possible effects on succeeding crops must be considered.

Soil disinfection and soil fumigation is not best agricultural practice.

Rate and Frequency of Applications

Using a product as a general precaution without first ascertaining the need for control is not best agricultural practice.

Products which are most suitable for the crop and the harmful organisms in question and which are least toxic and least hazardous to the environment must be used according to the situation, with the aim to use as little active substance as possible. Site conditions and weather conditions must be carefully noted to avoid run-off of plant protection products. In some cases, additives may enhance the efficiency of the product and thereby allow reduction of the application rate.

In the individual cases, the actual number of applications and application rates should fall below the maximum levels specified on the label. The supposition therefore is that the harmful organisms can be monitored and that the assessment of infestation is possible. All decision aids available should be used to this end.

Treatment of Field Patches, Field Boundaries and Single Plants

With weeds, insects and fungi often migrating into a field from the periphery, it is sufficient to treat only parts of the crop area or single plants. This is all the more the case with large fields. Sometimes it is also useful to treat field patches at the first signs of infestation to avoid later treatment of the whole field.

Treatments of field patches, boundaries or single plants often forestall extensive control measures.

9. Suitable and Safe Plant Protection Equipment

These principles must be followed when employing field sprayers:

Spraying equipment serves the purpose of evenly depositing plant protection products on target areas in exact doses and with as little loss as possible. Loss-reducing technology (drift-reducing nozzles, recycling equipment) need to be used. The water application per hectare must be determined before starting the operation. The water application rate depends on the product to be used, the growth stage of the crop and the weather.

The instructions for operation of the equipment must say everything necessary concerning the choice of nozzles, the adjustment of spraying pressure and driving speed, and a method of checking the dosage accuracy before the beginning of operation.

Empty plant protection product containers must be thoroughly rinsed. The water used for rinsing is added to the spray liquid. Chemical introduction bowls with integrated container-washing facility are very suitable for that purpose. Washed containers can be returned to product manufacturers free of charge.

To achieve an even horizontal and longitudinal distribution, the driving speed must be 6 km/h.

Spraying at wind speeds over 5 m/s, temperatures over 25 °C, or relative air humidity over 30 % will entail high losses through drift and volatilisation and is not best agricultural practice.

If any objects neighbouring the treatment area are at risk, the wind direction must be considered. When treating near water bodies and biotops, drift reducing measures have to be taken in addition to following the label instructions, namely slowing down the speed and applying proportionately less product, applying coarser drops, or switching off the outer nozzles. Buffer zones must be used to protect areas at risk such as residential areas, gardens, amenity and sports grounds, or pastures. If product drifts to neighbouring areas in spite of all precautions, the user of these areas must be immediately contacted and informed about special precautions, such as waiting periods or a ban on consumption, if necessary.

After finishing spraying, the spray residue in the tank should immediately be diluted by 1 : 10 with clear water and sprayed over the remaining untreated area. The residue which has remained in the pipes between controls and nozzles cannot be diluted, so that the first metres are sprayed with full concentration.

The outside of the sprayer should be cleaned somewhere in the treated field.

Sprayers should also be carefully cleaned and maintained in between the legal inspection dates to guarantee faultless operation and accuracy of dosage and distribution.

Aerial applications are not best agricultural practice.

These principles must be followed in addition to, or instead of the above-mentioned, when employing orchard, vineyard or hop sprayers:

According to the official recommendations, the sprayers must be adjusted to the crop (e. g., fruits, grapes, hops), crop growth stage, shape of crop plants and objects to be treated (e.g., round wood with bark), so as to produce precise application with little losses. Spray drift is naturally higher in elevated crops, which means that drift-reducing measures must get particular attention.

The consumption of water and plant protection products is adjusted depending on the crop growth stage in vineyards and hopgardens and depending on the crown height of fruit trees in orchards. In vineyards, the driving speed should not be more than 6 km/h.

If objects neighbouring the treatment area are at risk, spraying along the edge of the treatment area should be directed inside, as far as wind conditions allow this.

Aerial applications are not best agricultural practice.

10. Verification and Documentation of Success

Each chemical and non-chemical plant protection measure has to be followed by an inspection. This allows competent decisions about further steps and gathering experience about the effect of plant protection measures in certain situations.

Documenting plant protection measures serves to critically analyse and, in the long run, optimise plant protection at the location concerned.

Plant protection measures have to be documented in a way as to compile experience with regard to the location and situation.

Growers can document plant protection measures in different ways in the framework of general book-keeping, for instance

- in a logbook;
- in a field card index;
- in a computerised field card index.

It is recommended that growers collect and store the following data:

- name and address of the applicator;
- community name/code, postal code or other identification of the treated field/site location;
- name and registration number (for the pesticide product(s) used;
- quantity of the pesticide product(s) applied;
- application method;
- date of the application;
- size of the field/site treated;
- planted and treated acreage;
- date of the plant protection treatment;
- crop growth stage, age, variety;
- kind and purpose of treatment (target organism, pest density);
- assessment of efficiency;
- conditions of application (water application rate, temperature, wind speed and direction, etc.);
- particularities.

11. Storage, Disposal and Other Handling of Plant Protection Products

Storage of plant protection products must be limited to the necessary minimum in time and amount, and is subject to the duty of special care.

The store must be sound, secure, well ventilated, frost proof, have ease of access and have sufficient light to enable the spray operator to read the product label. General warning signs must be placed on access doors.

The store must be able to retain any spillages or have an adequate sump to prevent contamination of watercourses. It must have emergency facilities to deal with accidental spillages e.g. bucket of sand or absorbent granules. The store, including any doors but not the roof, must be made of materials which will resist fire for 30 minutes or longer.

The store must be away from other flammable materials. The store should have shelves made of non-absorbent materials. Pesticides must be stored in their original package, powders must be stored on shelves above liquids.

An inventory of pesticide stocks must be maintained and a copy held away from the pesticide store; existing stocks of pesticides have to be used before new stocks, the stock rotation has to be documented.

Safe disposal of redundant pesticides has to be planned and recorded, and obsolete pesticides only be disposed of through a certified or approved chemical waste contractor or the supplying company. When transporting plant protection products, special precautions must be taken to prevent damage to transport containers and contamination of the environment.

12. Crop Standards

Plant protection is very specific to crop and region. Following guidelines for crop specific Best Plant Protection Practices (BPP), build a framework for environmental protection and sustainable agriculture on farm level. National authorities, farm advisers, scientists and farmers must fill this frame in order to develop BPP standards for all major field crops, vine, fruits and vegetables. The BPP standards must focus on avoiding the use of chemical plant protection practices.

BPP standards for crops must include:

- a detailed description (lifecycle, habitus, time of occurrence, favourable conditions) of major pests diseases and weeds, specific for regions and their natural predators;
- diagnosis possibilities for major pests, diseases and weeds, specific for regions and their natural predators (light traps, yellow traps, coloured glue traps etc.);
- economic threshold values;
- possible preventive measures, basic strategies (reduced fertilising, tillage, delayed sowing etc.);
- biological means of control (support and/ or introduction of beneficial insect, use biological pesticides);
- chemical means of control;
- application time, frequency and equipment;
- measures to manage resistance.

BPP crop standards must be available to all farmers and they must be updated regularly. Fulfilment of BPP crop standards could be a condition for subsidy schemes to farmers.

An example of a first approach towards a BPP standard for wheat can be found in Annex 12 which contains major diseases, insect and weed and basic strategies for control. Specific strategies and thresholds which apply in Denmark are added. These examples are examples of Good Plant Protection Practice (GPP) developed by EPPO, the European and Mediterranean Plant Protection Organisation. The EPPO standards not specific to regions and control measure focus more on chemical control and on current common practice. EPPO standards have been developed for all major crops. These standards could potentially serve as starting points for BPP in DRB countries.

8 Recommendations for Policy Reform

The national governments of all DRB countries should aim to effectively control pesticide pollution in order to minimise the risks presented to human health, the quality of environmental resources, and the integrity of natural ecosystems in the region.

The following objectives are recommended for all national strategies aiming to control pesticide pollution from agriculture, together with comments on policy instruments that should be adopted **where appropriate to the national context** (not all policy instruments are appropriate to all countries).

OBJECTIVE 1: Reduce the levels of harmful active substances used for crop protection by prohibiting and/or substituting the most dangerous priority pesticides with safer (including non-chemical) alternatives

1.1 **Pesticide Ban** - the use of Atrazine, Lindane, Diuron and Endosulfan needs to be banned immediately. Atrazine is the pesticide most often detected in the Danube basin, Lindane, Diuron and Endosulfan are toxic and persistent pesticides.

1.2 **Pesticide Phase-out** - the use of all other priority pesticides which are authorised should be reduced to a minimum, and the use should be phased out if possible, and substituted by less-dangerous pesticides, including non-chemical alternatives. Considering the current low levels of pesticide use and a lower dependency of farmers upon these chemicals in the DRB regions, the targets for further pesticide reduction can be ambitious.

1.3 **Cut-off Criteria** - in order to prevent the replacement of the priority pesticides which are going to be banned or phased out with other hazardous pesticides, cut-off criteria for the approval of other pesticides need to be defined. Pesticides with distribution coefficients (K_{oc}) below 300g/l (low absorption to soil, prone to leaching and run-off) and a half life greater than 20 days need to be regulated (prohibition, taxes and transferable permits are possible policy tools). Persistent pesticides should not receive authorisation.

OBJECTIVE 2: Improve controls on the use and distribution of pesticides

2.1 **Monitor Trade** - retailers, importers and distributors should be required to supply information on the amounts of all pesticide sold. Retail sellers need to keep records of their sales of pesticide products and to submit annual reports to national authorities.

2.2 **Control Trade** - all DRB countries must work towards stopping the uncontrolled and illegal trade of pesticides. The authorities at the borders should receive training on the issue of illegal pesticide trade. National legislation should enable authorities to effectively prosecute those selling illegal pesticides and to penalise them with high fines.

2.3 **Raise Awareness** – agricultural extension services and farmers should get access to information about the dangers of illegal and often unlabelled pesticides.

2.4 **Monitor Pesticide Use** – effective monitoring of pesticide use at the farm level is an essential tool for improving the control of pesticide use and distribution, as well as assessing environmental risks, developing non-chemical alternatives etc. Uniform record keeping by farming is essential for a functioning pesticide monitoring system. National regulation must require that pesticide use records are **kept** by all pesticide applicators (as in the Czech Republic and Slovakia) according to certain minimum standards and are **reported** to the relevant authorities.

2.5 **Elimination of Obsolete Pesticides** – all efforts must be made to immediately secure and remove stockpiles of obsolete pesticides.

OBJECTIVE 3: Encourage the proper use of pesticides by farmers and other operators

3.1 **Raise Farmers' Awareness** - simple and easy to understand information materials, combined with well-targeted publicity campaigns, can be very effective in raising farmers' awareness of the dangers of improper pesticide use and the importance of key issues such as the safe storage, handling, and disposal of pesticide products. Retail stores, extension services and other organisations working with farmers can serve as effective distributors of information material.

3.2 **Develop National Codes of Good Practice** – national authorities should agree upon clear and simple codes of good crop protection practice when using pesticides. There are numerous frameworks for such codes, but as a minimum they should provide guidance to farmers on:

- basic elements of crop protection;
- choice of chemicals available for crop protection, including obsolete/illegal pesticides;
- integrated crop management and non-chemical alternatives for weed, pest and disease control;
- quantity and types of pesticide product to use;
- pesticide storage;
- use of spray equipment, including cleaning equipment;
- disposal of surplus pesticides and spray mixture (diluted pesticide);
- disposal of empty pesticide containers;
- records of application;
- protective clothing and emergency procedures.

3.3 **Mandatory Farming Training** - comprehensive training is the most important instrument to prevent pesticide pollution at the farm level. All farmers and other operators (e.g. contract workers) who wish to purchase and apply pesticides should be required to have a licence confirming that they have participated in an approved training programme. As a minimum, training should highlight the possible adverse effects of pesticides and promote the National Code of Good Practice for the storage of pesticides, safe handling and application of pesticides, correct use of spraying equipment, disposal of unused pesticide and containers, and record keeping (see above).

3.4 **Develop Appropriate Extension Capacity** – agricultural extension services play a key role in raising awareness and improving the technical skills of farmers with respect to good crop protection practice, however they often require support in developing the necessary capacity to do this. National funding should be provided for the training of advisers in good practice and modern extension techniques, as well as the development of appropriate institutional frameworks for extension services (including the link to progressive and well-funded research programmes).

3.5 **Use Economic Instruments to Promote Good Practice** – where government schemes provide support to farmers, the principle of "cross-compliance" can be applied. This involves the establishment of certain conditions (e.g. compliance with verifiable standards of good agricultural practice) that farmers have to meet in order to be eligible for government support.

OBJECTIVE 4: Promote certified organic farming, together with integrated crop management (ICM) systems, as viable alternatives to conventional pesticide use

4.1 **Raise Farmers' Awareness** – viable alternatives to conventional pesticide use, such as organic farming and ICM, should be actively promoted to farmers through the preparation of simple and easy-to-understand information materials, combined with well-targeted publicity campaigns. Organic farming is the most developed of all alternative farming systems and has the highest potential for a reduction of the use of toxic pesticides (especially since the former intense use of copper compounds in organic vegetables and fruit has been controlled), plus there are a number of market opportunities available to organic farmers in the DRB countries.

4.2 **Develop Relevant Legislation** – the national legislation for the definition of organic farming systems in compliance with internationally recognised standards should be developed and implemented as a high priority (particularly those in accordance with EC legislation) in order to promote the development of domestic markets and international trade.

4.3 **Develop Appropriate Extension Capacity** – agricultural extension services and farm advisers play a fundamental role in the re-orientation of farmers towards new production systems, particularly systems such as organic farming and ICM, which require higher levels of technical knowledge and management. National funding should be provided for the development of appropriate extension capacity as 3.4 above.

4.4 **Develop On-farm "Quality Assurance Schemes"** - in addition to their growing interest in organic food and farming, the food processing and retail sectors of many European countries are developing additional "on-farm quality assurance schemes" that promote integrated crop management and the sale of food products that have been grown with reduced or minimal pesticide inputs. National authorities in the DRB should support the development of such "market-led" initiatives since they offer a potential market opportunity for DRB farmers and will contribute to reducing the risk pesticide pollution now and in the future.

4.5 **Use Economic Instruments to Promote Organic Farming and ICM** – farmers converting to organic farming and ICM techniques can incur certain additional costs associated with reductions in input, the establishment of new crop rotations, the adoption of new technologies etc. These costs can be a significant obstacle to farmers who decide to make the transition from a conventional farming system. Where national funds and/or other forms of co-financing are available, national authorities should encourage farmers to convert to organic farming and ICM by offering appropriate levels of compensatory payment.

Annex 1

Chemical Fact Sheets

Annex 1: Chemical Fact Sheets

Acknowledging the facts already mentioned data sources were used, which are officially respected such as the classification applied regarding to EU Council Directive 67/548/EC and sources which summarise toxicological, chemical, physical data such as "The Pesticide Manual" and the EXTOXNET Pesticide Profile. Since human beings are part of the environment, information on the human toxicity of the Danube priority pesticides is included as well. For Aldrin and some Copper compounds the sources cited below provide none or very little information, therefore no fact sheets were created for those.

For the metals e.g. Copper and Zinc compounds, and pesticides not authorised in any of the DRP countries no chemical fact sheet were created.

Data Sources used in the Chemical Fact sheets

Physical and Chemical Properties

The Pesticide Manual – A World Compendium is published by the British Crop Protection Council and contains information on nomenclature, uses, properties, toxicology for over 800 pesticides.[i]

ARS PPD Compendium - The Agricultural Research Service (ARS) Pesticide Property Database (PPD) is a compendium of chemical and physical properties of 334 widely used pesticides. Information included in the database focuses on 16 of the most important properties that affect pesticide transport and degradation characteristics. The ARS PPD relies on experimentally determined data. Its developers, working with the American Crop Protection Association, have communicated directly with the manufacturers to obtain the original experimental data used to characterize the pesticide properties. The data are augmented with data from the scientific literature.

Extension Toxicology Network (ExToxNet) - toxicology and environmental chemistry with a variety of information about specific pesticides. Developed and maintained by University of California-Davis, Oregon State University, Michigan State University, Cornell University, and the University of Idaho.

Environmental Health Criteria (EHC) – for some compounds EHC data are used. EHC presents comprehensive data from scientific sources for the establishment of safety standards and regulations. EHC publications are monographs designed for scientists and administrators responsible for the establishment of safety standards and regulations. This series issued by the International Programme on Chemical Safety (IPCS), provides basic scientific risk evaluation of a wide range of chemicals and groups of chemicals.

German Environmental Agency (UBA) – for a number of pesticides additional information from the UBA publication on the estimation of input of agricultural pesticides in Germanys surface water.[ii]

Additional data sources – in some cases no information was found at the sources above. Additional data were taken from other source, which are then cited in the endnotes.

Environmental Toxicity

EU Council Directive 67/548 - In the European Union, the major legislative framework in force dealing with the classification of dangerous substances is Council Directive 67/548/EC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances. Classification and labelling involves an evaluation of the hazard of a substance and preparation. This evaluation must be made for any substance manufactured within or imported into the EU and placed on the EU market, and results in classification of the substance/preparation as dangerous for one or several end-points concerning physical-chemical properties, health or environmental effects.

Extension Toxicology Network (ExToxNet) – see above - used for data on effects on aquatic organisms and other organisms

Pesticide Acute Reference Dose for Birds – an interspecies distribution-based approach using pesticide-specific data available in order to define shape of the distribution through the estimation of a mean and variance for the distribution. The approach in-cooperated a scaling factor for birds body weight to improve cross-species comparisons of toxicological susceptibility, and applied a strategy allowing the consideration of chemicals for which there are insufficient data. The data are believed to be the most scientifically defensible reference values that can be used for assessing the relative acute risks of different pesticides to birds.[iii]

Environmental Health Criteria (EHC) – for some compounds (copper, zinc, aldrin and ethylene dichloride) EHC data are used – see above.

Additional data sources – in some cases no information was found at the sources above. Additional data were taken from other source, which are then cited in the endnotes.

Endocrine Disruption, Persistence, Exposure Potential

European Commission - in 2000, the European Union published a study: Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption - preparation of a candidate list of substances as a basis for priority setting. In this study 564 substances were reviewed concerning their potential endocrine disrupting properties. The expert meeting created a list of 147 substances with endocrine disruption classifications. The expert also looked at the persistence of the substances in soil and the exposure concern to those 147, which have been categorised.[iv]

Illinois Environmental Protection Agency - Report on Endocrine Disrupting Chemicals[v]

L. H. Keith - Environmental Endocrine Disruptors: A Handbook of Property Data[vi]

T. Colborn, D. Dumanoski, and J. P. Myers - Our Stolen Future[vii]

C. M. Benbrook - Growing Doubt: A Primer on Pesticides Identified as Endocrine Disruptors and/or Reproductive Toxicants[viii]

Additional data sources – in some cases valuable information was found at the additional sources these are then cited in the endnotes.

Human Toxicity

EU Council Directive 67/548 – see above

World Health Organisation (WHO) - The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification[ix]

International Agency for Research on Cancer (IARC) - evaluates with the assistance of international working groups critical reviews and evaluations of evidence of carcinogenicity.[x]

U.S. EPA Office of Pesticide Programme - maintains a list of chemicals evaluated for carcinogenic potential. This list is a product of the general risk assessment included in the process of the pesticide registration.[xi]

Definitions

The following chapter will shortly explain definitions of the chemical and physical properties.

Partition coefficient K_d: The partition coefficient refers to the sorption of organic compounds in soil. The terms "partition coefficient" and distribution coefficient" are used interchangeably in the literature for the K_d parameter.

The K_d parameter is very important in estimating the potential for the adsorption of dissolved contaminants in contact with soil. As typically used in fate and contaminant transport calculations, the K_d is defined as the ratio of the contaminant concentration associated with the solid to the contaminant concentration in the surrounding aqueous solution when the system is at equilibrium. Soil and geochemists knowledgeable of sorption processes in natural environments have long known that generic or default K_d values can result in significant error when used to predict the absolute impacts of contaminant migration or site-remediation options. Therefore, for site-specific calculations, K_d values measured at site-specific conditions are absolutely essential. However, for the chemical fact sheets ranges for K_d parameter are used to show trends and potentials.

Adsorptions coefficient (K_{oc}): The adsorption coefficient usually refers to the sorption of organic compounds to organic matter (C_{org}) in soil.

High K_{oc} values indicate a tendency for the material to be adsorbed by soil particles rather than remain dissolved in the soil solution. Strongly adsorbed molecules will not leach or move unless the soil particle to which they are adsorbed moves (as in erosion). K_{oc} values of less than 300 indicate little or no adsorption and a potential for leaching.

Octanol/water partitioning (log K_{ow}): The ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase octanol/water system.

n-Octanol is an amphiphilic substance, and has both a hydrophobic and hydrophilic piece (the n-alkane and alcohol groups, respectively). This means that it can interact with hydrophilic substances via hydrogen bonding, and with hydrophobic substances..

Solubility of hydrophobic compounds in water; sorption of hydrophobic compounds onto soils organic matter, and the accumulation of hydrophobic compounds in aquatic organisms can be related to the K_{ow}.

A compound with a with high K_{ow} is considered relatively hydrophobic, and would tend to have

- low water solubility,
- large soil/sediment adsorption coefficient,
- large retardation factor
- large bioconcentration factor.

Henry's Law constant: Henry's law expresses the proportionality between the concentration of a dissolved component in a solvent and its partial pressure in the atmosphere above the solvent mixture at equilibrium.

For environmental issues the mixture is typically a lake, river, rain or fog droplet, the ocean, dew on a plant surface, etc.

Henry's law constants (HLCs) are usually determined by measuring the equilibrium partial pressure and dissolved concentration of the compound and then calculating the ratio with eqns 2 or 3. Unfortunately, this is only feasible in a laboratory experiment. The tendency of a contaminant to volatilize from water to air is largely determined by the HLC:

- Chemicals with high HLC favour volatilisation.
- Those with low HLC may persist in surface- or ground-waters, or soil.

2,4-D

Chemical Identification

CAS: 94-75-7	**EC:** 202-361-1	**CIPAC:** 1	**Use Type:** Selective systemic herbicide to control broad-leaved weeds.	**Chemical Class:** Chlorophenoxy acid or ester

Chemical and physical properties

Water Solubility in mg/l (pH 1, 25°C):	311 – 900
Water Solubility in mg/l (pH 5, 25°C):	20031
Water Solubility in mg/l (pH 7, 25°C):	23180
Adsorptions coefficient (K_{oc}) in l/kg:	35 – 79
Partition coefficient (K_d) in l/kg	0,08 -1
Octanol/water partitioning (log K_{ow})	2,83 (pH1) -0,75 (pH7)
Half-life in soil in days:	<7 – 12
Persistence:	Not persistent
Half-life in water in days:	In aquatic environments, microorganisms readily degrade 2,4-D. Rates of breakdown increase with increased nutrients, sediment load, and dissolved organic carbon. Under oxygenated conditions the half-life is 1 week to several weeks.
Vapour pressure in mPa (25°C):	0,02
Henry's Law constant in Pa m^3/mol	$4{,}5 \times 10^{-10}$ - $1{,}3 \times 10^{-5}$

Environmental Toxicity

EU Symbol:	none	**EU Risk phrase:**	R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Some formulations of 2,4-D are highly toxic to fish while others are less so. For example, the LC50 ranges between 1.0 and 100 mg/L in cutthroat trout, depending on the formulation used. Channel catfish had less than 10% mortality when exposed to 10 mg/L for 48 hours. Green sunfish, when exposed to 110 mg/L for 41 hours, showed no effect on swimming response. Limited studies indicate a half-life of less than 2 days in fish and oysters. Concentrations of 10 mg/L for 85 days did not adversely affect the survival of adult Dungeness crabs. For immature crabs, the 96-hour LC50 is greater than 10 mg/L, indicating that 2,4-D is only slightly toxic. Brown shrimp showed a small increase in mortality at exposures of 2 mg/L for 48 hours.
Effects on other organisms:	Moderate doses of 2,4-D severely impaired honeybees brood production. At lower levels of exposure, exposed bees lived significantly longer than the controls. The honeybee LD50 is 0,0115 mg/bee.
Hazardous Dose for Birds (HD_5 50%):	132,90

<table>
<tr><td colspan="4">Endocrine Disruption</td></tr>
<tr><td colspan="2">European Commission:</td><td colspan="2">Category 2: Potential for endocrine disruption. In vitro data indicating potential for endocrine disruption in intact organisms. Also includes effects in-vivo that may, or may not, be ED-mediated. May include structural analyses and metabolic considerations.</td></tr>
<tr><td colspan="2">EPA Illinois</td><td colspan="2">Probable</td></tr>
<tr><td colspan="2">Keith:</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2">Colborn:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Benbrook:</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2">Exposure Potential:</td><td colspan="2">Not evaluated</td></tr>
<tr><td colspan="4">Human Toxicity</td></tr>
<tr><td>EU Symbol</td><td>Xn: Harmful</td><td>EU Risk Phrase:</td><td>R22: Harmful if swallowed.
R37: Irritating to respiratory system.
R41: Risk of serious damage to eyes.
R43: May cause sensitization by skin contact.</td></tr>
<tr><td>Acute Toxicity (WHO)</td><td>III; Moderately Hazardous</td><td colspan="2"></td></tr>
<tr><td>Cancer IARC:</td><td colspan="3">Group 2B: The agent is possibly carcinogenic to humans.</td></tr>
<tr><td>Cancer U.S. EPA:</td><td colspan="3">Unclassifiable, ambiguous data</td></tr>
<tr><td>Cancer EU</td><td colspan="3"></td></tr>
</table>

Alachlor

Chemical Identification

CAS:	EC:	CIPAC:	Use Type:	Chemical Class:
15972-60-8	240-110-8	204	Alachlor is a selective systemic herbicide, absorbed by germinating shoots and by roots. It works by interfering with a plant's ability to produce protein and by interfering with root elongation.	Aniline; Chloroacetaniline

Chemical and physical properties

Water Solubility in mg/l (25°C):	148 – 242
Water Solubility in mg/l (20°C):	148
Distribution coefficient (K_{oc}) in l/kg:	54-209
Partition coefficient (K_d) in l/kg	0,3-3,7
Octanol/water partitioning (log K_{ow})	2,64-2,9
Half-life in soil in days (aerobic):	14-24
Persistence:	Not persistent
Half life in water in days:	Alachlor breaks down rapidly in natural water, primarily due to the action of microorganisms. The breakdown rate is much slower in water with no oxygen.
Vapour pressure in mPa (25°C):	1,86-4,13
Henry's Law constant in Pa m^3/mol	2,1 x 10^{-3}

Environmental Toxicity

EU Symbol:	N; Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Alachlor is moderately toxic to fish. The LC50 (96-hour) for alachlor is 2.4 mg/L in rainbow trout, 4.3 mg/L in bluegill sunfish, 6.5 mg/L in catfish, and 4.6 mg/L in carp [1,8]. It is only slightly toxic to crayfish, with a LC50 (96-hour) of 19.5 mg/L [8,37]. The bioaccumulation factor in the channel catfish is 5.8 times the ambient water concentration, indicating that alachlor is not expected to accumulate appreciably in aquatic organisms.
Effects on other organisms:	Alachlor is not toxic to bees. It is practically non-toxic to earthworms.
Hazardous Dose for Birds (HD_5 50%):	330,42

Endocrine Disruption

European Commission:	Category 1: At least one study providing evidence of endocrine disruption in an intact organism. Not a formal weight of evidence approach.
EPA Illinois	Probable

Keith:		Yes	
Colborn:		Thyroid	
Benbrook:		Yes	
Exposure Potential:		High	
Human Toxicity			
EU Symbol	Xn: Harmful	**EU Risk Phrase:**	R22: Harmful if swallowed. R40: Limited evidence of a carcinogenic effect. R43: May cause sensitization by skin contact.
Acute Toxicity (WHO)	III; Slightly Hazardous		
Cancer IARC:			
Cancer U.S. EPA:	Likely to be carcinogenic to humans in high doses. Not likely to be carcinogenic to humans in low doses.		
Cancer EU	Category 3: Substances which cause concern for humans owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment. There is some evidence from appropriate animal studies, but this is insufficient to place the substance in Category 2.		

Atrazine

Atrazine				
Chemical Identification				
CAS: 1912-24-9	**EC**: 217-617-8	**CIPAC:** 91	**Use Type:** Atrazine is a selective triazine herbicide used to control broadleaf and grassy weeds.	**Chemical Class:** Triazine

Chemical and physical properties	
Water Solubility in mg/l (20 - 25°C):	29,9-33
Distribution coefficient (K_{oc}) in l/kg:	38-288
Partition coefficient (K_d) in l/kg	0,2-2,46
Octanol/water partitioning (log K_{ow})	2,34-2,80
Half-life in soil in days (aerobic):	146-330
Half-life in soil in days (anaerobic):	15-77
Persistence:	Persistent
Half-life in water in days:	Atrazine is moderately soluble in water. Chemical hydrolysis, followed by biodegradation, may be the most important route of disappearance from aquatic environments. Hydrolysis is rapid under acidic or basic conditions, but is slower at neutral pHs. Atrazine is not expected to strongly adsorb to sediments.
Vapour pressure in mPa (10°C):	0,0076
Vapour pressure in mPa (20°C):	0,04
Vapour pressure in mPa (25°C):	0,038
Henry's Law constant in Pa m^3/mol	$2{,}48 \times 10^{-4}$

Environmental Toxicity			
EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Atrazine is slightly toxic to fish and other aquatic life. Atrazine has a low level of bioaccumulation in fish. In whitefish, atrazine accumulates in the brain, gall bladder, liver, and gut.
Effects on other organisms:	Atrazine is not toxic to bees.
Hazardous Dose for Birds (HD_5 50%):	408,98

Endocrine Disruption	
European Commission:	Category 1: At least one study providing evidence of endocrine disruption in an intact organism. Not a formal weight of evidence approach.
EPA Illinois	Known
Keith:	Yes
Colborn:	Neuroendocrine-pituitary (depression of LH surge), testosterone metabolism.
Benbrook:	Yes

<table>
<tr><td colspan="2">Exposure Potential:</td><td colspan="2">High</td></tr>
<tr><td colspan="2">Additional information on endocrine disruption:</td><td colspan="2">Hayes et al. demonstrate that at exposure levels far beneath those found in the lakes, rivers, streams, drinking water and even rainwater, atrazine causes frogs to mature with multiple, mixed gonads and to become demasculinized. These effects occurred at exposure levels 10,000 - 30,000 times beneath levels previously identified as non-toxic to frogs.

Atrazine's impact on frogs appears to be caused by this herbicide's ability to promote the conversion of testosterone to estrogen via activity of the enzyme aromatase. This mechanism is found not just in frogs, but other vertebrates as well, including mammals.[xii] [xiii]</td></tr>
<tr><td colspan="4">Human Toxicity</td></tr>
<tr><td>EU Symbol:</td><td>Xn, Harmful</td><td>EU Risk Phrase:</td><td>R43: May cause sensitization by skin contact.

R48/22: Harmful: danger of serious damage to health by prolonged exposure if swallowed.</td></tr>
<tr><td>Acute Toxicity (WHO)</td><td colspan="3">U; Unlikely to be Hazardous</td></tr>
<tr><td>Cancer IARC:</td><td colspan="3">Group 3: The agent is not classifiable as to its carcinogenicity to humans.</td></tr>
<tr><td>Cancer U.S. EPA:</td><td colspan="3">Category C: Possible human carcinogens, where the data show limited evidence of carcinogenicity in the absence of human data.</td></tr>
<tr><td>Cancer EU</td><td colspan="3"></td></tr>
</table>

Chlorfenvinphos

Chemical Identification

CAS: 470-90-6	**EC:** 207-432-0	**CIPAC:** 88	**Use Type:** Chlorfenvinphos is a broad-spectrum organophosphate insecticide.	**Chemical Class:** Organophosphate

Chemical and physical properties[xiv]

Water Solubility in mg/l (23°C):	145
Distribution coefficient (K_{oc}) in l/kg:	2,45
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (log K_{ow})	3,806
Half-life in soil in days:	
Persistence:	Not persistent
Half-life in water in days:	
Vapour pressure in mPa (20 – 25°C):	$1,7 \times 10^{-7} – 7,5 \times 10^{-6}$
Henry's Law constant in atm m^3/mol	$2,76 \times 10^{-9}$ - $1,53 \times 10^{-8}$

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Chlorfenvinphos is highly to very highly toxic to fish and aquatic invertebrates. The reported LC50 (Mortality) for Japanese eel (Anguilla japonica) 48h was 38,0 ug/L.[xv] Toxicity (Mortality) to Goldfish (Carassius auratus) and Common carp (Cyprinus carpio) was LC50, 48h: 340,0 ug/L and 270,0 ug/L, respectively.[xvi] The reported LC50 (Mortality) for Stonefly (Pteronarcys californicus) 24h was 5,8-9,2 ug/L and for 96h 0,70-1,10 ug/L. For scud (Gammarus fasciatus) the LC50 (Mortality) 24h was 27,0-41,0 ug/L for 96h LC50 was 9,60-12,7 ug/L.[xvii]
Effects on other organisms:	
Hazardous Dose for Birds (HD_5 50%):	2,73

Endocrine Disruption

European Commission:	
EPA Illinois	
Keith:	
Colborn:	
Benbrook:	
Exposure Potential:	

Human Toxicity			
EU Symbol	T+: Very Toxic	**EU Risk Phrase:**	R24: Toxic in contact with skin. R28: Very toxic if swallowed.
Acute Toxicity (WHO)	Ib; Highly Hazardous		
Cancer IARC:			
Cancer U.S. EPA:			
Cancer EU			

Chlorpyrifos

Chemical Identification

CAS: 2921-88-2	**EC:** 220-864-4	**CIPAC:** 221	**Use Type:** Chlorpyrifos is a broad-spectrum organophosphate insecticide.	**Chemical Class:** organophosphate

Chemical and physical properties

Water Solubility in mg/l (10°C):	0,45
Water Solubility in mg/l (20 - 25°C):	0,73 – 1,39
Distribution coefficient (K_{oc}) in l/kg:	6100 - 14000
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (log K_{ow})	4,7 – 5,3
Half-life in soil (aerobic) in days:	30,5
Persistence:	Not persistent
Half-life in water in days:	The concentration and persistence of chlorpyrifos in water will vary depending on the type of formulation. For example, a large increase in chlorpyrifos concentrations occurs when emulsifiable concentrations and wettable powders are released into water. As the pesticide adheres to sediments and suspended organic matter, concentrations rapidly decline. The increase in the concentration of insecticide is not as rapid for granules and controlled release formulations in the water, but the resulting concentration persists longer. Volatilization is probably the primary route of loss of chlorpyrifos from water. Volatility half-lives of 3.5 and 20 days have been estimated for pond water. The photolysis half-life of chlorpyrifos is 3 to 4 weeks during midsummer in the U.S. Its change into other natural forms is slow. Research suggests that this insecticide is unstable in water, and the rate at which it is hydrolyzed increases with temperature, decreasing by 2,5 to 3-fold with each 10 C drop in temperature. The rate of hydrolysis is constant in acidic to neutral waters, but increases in alkaline waters. In water at pH 7,0and 25 C, it had a half-life of 35 to 78 days.
Vapour pressure in mPa (20 – 25°C):	2,3 – 2,7
Henry's Law constant in Pa m^3/mol	0,743

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Chlorpyrifos is very highly toxic to freshwater fish, aquatic invertebrates and estuarine and marine organisms.Cholinesterase inhibition was observed in acute toxicity tests of fish exposed to very low concentrations of this insecticide. Application of concentrations as low as 0.01 pounds of active ingredient per acre may cause fish and aquatic invertebrate deaths. Chlorpyrifos toxicity to fish may be related to water temperature. The 96-hour LC50 for chlorpyrifos is 0,009 g/L in mature rainbow trout, 0,098 mg/L in lake trout, 0,806 mg/L in goldfish, 0,01 mg/L in bluegill, and 0,331 mg/L in fathead minnow. When fathead minnows were exposed to Dursban for a 200-day period during which they reproduced, the first generation of offspring had decreased survival and growth, as well as a significant number of deformities. This occurred at approximately 0,002 mg/L exposure for a 30-day period. Chlorpyrifos accumulates in the tissues of aquatic organisms. Studies involving continuous exposure of fish during the embryonic through fry stages have shown bioconcentration values of 58 to 5100. Due to its high acute toxicity and its persistence in sediments, chlorpyrifos may represent a hazard to sea bottom dwellers. Smaller organisms appear to be more sensitive than larger ones.
Effects on other organisms:	Aquatic and general agricultural uses of chlorpyrifos pose a serious hazard to wildlife and honeybees.
Hazardous Dose for Birds (HD_5 50%):	0,09

Endocrine Disruption

European Commission:	
EPA Illinois	
Keith:	Yes
Colborn:	
Benbrook:	
Exposure Potential:	Not evaluated

Human Toxicity

EU Symbol	T: Toxic	**EU Risk Phrase:**	R24/25: Toxic in contact with skin and if swallowed.
Acute Toxicity (WHO)	III; Moderately Hazardous		
Cancer IARC:			
Cancer U.S. EPA:	Category E: Probably not carcinogenic, with no evidence of carcinogenicity in at least two adequate animal tests in different species in adequate epidemiological and animal studies. This classification is based on available evidence and does not mean that the agent will not be a carcinogen under any circumstances.		
Cancer EU			

Diuron

Chemical Identification

CAS: 330-54-1	**EC**: 206-354-4	**CIPAC:** 100	**Use Type:** Diuron is a substituted urea herbicide used to control a wide variety of annual and perennial broadleaf and grassy weeds, as well as mosses.	**Chemical Class:** Urea

Chemical and physical properties

Water- Solubility in mg/l (25°C):	42
Distribution coefficient (K_{oc}) in l/kg:	418-560
Partition coefficient (K_d) in l/kg	2,9-13
Octanol/water partitioning (log K_{ow})	2,8
Half-life in soil in days (aerobic):	372
Persistence:	Not persistent
Half-life in water in days:	Diuron is relatively stable in neutral water. Microbes are the primary agents in the degradation of diuron in aquatic environments.
Vapour pressure in mPa (25°C):	$9,2 \times 10^{-3}$
Henry's Law constant in Pa m^3/mol	$3,5 \times 10^{-5}$

Environmental Toxicity

EU S-ymbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	The LC50 (48 hour) values for diuron range from 4.3 mg/L to 42 mg/L in fish, and range from 1 mg/L to 2.5 mg/L for aquatic invertebrates. The LC50 (96-hour) is 3.5 mg/L for rainbow trout. Thus, diuron is moderately toxic to fish and highly toxic to aquatic invertebrates.
Effects on other organisms:	Diuron is non-toxic to bees.
Hazardous Dose for Birds (HD_5 50%):	193,04

Endocrine Disruption

European Commission:	Category 2: Potential for endocrine disruption. In vitro data indicating potential for endocrine disruption in intact organisms. Also includes effects in-vivo that may, or may not, be ED-mediated. May include structural analyses and metabolic considerations.
EPA Illinois	
Keith:	
Colborn:	
Benbrook:	

Exposure Potential:		Not evaluated	
Human Toxicity			
EU Symbol:	Xn, Harmful	**EU Risk Phrase:**	R22: Harmful if swallowed. R40: Limited evidence of a carcinogenic effect. R48/22: Harmful: danger of serious damage to health by prolonged exposure if swallowed.
Acute Toxicity (WHO)	U; Unlikely to be Hazardous		
Cancer IARC:			
Cancer U.S. EPA:	Known/Likely: This category of descriptors is appropriate when the available tumour effects and other key data are adequate to convincingly demonstrate carcinogenic potential for humans; it includes: Agents known to be carcinogenic in humans based on either epidemiological evidence of a combination of epidemiological and experimental evidence, demonstrating causality between human exposure and cancer. Agents that should be treated as if they were known human carcinogens, based on a combination of epidemiological data showing a plausible causal association (not demonstrating it definitively) and strong experimental evidence. Agents that are likely to produce cancer in humans due to the production or anticipated production of tumours by modes of action that are relevant or assumed to be relevant to human carcinogenicity.		
Cancer EU	Category 3: Substances which cause concern for humans owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment. There is some evidence from appropriate animal studies, but this is insufficient to place the substance in Category 2.		

Endosulfan & alpha – Endosulfan

Chemical Identification

Technical endosulfan is made up of a mixture of two molecular forms (isomers) of endosulfan, the alpha- and beta-isomers.

CAS: 115-29-7 **CAS:** 959-98-8 (alpha-isomer) **CAS:** 33213-65-9 (beta-isomer)	**EC:** 204-079-4	**CIPAC:** 89	**Use Type:** Endosulfan is a chlorinated hydrocarbon insecticide and acaricide of the cyclodiene subgroup which acts as a poison to a wide variety of insects and mites on contact.	**Chemical Class:** chlorinated hydrocarbon

Chemical and physical properties

Water Solubility in mg/l (20 - 25°C):	0,1 - 0,53
Distribution coefficient (K_{oc}) in l/kg:	2040 - 200000
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (log K_{ow})	2,23 – 3,62
Half-life in soil (aerobic) in days:	27
Persistence:	Highly persistent
Half-life in water in days:	In raw river water at room temperature and exposed to light, alpha-endosulfan isomers disappeared in 4 weeks. A breakdown product first appeared within the first week. The breakdown in water is faster (5 weeks) under neutral conditions than at more acidic conditions or basic conditions (5 months). Under strongly alkaline conditions the half-life of the compound is 1 day. Large amounts of endosulfan can be found in surface water near areas of application.
Vapour pressure in mPa (20°C):	0,826
Vapour pressure in mPa (25°C):	0,023
Henry's Law constant in Pa m^3/mol	0,029 – 1,09

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Endosulfan is very highly toxic to four fish species and both of the aquatic invertebrates studied; in fish species, the reported 96-hour LC50 values were (in ug/L): rainbow trout, 1,5; fathead minnow, 1,4; channel catfish, 1,5; and bluegill sunfish, 1,2. In two aquatic invertebrates, scuds (G. lacustris) and stoneflies (Pteronarcys), the reported 96-hour LC50 values were, respectively, 5,8 ug/L and 3,3 ug/L. The bioaccumulation for the compound may be significant; in the mussel (Mytelus edulis) the compound accumulated to 600 times the ambient water concentration.
Effects on other organisms:	It is moderately toxic to bees and is relatively nontoxic to

		beneficial insects such as parasitic wasps, lady bird beetles, and some mites.	
Hazardous Dose for Birds (HD_5 50%):		9,53	
Endocrine Disruption			
European Commission:		Category 2: Potential for endocrine disruption. In vitro data indicating potential for endocrine disruption in intact organisms. Also includes effects in-vivo that may, or may not, be ED-mediated. May include structural analyses and metabolic considerations.	
EPA Illinois		Known	
Keith:		Yes	
Colborn:		Estrogen	
Benbrook:		Yes	
Exposure Potential:		Not evaluated	
Additional information on endocrine disruption:		Park et al. discover that exposure to extremely low levels (5ppb) of endosulfan, interferes with reproduction in the red-spotted newt Notophthalmus viridescens by disrupting the development of glands that synthesize a pheremone used in female-male communication. The disrupted development then leads to lower mating success.[xviii]	
Human Toxicity			
EU Symbol	T: Toxic	**EU Risk Phrase:**	R24/25: Toxic in contact with skin and if swallowed. R36: Irritating to eyes.
Acute Toxicity (WHO)	III; Moderately Hazardous		
Cancer IARC:			
Cancer U.S. EPA:	Not likely: Agents not likely to be carcinogenic to humans because they have been evaluated in at least two well conducted studies in two appropriate animal species without demonstrating carcinogenic effects. Agents not likely to be carcinogenic to humans because they have been appropriately evaluated in animals and show only carcinogenic effects that have been shown not to be relevant to humans (e.g., showing only effects in the male rat kidney due to accumulation of alpha(2u)-globulin). Agents not likely to be carcinogenic to humans when carcinogenicity is dose or route dependent. For instance, not likely below a certain dose range (categorized as likely by another route of exposure). To qualify, agents will have been appropriately evaluated in animal studies and the only effects show a dose range or route limitation, or a route limitation is otherwise shown by empirical data. Agents not likely to be carcinogenic to humans based on extensive human experience that demonstrates lack of effect (e.g., phenobarbital).		
Cancer EU			

Isoproturon

Chemical Identification				
CAS: 34123-59-6	**EC:** 251-835-4	**CIPAC:** 336	**Use Type:** Pre- and post emergence herbicide to control annual grasses and broad-leaved weeds.	**Chemical Class:** Urea

Chemical and physical properties[xix]	
Water Solubility (20°C) in mg/l:	55 - 72
Distribution coefficient (K_{oc}) in l/kg:	100
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (K_{ow})	177
Half-life in soil in days:	20 - 40
Persistence:	Not persistent
Half-life in water in days:	30
Vapour pressure in mPa (20°C):	$0{,}003 \times 10^{-3}$
Henry's Law constant in Pa m^3/mol	
Additional information:	Isoproturon is highly persistent in the water-sediment environment.

Environmental Toxicity			
EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	
Effects on other organisms:	
Hazardous Dose for Birds (HD_5 50%):	313,40

Endocrine Disruption	
European Commission:	
EPA Illinois	
Keith:	
Colborn:	
Benbrook:	
Exposure Potential:	

Human Toxicity			
EU Symbol	Xn: Harmful	**EU Risk Phrase:**	R22:Harmful if swallowed. R40: Limited evidence of a carcinogenic effect.

Acute Toxicity (WHO)	III; Slightly Hazardous	
Cancer IARC:		
Cancer U.S. EPA:		
Cancer EU	Category 3: Substances which cause concern for humans owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment. There is some evidence from appropriate animal studies, but this is insufficient to place the substance in Category 2.	

Lindane

Chemical Identification

CAS: 58-89-9	**EC**: 200-401-2	**CIPAC:** 488	**Use Type:** Lindane is an organochlorine insecticide and fumigant which has been used on a wide range of soil-dwelling and plant-eating (phytophagous) insects.	**Chemical Class:** Organochlorine

Chemical and physical properties

Water Solubility in mg/l (20°C):	6,6-7
Distribution coefficient (K_{oc}) in l/kg:	686-12400
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (log K_{ow})	
Half-life in soil:	15 months
Persistence:	Persistent
Half-life in water in days:	Lindane is very stable in both fresh and salt water environments, and is resistant to photodegradation. It will disappear from the water by secondary mechanisms such as adsorption on sediment, biological breakdown by microflora and fauna, and adsorption by fish through gills, skin, and food.
Vapour pressure in mPa (20°C):	1,2-5,6
Henry's Law constant in Pa m^3/mol	0,183
Adsorptions coefficient:	
Additional information:	

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Lindane is highly to very highly toxic to fish and aquatic invertebrate species. Reported 96-hour LC50 values range from 1,7 to 90 ug/L in trout (rainbow, brown, and lake), coho salmon, carp, fathead minnow, bluegill, largemouth bass, and yellow perch. Water hardness did not seem to alter the toxicity to fish, but increased temperature caused increased toxicity for some species and decreased toxicity for others. Reported 96-hour LC50 values in aquatic invertebrates were: in Daphnia, 460 ug/L; in scuds, 10-88 ug/L; and in Pteronarcys (stone flies), 4,5 ug/L. The bioconcentration factor for the compound is 1400 times ambient water concentrations, indicating significant bioaccumulation.
Effects on other organisms:	Lindane is highly toxic to bees.
Hazardous Dose for Birds (HD_5 50%):	10,5

Endocrine Disruption

European Commission:		Category 1: At least one study providing evidence of endocrine disruption in an intact organism. Not a formal weight of evidence approach.	
EPA Illinois		Known	
Keith:		Yes	
Colborn:		Estrogen/Androgen	
Benbrook:		Yes	
Exposure Potential:		High	
Human Toxicity			
EU Symbol:	T, Toxic	**EU Risk Phrase:**	R23/24/25: Toxic by inhalation, in contact with skin and if swallowed. R36/38: Irritating to eyes and skin.
Acute Toxicity (WHO)	II; Moderately Hazardous		
Cancer IARC:	Group 2B: The agent is possibly carcinogenic to humans.		
Cancer U.S. EPA:	Category B2: Known to cause cancer in animals but not yet definitively shown to cause cancer in humans. These chemicals are designated probable human carcinogens. Category B is further split into pesticides for which some evidence exists that it causes cancer in humans (B1) and those for which evidence exists only in animals (B2).		
Cancer EU			

Malathion

Chemical Identification

CAS: 121-75-5	**EC:** 121-75-5	**CIPAC:** 12	**Use Type:** Malathion is a nonsystemic, wide-spectrum organophosphate insecticide.	**Chemical Class:** organophosphate

Chemical and physical properties

Water Solubility in mg/l:	130 – 145
Distribution coefficient (K_{oc}) in l/kg:	93 – 1800
Partition coefficient (K_d) in l/kg	
Octanol/water partitioning (log K_{ow})	2,7
Half-life in soil (aerobic) in days:	< 1
Half-life in water in days:	In raw river water, the half-life is less than 1 week, whereas malathion remained stable in distilled water for 3 weeks. Applied at 1 to 6 lb/acre in log ponds for mosquito control, it was effective for 2,5 to 6 weeks. In sterile seawater, the degradation increases with increased salinity. The breakdown products in water are mono- and dicarboxylic acids.
Vapour pressure in mPa (20 – 25°C):	0,45 – 0,7
Henry's Law constant in Pa m^3/mol	0,00114

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Malathion has a wide range of toxicities in fish, extending from very highly toxic in the walleye (96-hour LC50 of 0,06 mg/L) to highly toxic in brown trout (0,1 mg/L) and the cutthroat trout (0,28 mg/L), moderately toxic in fathead minnows (8,6 mg/L) and slightly toxic in goldfish (10.7 mg/L). Various aquatic invertebrates are extremely sensitive, with EC50 values from 1 ug/L to 1 mg/L. Malathion is highly toxic to aquatic invertebrates and to the aquatic stages of amphibians. Because of its very short half-life, malathion is not expected to bioconcentrate in aquatic organisms. However, brown shrimp showed an average concentration of 869 and 959 times the ambient water concentration in two separate samples.
Effects on other organisms:	The compound is highly toxic to honeybees.
Hazardous Dose for Birds (HD_5 50%):	139,10

Endocrine Disruption

European Commission:	
EPA Illinois	Suspected
Keith:	Yes

Colborn:		Thyroid	
Benbrook:			
Persistence:		Not persistent	
Exposure Potential:			
Human Toxicity			
EU Symbol	Xn: Harmful	**EU Risk Phrase:**	R22:Harmful if swallowed.
Acute Toxicity (WHO)	III; Slightly Hazardous		
Cancer IARC:			
Cancer U.S. EPA:			
Cancer EU			

Simazine

Chemical Identification

CAS: 122-34-9	**EC**: 204-535-2	**CIPAC: 22**	**Use Type:** Simazine is a selective triazine herbicide used to control broadleaf and grassy weeds.	**Chemical Class:** Triazine

Chemical and physical properties

Water- Solubility in mg/l (20 – 22°C):	3,50-6,2
Distribution coefficient (K_{oc}) in l/kg:	103-238
Partition coefficient (K_d) in l/kg	0,48-4,31
Octanol/water partitioning (log K_{ow})	2,1
Half-life in soil in days (aerobic):	91
Half-life in soil in days (anaerobic):	58
Persistence:	Not persistent
Half-life in water in days:	The average half-life of simazine in ponds where it has been applied is 30 days, with the actual half-life dependent on the level of algae present, the degree of weed infestation, and other factors. Simazine may undergo hydrolysis at lower pH. It does not readily undergo hydrolysis in water at pH = 7.
Vapour pressure in mPa (10°C):	$1,2 \times 10^{-4}$
Vapour pressure in mPa (20°C):	8×10^{-4}
Vapour pressure in mPa (25°C):	0,003
Henry's Law constant in Pa m^3/mol	$9,8 \times 10^{-5}$
Additional information:	Simazine is not degradable in the water-sediment environment.

Environmental Toxicity

EU Symbol:	N, Dangerous for the Environment	**EU Risk phrase:**	R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Effects on aquatic organisms:	Simazine is slightly to practically nontoxic to aquatic species. The 96-hour LC50 for simazine is >100 mg/L in rainbow trout, 100 mg/L (wettable powder) in bluegill sunfish, 0.100 mg/L in fathead minnows, as well as carp . It may be more toxic to Daphnia and stoneflies. A 96-hour LC50 of >3.7 mg/L is reported in oysters.
Effects on other organisms:	While many mammals may be insensitive to simazine, sheep and cattle are especially sensitive. Simazine is nontoxic to bees. A soil LC50 in earthworms of >1000 mg/kg has been reported.
Hazardous Dose for Birds (HD_5 50%):	965,25

<table>
<tr><td colspan="4">Endocrine Disruption</td></tr>
<tr><td colspan="2">European Commission:</td><td colspan="2">Category 2: Potential for endocrine disruption. In vitro data indicating potential for endocrine disruption in intact organisms. Also includes effects in-vivo that may, or may not, be ED-mediated. May include structural analyses and metabolic considerations.</td></tr>
<tr><td colspan="2">EPA Illinois</td><td colspan="2"></td></tr>
<tr><td colspan="2">Keith:</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2">Colborn:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Benbrook:</td><td colspan="2"></td></tr>
<tr><td colspan="2">Exposure Potential:</td><td colspan="2">Not evaluated</td></tr>
<tr><td colspan="4">Human Toxicity</td></tr>
<tr><td>EU Symbol:</td><td>Xn, Harmful</td><td>EU Risk Phrase:</td><td>R40: Limited evidence of a carcinogenic effect.</td></tr>
<tr><td>Acute Toxicity (WHO)</td><td colspan="3">U; Unlikely to be Hazardous</td></tr>
<tr><td>Cancer IARC:</td><td colspan="3">Group 3: The agent is not classifiable as to its carcinogenicity to humans.</td></tr>
<tr><td>Cancer U.S. EPA:</td><td colspan="3">Category C: Possible human carcinogens, where the data show limited evidence of carcinogenicity in the absence of human data.</td></tr>
<tr><td>Cancer EU</td><td colspan="3">Substances which cause concern for humans owing to possible carcinogenic effects but in respect of which the available information is not adequate for making a satisfactory assessment. There is some evidence from appropriate animal studies, but this is insufficient to place the substance in Category 2.</td></tr>
</table>

<table>
<tr><td colspan="6">Trifluralin</td></tr>
<tr><td colspan="6">Chemical Identification</td></tr>
<tr><td>CAS: 1582-09-8</td><td>EC: 216-428-8</td><td>CIPAC: 183</td><td colspan="2">Use Type: Trifluralin is a selective, pre-emergence dinitroaniline herbicide used to control many annual grasses and broadleaf weeds.</td><td>Chemical Class: dinitroaniline</td></tr>
<tr><td colspan="6">Chemical and physical properties</td></tr>
<tr><td colspan="3">Water- Solubility in mg/l (20 - 22°C):</td><td colspan="3">0,32 – 7,5</td></tr>
<tr><td colspan="3">Distribution coefficient (K_{oc}) in l/kg:</td><td colspan="3">1200 – 13700</td></tr>
<tr><td colspan="3">Partition coefficient (K_d) in l/kg</td><td colspan="3">18,6 – 155,6</td></tr>
<tr><td colspan="3">Octanol/water partitioning (log K_{ow})</td><td colspan="3">3,97 – 5,07</td></tr>
<tr><td colspan="3">Half-life in soil in days (aerobic):</td><td colspan="3">116 – 189</td></tr>
<tr><td colspan="3">Persistence:</td><td colspan="3">Persistent</td></tr>
<tr><td colspan="3">Half-life in water in days:</td><td colspan="3">Trifluralin is nearly insoluble in water. It will probably be found adsorbed to soil sediments and particulates in the water column.</td></tr>
<tr><td colspan="3">Vapour pressure in mPa (20-25°C):</td><td colspan="3">6,7 – 14,6</td></tr>
<tr><td colspan="3">Henry's Law constant in Pa m^3/mol</td><td colspan="3">1,53</td></tr>
<tr><td colspan="6">Environmental Toxicity</td></tr>
<tr><td>EU Symbol:</td><td colspan="2">N, Dangerous for the Environment</td><td>EU Risk phrase:</td><td colspan="2">R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.</td></tr>
<tr><td colspan="3">Effects on aquatic organisms:</td><td colspan="3">Trifluralin is very highly toxic to fish and other aquatic organisms. The 96-hour LC50 is 0,02 to 0,06 mg/L in rainbow trout, and 0,05 to 0,07 mg/L in bluegill sunfish. The 96-hour LC50 in channel catfish is approximately 1,4 to 3,4 mg/L . Variables such as temperature, pH, life stage, or size may affect the toxicity of the compound. Trifluralin is highly toxic to Daphnia, a species of small freshwater crustacean, with a 48-hour LC50 of 0,5 to 0,6 mg/L. The compound shows a moderate tendency to accumulate in aquatic organisms.</td></tr>
<tr><td colspan="3">Effects on other organisms:</td><td colspan="3">At exposure levels well above permissible application rates (100 mg/kg), trifluralin has been shown to be toxic to earthworms. However, permitted application rates will result in soil residues of approximately 1 ppm trifluralin, a level that had no adverse effects on earthworms. It is nontoxic to bees.</td></tr>
<tr><td colspan="3">Hazardous Dose for Birds (HD_5 50%):</td><td colspan="3">245,55</td></tr>
<tr><td colspan="6">Endocrine Disruption</td></tr>
<tr><td colspan="3">European Commission:</td><td colspan="3"></td></tr>
<tr><td colspan="3">EPA Illinois</td><td colspan="3">Probable</td></tr>
<tr><td colspan="3">Keith:</td><td colspan="3">Yes</td></tr>
<tr><td colspan="3">Colborn:</td><td colspan="3">Reproductive/Metabolic</td></tr>
</table>

Benbrook:		Yes	
Exposure Potential:		Not evaluated	
Human Toxicity			
EU Symbol:	Xi, Irritating	**EU Risk Phrase:**	R36: Irritating to eyes. R43: May cause sensitization by skin contact.
Acute Toxicity (WHO)	U; Unlikely to be Hazardous		
Cancer IARC:	Group 3: The agent is not classifiable as to its carcinogenicity to humans.		
Cancer U.S. EPA:	Category C: Possible human carcinogens, where the data show limited evidence of carcinogenicity in the absence of human data.		
Cancer EU			

Annex 2

Pesticide Usage in Bosnia and Herzegovina

Annex 2 Pesticide Usage in Bosnia and Herzegovina

2.1 Federation of Bosnia and Herzegovina

Exact data regarding consumption of pesticides on the territory of the Federation of Bosnia and Herzegovina are very difficult to obtain because of the fact that borders are still very porous and permeable. It very often happens that farmers a buying pesticides abroad without any control so it is almost impossible to collect exact data.

However, available sales data on the priority pesticides were submitted, they are presented in Table 1 below.

The table shows that all sales except 2,4-D between 2002 and 2003 so far significantly dropped. The year 2003, however is not over and coming sales might be added.

Concerning 2,4-D in the first half year of 2003 the double amount from the last year is already sold. The question is how many of the pesticide used were reported last year, and if reporting schemes and/or illegal trade have changed.

Table 1: Amounts Priority Data Sold in Federation of Bosnia & Herzegovina

Pesticide	Amounts Sold in 2002 (kg or l ai)	Amounts Sold in 2003 (kg or l ai)
2,4-D	24,000	42,600
Chlorpyrifos	13,038	6,770
Copper hydroxide	1,995	2,750
Copper sulphate (basic)	14,875	1,700
Copper oxychloride	0	550
Trifluralin	816	480
Atrazine	800	250
Endosulfan	4	35
TOTAL	55,527	55,135

Table 2 presents expert estimates on the treated area in Bosnia & Herzegovina. The data show that only a small percentage of the crop area is treated with priority pesticides. Vineyards with 40% treatment account for the highest density.

Table 2: Areas Treated with Priority Pesticides in Bosnia and Herzegovina

Active Ingredients (AI)	Name of Product	Main Crops Applied to	Application Rate (kg or litre per ha)	Number of Applications per Year	% Crops Treated
2,4-D	Deherban A SL	Wheat, Barley, Ray, Maize, Pasture, Meadows	1.5 – 2.5 l/ha	1	20
Atrazine	Gesaprim	Maize	2 – 4 l	1	10
Copper hydroxide	Champion	Vegetables, Stone fruits, Vineyards	4 kg/ha	2, 4	5
Copper oxychloride	Koside B	Vegetables, Stone fruits, Vineyards	4 kg/ha	2, 4	3
Copper sulphate (basic)	Modra galica	Vineyards, Vegetables	7 – 10 kg/ha	4	40 Vineyards, and 20% Vegetable

Active Ingredients (AI)	Name of Product	Main Crops Applied to	Application Rate (kg or litre per ha)	Number of Applications per Year	% Crops Treated
Chlorpyrifos	Dursban E 48 Chromorel D Chromorel P2 Dursban G-7,5	Fruit trees and Soil Potato Potato Soil	2 l for Fruit trees/ha, 2-8 l for Soil 0.75 – 1 l/ha 15 –20 kg/ha 15 – 60 kg/ha	1 2 2 1	2 for fruit trees 0.5 for soil 15 25 1,5
Endosulfan	Thiodan – 35	Fruit trees, Vineyards, Oil rape	2.5 – 3.0 l/ha	2	0.05
Trifluralin	Treflan EC	Vegetables, Soya been, Oil rape	1-2.5 l/ha	1	0.02

Problems Associated with Pesticide Use in Bosnia & Herzegovina

The experts state that farmers apply the herbicides 2,4-D and Atrazine not at the best time for an application, that Chlorpyrifos is applied in amounts larger than recommended. The use of copper in fruits causes sometimes phytotoxic effects on the fruit trees.

2.2 Republic of Srpska

Data on the amounts sold and the areas treated with priority pesticides in the Republic of Srpska were submitted by the national experts. Table 3 shows sales by active ingredient, these data were extracted from the products sales data. The detailed information on product sales in 2000 and 2001 can be found in Table 5 in the end on the Annex. Table 3 shows that usage of priority pesticides declined from 2000 to 2001, especially 2,4-D, Alachlor and Malathion and Trifluralin were used much less. These numbers cannot be used for trend estimation, since information on the reporting system, shift to other pesticides, trade issues are not available.

Table 3: Priority Pesticides Sold in the Republic of Srpska 2000 & 2001

Pesticide	2000	2001
	kg or l active ingredient	kg or l active ingredient
Atrazine	71,000	73,037
2,4-D	16,184	5,789
Alachlor	11,040	4,800
Copper sulphate	7,628	4,245
Copper oxychloride	4,000	3,991
Malathion	6,178	3,067
Trifluralin	5,952	2,208
Copper hydroxide	2,500	1,000
Lindan	412	684
Zinc phosphide	100	52
Endosulfan	2,625	0
Isoproturon		0
Simazine		0
Total	129,619	100,873

Table 4 shows the use intensity of priority pesticides by crop. It shows that up to 80% of the field vegetable receive a Trifluralin application, and that 60% of the maize area is treated either with Alachlor and/or Atrazine.

Table 4: Intensity of Use of Priority Pesticides by Crop in the Republic of Srpska

Pesticide	Product Name	Crop	Application Rate	Number of Application per Year	% of Crop Treated
2,4-D	Monosan Herbi	Wheat	2 l/ha	1	50%
Alachlor	Alahlor 480, Alahlor 48-EC	Maize	4 l/ha	1	60%
Atrazine	Atrazin SC, Radazin T-50	Maize	2 l/ha	1	60%
Copper hydroxide	Blauvit	Fruit, field vegetables	5 kg/ha	2	15%
Copper oxychloride	Bakrocid 50, Bakarni krec	Fruit, field vegetables	10 kg/ha	1	15%
Copper sulphate (basic)	Bordovska corba, Plavi kamen	Fruit, field vegetables	10 kg/ha	1	15%
Endosulfan	Tiocid- 35	Fruit	1 kg/ha	2	10%
Lindane (gamma-HCH)	Lindan E-20	Fruit, vegetables	1 kg/ha	2	5%
Malathion	Etiol specijal, Etiol tecni	Field vegetables	1,5 kg/ha	2	30%
Trifluralin	Zupilan, Trefgal	Field vegetables	2 l/ha	1	80%

Problems Associated with Pesticide Use

Only a few problems associated with pesticide use were listed by the national experts.

2,4-D is used not in the appropriate timespan, often too late in the season. Lindane is used for crops it is not registered for, such as vegetables, and application rates of Atrazine often exceed recommendations.

Table 5: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides, and Amounts Sold in the Republic of Srpska

Pesticide	Product Name	% ai	Amount Product Sold kg or l	Amount ai Sold kg or l	Year
2,4-D	Maton	60	600	360	2000
		60	48	29	2001
	Monosan Herbi	46	34,400	15,824	2000
		46	12,400	5,704	2001
	Esteron	56	100	56	2001
Alachlor	Alahlor 480	48	8,000	3,840	2000
		48	10,000	4,800	2001
	Alahlor E- 48	48	15,000	7,200	2000
Atrazine	Atrazin TS	50	12,000	6,000	2000
	Atrazin SC	50	130,000	65,000	2000
		50	90,526	45,263	2001

Pesticide	Product Name	% ai	Amount Product Sold kg or l	Amount ai Sold kg or l	Year
	Radazin WP- 50	50	540	270	2001
	Radazin T- 50	50	47,520	23,760	2001
	Gesaprim 90- WG	90	4,160	3,744	2001
Copper hydroxide	Blauvit	50	5,000	2,500	2000
		50	2,000	1,000	2001
Copper oxychloride	Bakrocid 50	50	8,000	4,000	2000
		50	6,305	3,153	2001
	Bakarni krec	25	3,352	838	2001
Copper sulphate	Bordovska corba	25	10,260	2,565	2000
		25	4,510	1,128	2001
	Plavi kamen	25	20,250	5,063	2000
		25	11,000	2,750	2001
	Kupragin	35	1,050	368	2001
Endosulfan	Tiocid- 35	35	7,000	2,450	2000
	Thiodan E- 35	35	500	175	2000
Lindan	Lindan E- 20	20	2,000	400	2000
		20	3,375	675	2001
	Ksilolin	3	400	12	2000
		3	300	9	2001
Malathion	Radotion E- 50	50	1,000	500	2000
	Etiol tecni	60	6,180	3,708	2000
		60	4,788	2,873	2001
	Etiol prah- 5	5	1,884	94	2000
		5	288	14	2001
	Etiol specijal	1	2,010	20	2000
		1	12,015	120	2001
	Vetiol	40	4,620	1,848	2000
	Vetiol plv 2%	2	384	8	2000
	Malation E- 50	50	120	60	2001
Isoproturon	-	0	-		
Simazine	-	0	-		
Trifluralin	Zupilan	48	10,000	4,800	2000
		48	2,600	1,248	2001
	Trefgal	48	2,400	1,152	2000
		48	2,000	960	2001
Zinc phosphide	Cinkfosfid mamak	2	400	8	2000
		2	1,000	20	2001
	Cinkfosfid prah	84	110	92	2000
	Cinkosan	2	20	0	2001
	Pacomor	2	1,570	31	2001

Annex 3

Pesticide Usage in Bulgaria

Annex 3: Pesticide Usage in Bulgaria

The national experts submitted information on the overall use in Bulgaria, registration data as well as overall usage data by region. The National Service for Plant Protection (NSPP) was the main source of information and delivered data from each of its 29 regions (see Table 6).

0 below shows that total use of formulated products in Bulgaria is about 5 million kg, while import data extracted from the FAO database in 0 indicates that pesticide usage rose between 1995 and 2001 by some 23%. Data on domestic pesticide production are not available.

Detailed usage data by crop and region are also not available. Agricultural data such as hectare by crop by region as well as information on the geographical location of the NSPP region in the Danube basin were not submitted.

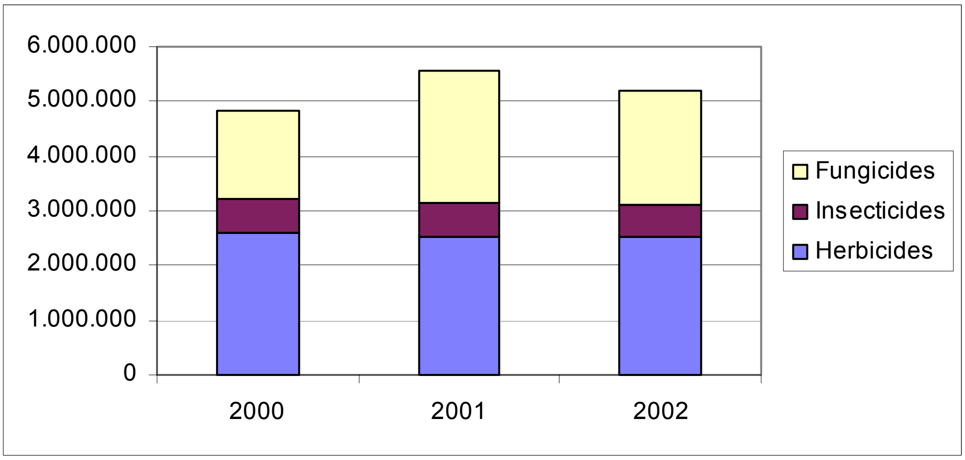

Figure 1: Pesticide Usage in Bulgaria (kg formulated product) 2000-2002

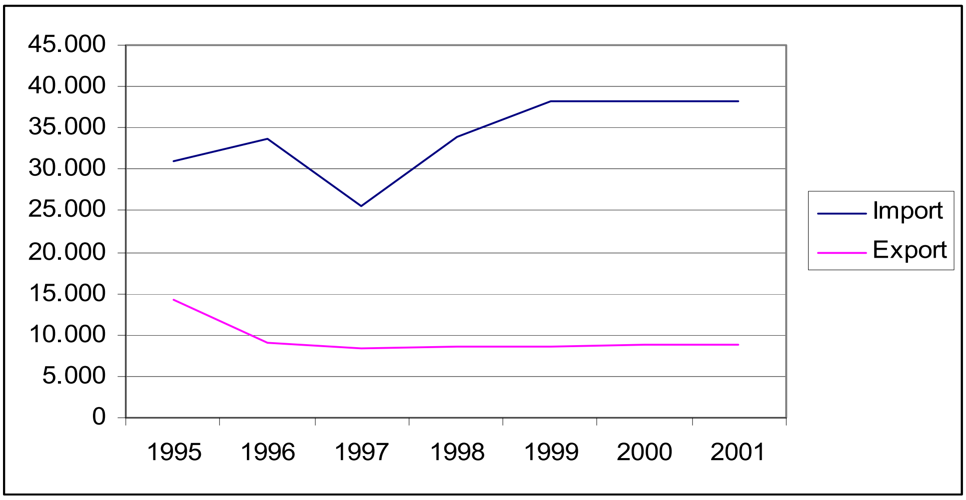

Figure 2: Pesticide Import and Export in Bulgaria (value $1000) 1995-2001

Source: FAO Database

Table 6: Overall Pesticide Consumption in Bulgarian Regions

	Herbicides			Insecticides			Fungicides		
NSPP Regions	**2000**	**2001**	**2002**	**2000**	**2001**	**2002**	**2000**	**2001**	**2002**
Dobrich	486,000	495,000	489,000	79,000	89,000	85,000	129,000	135,000	133,000
Bourgas	147,000	136,000	186,000	23,000	22,000	29,000	321,000	296,000	340,000
Silistra	168,000	162,100	164,300	48,000	53,200	46,800	43,000	41,400	44,200
Rousse	116,751	110,483	154,030	14,315	17,060	25,909	23,228	19,765	42,474
Pleven	188,613	157,690	146,860	35,297	34,268	36,475	60,113	58,825	53,940
Varna	165,500	157,200	142,500	6,400	5,900	5,150	187,500	167,300	154,200
Shoumen	125,300	137,500	132,400	2,010	2,200	1,960	12,700	13,500	14,300
Plovdiv	135,200	120,900	128,300	117,300	111,500	114,400	113,720	110,500	111,000
Vratza	97,685	123,782	104,662	27,371	25,056	10,287	85,719	105,780	136,439
Stara Zagora	139,200	112,400	104,200	19,800	17,900	15,300	67,500	65,800	61,500
Veliko Tarnovo	56,820	52,600	96,100	5,300	6,000	17,970	29,300	32,000	26,500
Razgrad	166,889	154,388	83,732	24,550	12,320	7,793	8,898	24,300	20,697
Yambol	64,600	91,715	81,617	15,200	19,050	14,946	50,100	41,360	50,325
Sliven	113,400	91,200	79,300	14,000	12,300	9,400	102,100	75,500	69,000
Targovishte	74,650	63,000	70,824	2,840	2,260	4,215	36,440	39,650	38,422
Pazardjik	70,000	56,700	61,000	82,000	60,500	58,200	120,000	896,000	496,000
Haskovo	27,820	29,100	52,800	15,100	15,900	16,500	72,340	75,280	76,300
Vidin	31,680	48,760	43,750	4,520	5,080	6,300	12,350	13,120	14,200
Sofia-region	47,150	43,370	42,700	4,520	5,200	3,900	6,100	9,150	7,500
Montana	68,700	56,224	38,600	7,100	6,365	6,200	45,779	65,150	37,500
Lovetch	42,422	40,773	31,610	9,973	8,900	3,600	20,174	20,832	15,687
Pernik	12,490	27,328	28,450	3,272	1,928	1,586	1,642	8,557	10,173
Blagoevgrad	15,400	21,605	27,320	21,750	32,360	27,870	23,500	60,800	75,500
Gabrovo	19,800	19,215	22,500	510	1,612	362	1,610	1,920	1,122
Smolyan	3,000	3,500	7,600	11,310	10,043	12,945	13,400	24,810	34,400
Kustendil	8,477	9,258	7,325	6,626	6,025	5,982	11,458	18,208	18,683
Sofia-town	5,390	5,530	6,980	122	120	106	2,428	2,530	2,825
Kardjali	200	287	930	9,067	18,230	9,030	8,442	8,930	10,237
TOTAL in 1000 kg	**2,598**	**2,528**	**2,535**	**610**	**602**	**577**	**1,610**	**2,432**	**2,096**

Table 7: Pesticide Consumption in Selected Bulgarian Regions

Region	Herbicides	Insecticides	Fungicides	Total
Dobrich	489,000	85,000	133,000	707,000
Pazardjik	61,000	58,200	496,000	615,200
Bourgas	186,000	29,000	340,000	555,000
Plovdiv	128,300	114,400	111,000	353,700
Varna	142,500	5,150	154,200	301,850
Silistra	164,300	46,800	44,200	255,300
Vratza	104,662	10,287	136,439	251,388
Pleven	146,860	36,475	53,940	237,275
Rousse	154,030	25,909	42,474	222,413
Stara Zagora	104,200	15,300	61,500	181,000

The total amounts in Table 6 show that usage was, except for fungicides, stable between 2000 and 2002. Table 7 presents the 10 regions with the highest pesticide use in Bulgaria. Of these, there are 5 regions that completely or partly fall within the DRB catchment – Dobrich, Silistra, Vratza, Pleven and Rousse.

Information on the use of priority pesticide was not submitted.

Detailed information about pesticide products containing priority pesticides in Bulgaria can be found in Table 8 and Table 9 at the end of this Annex.

Problems Associated with Pesticide Use

The national expert listed a number of problem associated with pesticide use.

1. Cases when the recommended dosages are exceeded are rarely observed because of the high prices of the plant protection products. Usually the other case is observed – reduction of the optimum dosages, that has also double negative effect – the soil is polluted without reaching the desired effect.
2. No respect of protection zones when treating with ground techniques and agricultural aviation – some damages could occur on the adjacent areas where different crops are grown.
3. Trade with non-registered pesticides from abroad with unclear contents.
4. The wind velocity during the treatment is overlooked – damages of adjacent areas with other crops is possible.
5. For some pesticides (Isoproturon, Chlorpyrifos, Alachlor and 2,4-D) the accurate treatment periods, recommended by the regional offices of the NSPP are missed, therefore the treatment effect is very low and unjustified.
6. Applied amounts of Atrazine and copper products exceed the recommended application rate. In the case of Atrazine this may affect the following crop, in the case of copper it may affect the same crop.
7. Storages with unused and not usable pesticide products, including priority pesticides such as 2,4-D and Atrazine are a larger problem. The storage houses are damaged and in very bad shape and they are not safe for the environment. Each year new storage houses with pesticides need to be cleaned. In 2002 a number of 493 storage houses for plant protection materials in the country were cleaned.

8. According to the FAO: *"Local pesticide pollution of soils occurs. Inadequate rates of pesticide application, in combination with bad storage, have contributed to pesticide amounts in soils above the maximum, permitted concentrations. The pesticides include some banned chloro-organic insecticides (e.g. hexachloran heptachlor, aldrin, dieldrin and endrin). The amount of pesticides applied decreased sharply between 1994 and 1997 for the same reason as the fertilizer decrease, i.e. prices have been too high. During the land privatization and the liquidation of the old structures, the problem of pesticide storage, protection and controlled application arose, as well as their destruction when they were no longer fit to be used. Cases were recorded in which outdated chemical preparations were removed from their original packaging and offered for sale."*

Table 8 Pesticide Registration Data of Pesticide Products Containing Pesticides in Bulgaria

Name of Product containing Active Ingredients	Main Crops Applied to	Application Rate (kg or litre formulated product per ha)	Typical Number of Applications per Year
2,4-D containing products			
2,4-D amino salt	Maize	1.2 l/ha	1
	Wheat, barley	1.5-2.0 l/ha	1
2,4-D KNE	Wheat	1.0-2.0 l/ha	1
Agro-D-Amin	Wheat	1.6-2.4 l/ha	1
Aminopielik 600 SL	Maize	1.2 l/ha	1
	Wheat, barley	1.5-2.0 l/ha	1
Valsamin	Wheat	1.5 l/ha	1
Dezormon liquid	Maize	1.2 l/ha	1
	Wheat, barley	1.5-2.0 l/ha	1
Dikamin D (from Malayzia)	Maize	1.2 l/ha	1
	Wheat, barley	1.5-2.0 l/ha	1
Dikamin D((from Bulgaria)	Wheat	1.5 l/ha	1
Dikopur F (from Austria)	Maize	1.2	1
	Wheat, barley	1.5-2.0 l/ha	1
Dikopur F (from Bulgaria)	Wheat	1.5 l/ha	1
Diovid 60 SL	Maize	1.2 l/ha	1
	Wheat, barley	1.5-2.0 l/ha	1
DMA 6	Maize	1.2	1
	Wheat	1.5-2.0 l/ha	1
Ester X	Wheat	1.25-1.6 l/ha	1
Luvaram	Maize	1.5 l/ha	1
	Wheat, barley	2.0-2.5 l/ha	1
Maton 600 EK	Maize	1.1 l/ha	1
	Wheat, barley	1.2-1.5 l/ha	1
Mostamin 720 SL	Maize	1.2 l/ha	1
	Wheat, barley	1.6 l/ha	1
Sanafen	Maize	1.2 l/ha	1
	Wheat	1.5-2.0 l/ha	1
Solution 800 SP	Maize	0.6 g/ha	1
	Wheat, barley	0.750 g/l	1
U 46 D Fluid	Maize	1. 4 l/ha	1
	Wheat, barley	1.6-2.4 l/ha	1
Herboxon	Maize	1.5 l/ha	1

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Application Rate (kg or litre formulated product per ha)**	**Typical Number of Applications per Year**
	Wheat, barley	2.0-2.5 l/ha	1
Buktril D	Wheat	0.8-1.0 l/ha	1
Defender SL (from India)	Wheat	0.8-1.0 l/ha	1
Defender SL (from Bulgaria)	Maize	1.2 l/ha	1
Pacific	Maize	1.2 l/ha	1
Weedmaster 646 SL (from Switzerland)	Wheat, barley	0.8-1.0 l/ha	1
	Maize	1.2 l/ha	1
Weedmaster SL (from Bulgaria)	Wheat, barley	0.8-1.0 l/ha	1
Sansac	Wheat, barley	1.0 l/ha	1
Dicopur MP Kombi	Wheat, barley	3.0-4.0 l/ha	1
Duplozan KB Kombi	Wheat, barley	2.5 l/ha	1
Mustang 306,25 SK	Wheat	0.6-0.8 l/ha	1
Lotus D	Wheat, barley	0.75-1.0 l/ha	1
Alachlor containing products			
Alanex 48 EK	Maize, sunflower, soy bean, bean, ground-nut	3.5-4.0 l/ha	1
Alanex Neo 48 EK	Maize, sunflower, potatoes	3.5-4.0 l/ha	1
Alachlor 48 EK-S	Maize, soy bean, sunflower, cotton	3.5-4.0 l/ha	1
Alachlor 48 EK-I	Maize, soy bean	3.5-4.0 l/ha	1
Lasagrin 48 EK	maize	3.5-4.0 l/ha	1
Laso 48 EK	Maize, sunflower, cotton, soy bean, bean, cabbages, potatoes	3.0-4.0 l/ha	1
Sanachlor 48 EK	Maize, soy bean	3.5-4.0 l/ha	1
Cotralin EK	Sunflower	8.0-10 l/ha	1
Alachlor & Atrazine containing products			
Alazin 25/25 CE	Maize	4.0 l/ha	1
Alazin 33/14 CE	Maize	4.0 l/ha	1
Atlas	Maize	4.0 l/ha	1
Lacorn Combi	Maize	5.0 l/ha	1
Atrazine containing products			
Atranex 50 SK	Maize	2.5-3.0 l/ha	1
Atranex 80 VP	Maize	2.0 kg/ha	1
Atranex 90 VDG	Maize	1.0-1.2 kg/ha	1
Gesaprim 90 VG	Maize	1.0-1.2 kg/ha	1
Guardian Extra	Maize	4.0-6.0 l/ha	1
Erunit 720 A	Maize	4.0 l/ha	1
Ladoc	Sorgo	3.0 l/ha	1
	Maize	4.0 l/ha	1
Primextra Gold 720 SK	Maize	2.5-3.0 l/ha	1
Aspect 500 SK	Maize	2.5-3.0 l/ha	1

Name of Product containing Active Ingredients	Main Crops Applied to	Application Rate (kg or litre formulated product per ha)	Typical Number of Applications per Year
Copper containing products			
Vitra 50 VP	Vineyards, potatoes	1.5 kg/ha	1-3[1]
Concentrate of Bordeax mixure CK 11	Vineyards	1%	1-3[1]
Kosaid 101 VP	Vineyards	0.15%	1-3[1]
	Tomatoes	0.3%	1-3[1]
Kosaid DF	Vineyards	0.18%	1-3[1]
Funguran ON 50 VP	Vineyards, tomatoes, peach	0.15%	1-3[1]
	Tomatoes, tobacco	0.3%	1-3[1]
	Potatoes, tobacco	1.5 kg/ha	1-3[1]
Champ Plus	Peach	0.15%	1-3[1]
Magic Cap 60 VP	Vineyards	0.2%	1-3[1]
	Apple	0.25%	1-3[1]
Lactofol Cupro	Vineyards	1%	1-3[1]
Copper oxychloride 50 VP (from Bulgaria)	Vineyards, tomatoes	0.25%	1-3[1]
	Potatoes	2.5 kg/ha	1-3[1]
Copper oxychloride 50 VP (from Germany)	Vineyards, tomatoes	0.25%	1-3[1]
Cupro 50 VP	Vineyards	0.25%	1-3[1]
Cuprol 50 VP	Vineyards	0.25%	1-3[1]
Rumba 35 SK	Vineyards	0.35%	1-3[1]
Forum R 460 VP	Vineyards	0.3%	1-3[1]
Melody Compact 24,5 VP	Vineyards	0.3%	1-3[1]
	Potatoes	4 kg/ha	1-3[1]
Cuprocine Super M	Vineyards	20%	1-3[1]
Axanit CU VP	Vineyards	0.25%	1-3[1]
Armetil S VP	Vineyards	0.25% (2.5 kg/ha)	1-3[1]
Cuproxil 48 VP	Potatoes	2.5 kg/ha	1-3[1]
Corseit R DF	Cucumbers, vineyards	0.25%	1-3[1]
Corseit R VP	Vineyards	0.25%	1-3[1]
	Potatoes	250 g/ha	1-3[1]
Cupronam 320 SK	Vineyards	0.25%	1-3[1]
Cuproseit 45 VP	Tomatoes	0.3%	1-3[1]
	Vineyards	0.4%; 1 tonne/ha solution	1-3[1]
Cuproseit Gold 45 VP	Vineyards, glasshouse tomatoes	0.25% (2.5 kg/ha)	1-3[1]
	Field tomatoes	2.5 kg/ha	1-3[1]
Cuprocin	Tomatoes	0.3-0.4%	1-3[1]
	Vineyards	0.4%	1-3[1]
	Potatoes	3 kg/ha	1-3[1]
	Onion, sugar beet	4 kg/ha	1-3[1]
Cuprocin Super	Vineyards	0.3 %	1-3[1]

[1] No more than 3 treatments with fungicide with the same active ingredients could be applied, since some ressistance of the product could occur

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Application Rate (kg or litre <u>formulated product</u> per ha)**	**Typical Number of Applications per Year**
	Tomatoes, raspberries	0.4 %	1-3[1]
	Potatoes	3 kg/ha	1-3[1]
	Sugar beet	4 kg/ha	1-3[1]
Cuprocin Super Special	Vineyards	0.25-0.4%	1-3[1]
Cuproxat FL	Vineyards, tomatoes, apple	0.3%	1-3[1]
	Potatoes, tobacco	3.0 l/ha	1-3[1]
Blue (copper) vitriol (from Romania)	Vineyards	1% Bordeax mixure	1-3[1]
Blue (copper) vitriol (from Ukraine)	Sugar beet	1.5% Bordeax mixure	1-3[1]
	Whe60 at	2% solution of Blue (copper) vitriol	1-3[1]
Bordozin Super Special 56 VP	Vineyards	0.25%	1-3[1]
Bordozin Combi 76 VP	Vineyards	0.25%	1-3[1]
Bordozin Super 75 VP	Vineyards	0.3%	1-3[1]
Isoproturon containing products			
Arelon 50 EK	Wheat, barley	3.5 ÷ 5.0 l/ha	1
Isoprotusan 500 SK	Wheat, barley	3.5 ÷ 4.0-5.0 l/ha	1
Izor 500 SK	Wheat, barley	3.5 ÷ 4.0-5.0 l/ha	1
Izoflo 500 SK	Wheat, barley	3.5 ÷ 4.0-5.0 l/ha	1
IP-50 Flo	Wheat, barley	3.5 ÷ 4.0-5.0 l/ha	1
IP-830 VG	Wheat, barley	2.1 ÷ 2.4-3.0 l/ha	1
Protugan 50 SK	Wheat, barley	3.5 ÷ 4.0-5.0 l/ha	1
Taifun	Wheat, barley	3.5 l/ha[2]	1
Quartz Super	Wheat, barley	3.0 l/ha	1
Kugar	Wheat, barley	1.5-2.0 l/ha	1
Trifluralin containing products			
Agriflan 24 EK	Strawberries	3 l/ha	1
	Soy bean, beans, sunflower, cabbage, tomatoes, carrots	3.0-4.0 l/ha	1
	Pea nuts, cotton	3.5 l/ha	1
	Vineyards	6.0-10.0 l/ha	1
Valsaflan 48 EK	Sunflower	1.5-2.0 l/ha	1
Eflurin 24 EK	Sunflower	3.0-4.0 l/ha	1
Eflurin 48 EK	Bean	1.5-2.0 l/ha	1
Califort 48 EK	Sunflower	1.5-2.0 l/ha	1
Premerlin 600 EK	Sunflower	3.0-4.0 l/ha	1
	Maize	3.5-4.0 l/ha	1
Tefralin 48 EK	Sunflower	1.5-2.0 l/ha	1
Treflan 24 EK	Cotton, soy beans	3.0-4.0 l/ha	1
	Beans, pepper, carrots, cabbage, tomatoes	3.5 l/ha	1
	Menthe	4.0 l/ha	1
Trifluralin 24 EK-I	Soy bean, sunflower, cotton, tomatoes	3.0-4.0 l/ha	1

2 Used only during vegetation period – after phase 3 leafs

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Application Rate (kg or litre formulated product per ha)**	**Typical Number of Applications per Year**
Triflurex 48 EK	Soy bean, sunflower, cotton, tomatoes	1.5-2.0 l/ha	1
Triflusan 48 EK	Soy bean, sunflower, tomatoes	1.5-2.0 l/ha	1
Trifunil 48 EK	Sunflower	1.5-2.0 l/ha	1

Table 9: Pesticide Products registered in Bulgaria containing Priority Pesticides

Active Ingredients (AI)	Name of Formulated Product containing AI	%, g/l, g/kg AI contained in Product (bold ai)
2,4-D	2,4-D amino salt	**600 g/l**
	2,4-D KNE	**600 g/l**
	Agro-D-Amin	**500 g/l**
	Aminopielik 600 SL	**600 g/l**
	Valsamin	**600 g/l**
	Dezormon liquid	**600 g/l**
	Dikamin D (from Malayzia)	**600 g/l**
	Dikamin D((from Bulgaria)	**600 g/l**
	Dikopur F (from Austria)	**600 g/l**
	Dikopur F (from Bulgaria)	**600 g/l**
	Diovid 60 SL	**600 g/l**
	DMA 6	**684 g/l**
	Ester X	**480 g/l**
	Luvaram	**610 g/l**
	Maton 600 EK	**600 g/l**
	Mostamin 720 SL	**600 g/l**
	Sanafen	**600 g/l**
	Solution 800 SP	**800 g/l**
	U 46 D Fluid	**500 g/l**
	Herboxon	**600 g/l**
2,4-D + Bromoxinil	Buktril D	**225 g/l** + 225 g/l
2,4-D + Dicamba	Defender SL (from India)	**360 g/l** + 120 g/l
	Defender SL (from Bulgaria)	**360 g/l** + 120 g/l
	Pacific	**360 g/l** + 120 g/l
	Weedmaster 646 SL (from Switzerland)	**344 g/l** + 120 g/l
	Weedmaster SL (from Bulgaria)	**360 g/l** + 120 g/l
2,4-D + Metosulam	Sansac	**360 g/l** + 5 g/l
2,4-D + MCPP	Dicopur MP Kombi	**100 g/l** + 400 g/l
	Duplozan KB Kombi	**160 g/l** + 360 g/l
2,4-D + Florasulam	Mustang 306,25 SK	**300 g/l** + 6,25 g/l
2,4-D + Cinidon-Etil	Lotus D	**420 g/l** + 50 g/l
Alachlor	Alanex 48 EK	**480 g/l**
	Alanex Neo 48 EK	**480 g/l**
	Alachlor 48 EK-S	**480 g/l**
	Alachlor 48 EK-I	**480 g/l**
	Lasagrin 48 EK	**480 g/l**
	Laso 48 EK	**480 g/l**
	Sanachlor 48 EK	**480 g/l**
Alachlor + Atrazine	Alazin 25/25 CE	**250 g/l** + 250 g/l
	Alazin 33/14 CE	**330 g/l** + 140 g/l
	Atlas	**336 g/l** + 144 g/l
	Lacorn Combi	**33,6%** + 14,4%
Alachlor + Prometrin	Cotralin EK	**23%** + 12%

Active Ingredients (AI)	**Name of Formulated Product containing AI**	**%, g/l, g/kg AI contained in Product (bold ai)**
Atrazine	Atranex 50 SK	**500 g/l**
	Atranex 80 VP	**800 g/kg**
	Atranex 90 VDG	**900 g/kg**
	Gesaprim 90 VG	**900 g/kg**
Atrazine + Acetochlor	Guardian Extra	**180 g/l** + 360 g/l
	Erunit 720 A	**270 g/l** + 410 g/l
Atrazine + Bentazon	Ladoc	**200 g/l** + 200 g/l
Atrazine + S-Metolachlor	Primextra Gold 720 SK	**320 g/l** + 400 g/l
Atrazine + Flufenacetate	Aspect 500 SK	**300 g/l** + 200 g/l
Copper and its compounds		
Copper carbonate, basic		
Copper hydroxide - $Cu(OH)_2$	Vitra 50 VP	**87,7%** (50% Cu)
	Concentrate of Bordeax mixure CK 11	**10-12%**
	Kosaid 101 VP	**770 g/kg** (500 g/kg Cu)
	Kosaid DF	**614 g/kg** (400 g/kg Cu)
	Funguran ON 50 VP	**770 g/kg** (500 g/kg Cu)
	Champ Plus	**360 g/l**
Copper hydroxide + Captan	Magic Cap 60 VP	**450 g/kg** + 150 g/kg
Copper hydroxide + Sulphur	Lactofol Cupro	**150 g/l** + 50 g/l
Copper oxychloride – $Cu_2 Cl(OH)_3$	Copper oxychloride 50 VP (from Bulgaria)	**500 g/kg**
	Copper oxychloride 50 VP (from Germany)	**500 g/kg**
	Cupro 50 VP	**880 g/kg** (500 g/kg Cu)
	Cuprol 50 VP	**885 g/kg** (500 g/kg Cu)
	Rumba 35 SK	**350 g/l**
Copper oxychloride + Dimetomorf	Forum R 460 VP	**400 g/kg** + 60 g/kg
Copper oxychloride + Iprovalicarb	Melody Compact 24,5 VP	**35%** (20,3% Cu) + 4,2%
Copper oxychloride + Mancoceb	Cuprocine Super M	**50%** (30% Cu) + 20%
Copper oxychloride + Metalaxil	Axanit CU VP	**400 g/kg** + 80 g/kg
	Armetil S VP	**700 g/kg** + 80 g/kg
	Cuproxil 48 VP	**400 g/kg** + 80 g/kg
Copper oxychloride + Simoxanil	Corseit R DF	**397,5 g/kg** + 42 g/kg
	Corseit R VP	**397,5 g/kg** + 42 g/kg
	Cupronam 320 SK	**40 g/l** + 60 g/l
Copper oxychloride + Simoxanil + Zineb	Cuproseit 45 VP	**290 g/kg** + 40 g/kg + 120 g/kg
	Cuproseit Gold 45 VP	**290 g/kg** + 40 g/kg + 120 g/kg
Copper oxychloride + Zineb	Cuprocin	**29,31%** (17% Cu) + 34%
	Cuprocin Super	**500 g/kg** (370 g/kg Cu) + 150 g/kg
	Cuprocin Super Special	**690 g/kg** (400 g/kg Cu) + 100 g/kg
Copper sulphate (basic) –	Cuproxat FL	**345 g/l** (190 g/l Cu)

Active Ingredients (AI)	**Name of Formulated Product containing AI**	**%, g/l, g/kg AI contained in Product (bold ai)**
$CuSO_4$ $5H_2O$	Blue (copper) vitriol (from Romania)	**98%**
	Blue (copper) vitriol (from Ukraine)	**96-98%**
Copper sulphate + Simoxanil + Zink sulphate	Bordozin Super Special 56 VP	**260 g/kg** + 60 g/kg + 270 g/kg
Copper sulphate + Fluzilazol + Zink sulphate	Bordozin Combi 76 VP	**370 g/kg** + 10 g/kg + 370 g/kg
Copper sulphate + Zink sulphate	Bordozin Super 75 VP	**37%** + 37%
Isoproturon	Arelon 50 EK	**500 g/l**
	Isoprotusan 500 SK	**500 g/l**
	Izor 500 SK	**500 g/l**
	Izoflo 500 SK	**500 g/l**
	IP-50 Flo	**500 g/l**
	IP-830 VG	**830 g/kg**
	Protugan 50 SK	**500 g/l**
	Taifun	**500 g/l**
Isoproturon + Diflufenikan	Quartz Super	**500 g/l** + 50 g/l
	Kugar	**500 g/l** + 100 g/l
Trifluralin	Agriflan 24 EK	**240 g/l**
	Valsaflan 48 EK	**480 g/l**
	Eflurin 24 EK	**240 g/l**
	Eflurin 48 EK	**480 g/l**
	Califort 48 EK	**480 g/l**
	Premerlin 600 EK	**600 g/l**
	Tefralin 48 EK	**480 g/l**
	Treflan 24 EK	**240 g/l**
	Trifluralin 24 EK-I	**240 g/l**
	Triflurex 48 EK	**480 g/l**
	Triflusan 48 EK	**480 g/l**
	Trifunil 48 EK	**480 g/l**

Annex 4

Pesticide Usage in Croatia

Annex 4: Pesticide Usage in Croatia

The registration data, agricultural data and some usage data for major pesticides (Atrazine, 2,4-D and Alachlor) were submitted. Table 10 presents an overview of the number of registered pesticides by type of use. Detailed information on pesticide products containing priority pesticides are listed in Table 12 and Table 13 at the end of the Annex.

Table 10: Number of Pesticides Registered in Croatia

Use	Number active ingredients	Number formulated product
Zoocides	86	201
Fungicides	80	216
Herbicides	90	226
Others	15	26

Table 11 shows that apples are the crops with the highest treatment frequency, followed by grapes and sugar beet. The table also apparently shows that “small” farms apply pesticide less often than “large” farms.

Table 11: Treatment Index for Major Crops in Croatia

Crop	Treatment Index
Apples	33.0
Vineyard	13.0
Sugar beet	6.3
Wheat (large farms)	4.0
Sunflower	4.0
Oilseed rape	3.5
Soy bean	3.5
Maize (large farms)	3.0
Potato	2.5
Wheat (small farms)	1.8
Maize (small farms)	1.2

Atrazine Use

According to the chemical industry, 406 tons of the active ingredient atrazine was used in 2001 in Croatia. If the average dosage was 1,25 kg/ha, then 324,000 ha of maize was treated, which means 87% of all surface under maize production. As atrazine is used in many herbicide combinations, it can surely be assumed that 100% of surface under maize were treated.

Alachlor Use

In Croatia, alachlor is used alone and in combinations. The use of alachlor dropped rapidly in the last years.

In 2001, 37 tons of pure alachlor was used. Average dosage is 2.50 kg ai/ha, what means that about 15,000 ha of maize, soy been, sunflower and oilseed rape was treated with formulated products.

The use of all three acetanilide (metolachlor, acetochlor, alachlor) in Croatia in 2001 was 517 tons, what make them one of the most hazardous groups, concerning the pollution of environment.

2,4-D Use

2,4 D herbicides are used in wheat, barley and maize. In 2001, 120 tons of 2,4-D (active ingredient) was used. Average dosage is 1 l/ha, so almost 100,000 ha of wheat and barley and 20,000 ha of maize was treated.

More detailed usage data by crop or active ingredient are not available.

Problems associated with Pesticide Use

1. Concerning atrazine use, the present situation is showing that water liability with atrazine in Croatia is probably very big and very urgent monitoring measures are needed. After the results with monitoring some restrictions and even prohibitions of atrazine would probably be needed.
2. In the two biggest river basins in Croatia there is approximately 365,000 ha under maize: in Sava basin 215,000 ha and in Drava and Dunav basin 150,000 ha. That means that in Sava basin about 240 tons of atrazine and in Drava-Dunav basin about 160 tons of atrazine is used per year. Part of the soils in Drava basin is more permeable, so on that soils the leaching of atrazine in ground waters can be dangerous.

Table 12: Data on Crops, Application Rate and Number of Applications of Pesticide Products Containing Pesticides in Croatia

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D containing products			
Deherban A	grain crops (not oat)	1.5-2.5 l/ha	1
	corn	1-1.5 l/ha	
	pastures and meadows	2.5-3 l/ha	
Dikocid	"	"	
Diconit	"	"	
Dicopur	"	"	
DMA 6	winter wheat, spring and winter barley	1-1.2 l/ha	
	corn	1 l/ha	
Alachlor containing products			
Lasso Microtech	corn, soy bean, sunflower	4-6 l/ha	1
	oil-seed rape	4-5 l/ha	
Bravo MC	"	"	
Lasso EC	corn, soy been, sunflower	4-5 l/ha	
Alaklor EC 48	"	"	
Bravo Terazin-T	corn	6-8 l/ha	
Alachlor & Atrazine containing products			
Lasso Atrazin	corn	5-8 l/ha	
Bravo Radazin-T SE	corn	5-8 l/ha	
Alazin 33/14	corn	5-8 l/ha	
Atrazine containing products			
Gesaprim 50 WP	corn, sorghum millet	2-3 kg/ha	1
Radazin WP 50	"	"	
Radazin WP 80	"	1.3-1.9 kg/ha	
Atranex 80 WP	corn	1.3-1.9 kg/ha	
	corn in monoculture	2-2.5 kg/ha	
Radazin T-50	corn, sorghum millet	2-3 l/ha	
Atranex 50 CS	corn	2-3 l/ha	
	corn in monoculture	3-4 l/ha	
Gesaprim 500 FL	"	"	
Aflazin 500 tekući	corn, sorghum millet	2-3 l/ha	
Atranit	"	"	
Copper containing products			
Champion WP	potato, onion, tomato, cucumber	0.35%	1-4
	grape vine, hop	0.35-0.45%	
	fruit trees in winter period	0.2-0.25%	
Champion tekući	tomato, potato	0.4-0.45%	
	grape vine	0.45%	
	cucumber, onion	0.3-0.4%	
	fruit trees in winter	0.7%	
Champ formula 2 FL	grape vine, apple	0.2-0.25%	
	potato-Phytophtora	2 l/ha	
	apple,pear-Erwinia	0.07%	
	peach - Taphrina	0.3-0.5%	
Cuproline	grape vine, sour cherry	0.3%	
	hop	0.4%	
	fruit trees in winter	0.6-0.7%	

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
Cuproxat	hop, onion bean, cucumber, grape vine, olives	0.5-0.75%	
	fruit trees in winter	1 %	
	potato, tomato	5-6 kg/ha	
Kocide DF	grape vine	0.15-0.2%	
	potato, tomato	2 kg/ha	
	olive trees	0.2%	
	apple - Erwinia	0.05%	
	peach	0.3-0.5%	
Bakreno vapno WP 50	potato,tomato,hop,onion,been ,cucumbers, grape vine, olive trees	0.5-0.75% 6-7 kg/ha	1-4
Gypso GD	"	"	
Kupropin		0.5-0.75%	
	fruit trees in winter	1 %	
	tomato, potato	5-6 kg/ha	
Pasta Caffaro	grape vine	3-4 l/ha	
Cuprocaffaro 50 WP		0.5-0.75% 6-7 kg/ha	
Modra galica		0.5-2% 10-12 kg/ha	1-4
Chlorpyrifos containing products			
Dursban E-48	fruit trees, potato, sugar beet, other field crops	0.1-0.15% 1-2 l/ha	1-2
Pirifos EC	"	"	
Finish E-48	"	"	
Pyrinex 25 ME	apples	0.2-0.3%	
	oilseed rape	2 l/ha	
Zlatica pirifos	potato	25 kg/ha	
Reldan 40	fruit trees, grape vine, field crop, cabbage	0.1-0.125% 1.25-1.75 l/ha	
Reldan super	"	0.075-0.1% 1-1.5 l/ha	
	empty warehouse	1 ml/m2	
Chromorel D	fruit trees potato oilseed rape sugar beet s.b. Bothinoderes	0.075-0.15% 0.6-0.9 l/ha 0.75-1 l/ha 1-1.5 l/ha 1.5-2.0 l/ha	
Nurelle-D	"	"	
Herborel D	oilseed rape potato	0.75 l/ha 0.9 l/ha	
Chromorel Z	potato	0.5-1 l/ha	
Chromorel ZP	potato	15-20 kg/ha	
Chromorel P-2	potato sugar beet	15-20 kg/ha 20-25 kg/ha	
Endosulfan containing products			
Thiodan E-35	grape vine, fruit trees	0.1-0.2% 1.2-2.5 l/ha	1-2
Thionex E 35	"	"	
Global E-35	"	"	
Malathion containing products			
Radotion E-50	vegetable, water melon, melons, fruit trees grape vine,	0.15-0.3% 1.5-2.5 l/ha	1-3

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	field crops		
Radotion P-50		20-30 kg/ha	
Isoproturon containing products			
Alon 50 disperzija	winter wheat, barley, rye	2.5-3.5 l/ha	1
Tolkan	winter wheat, barley	4-5 l/ha	
	rye pre-em	2.5-3.5 l/ha	
Protugan 50 SC		2.5-3.5 l/ha	
Alon forte	winter wheat and barley	2-2.5 kg/ha	
Alon super	winter wheat and barley	2 kg/ha	
Grodyl plus	winter wheat and barley	1.75-2 kg/ha	
Simazine containing products			
Radokor 50 WP	corn	2-3 kg/ha	1
Radokor T-50	corn	2-3 l/ha	
Simapin T-50	corn	2-3 kg/ha	
Trifluralin containing products			
Treflan EC	sunflower,soy been,oilseed rape, been,cabbage	1.5-2.5 l/ha	1
Triflurex 48 EC	"	"	
Lanos	"	"	
Triflur	"	"	

Table 13: Pesticide Products registered for use in Croatia containing Priority Pesticides

Active Ingredients (AI)	Name of Formulated Product containing AI	% or g/kg or g/l AI contained in Product
2,4-D	Deharban A	464 g/l
	Dicovit	464 g/l
	Dikocid	464 g/l
	Dicopur	464 g/l
	DMA 6	680 g/l
Alachlor	Lasso Microtech	48%
	Bravo MC	48%
	Lasso EC	48%
	Alaklor EC 48	48%
	Lasso Atrazin	34%+14% atrazin
	Bravo Radazin-T SE	33%+14% atrazin
	Bravo-Terazin-T	33,6%+14,4%terbutilazin
	Alazin 33/14	33,6%+14,4% atrazin
Atrazine	Gesaprim 50 WP	50%
	Radazin WP 50	50%
	Radazin WP 80	80%
	Atranex 80 WP	80%
	Radazin T-50	50%
	Atranex 50 SC	50%
	Gesaprim 500 FL	50%
	Aflazin 500 tekući	50%
	Atranit	50%
Copper and its compounds		
Copper hydroxide - $Cu(OH)_2$	Champion	50%
	Champion tekući	24%
	Champ formula 2 FL	35%

	Cuproline	348 g/l
	Cuproxat	19%
	Kocide	40%
Copper oxychloride – $Cu_2 Cl(OH)_3$	Bakreno vapno WP 50	50%
	Gypso GD	50%
	Kupropin	50%
	Pasta Caffaro	35%
	Cuprocaffaro 50 WP	50%
Copper sulphate (basic) – $CuSO_4$ $5H_2O$	Modra galica	25%
Chlorpyrifos	Dursban E-48	48%
	Pirifos EC	50%
	Finish E-48	48%
	Pyrinex 25 ME	25%
	Zlatica pirifos	4%
	Reldan 40	40%
	Reldan super	50%
	Chromorel D	50%+5% cipermetrin
	Nurelle-D	50%+5% cipermetrin
	Herborel D	50%+ 5% cipermetrin
	Chromorel Z	45%+30g/l betacipermetrina
	Chromorel ZP	1,8%+0,14% zetacipermetrina
	Chromorel P-2	1,8%+0,2% cipermetrina
Endosulfan	Thiodan E-35	35%
	Thionex E 35	35%
	Global E-35	35%
Malathion	Radotion E-50	50%
	Radotion P-5	5%
Isoproturon	Alon 50 disperzija	50%
	Tolkan	50%
	Protugan 50 SC	50%
	Alon forte	60%+1,5% fluoroglikofen
	Alon super	74%+1% amidosulfuron
	Grodyl plus	60%+1,5% amidosulfuron
Simazine	Radokor 50 WP	50%
	Radokor T-50	50%
	Simapin T-50	50%
Trifluralin	Treflan EC	48%
	Triflurex 48 EC	48%
	Lanos	48%
	Triflur	48%

Annex 5

Pesticide Usage in the Czech Republic

Annex 5: Pesticide Usage in the Czech Republic

The Czech Republic is one of the very few countries globally, which maintain a pesticide use reporting system and a permission system for highly toxic and toxic pesticides. All professional users of pesticides are required to record their pesticide use in detail. Article § 29 on the Handling of plant protection products describe the details:

(3) The use of plant protection products in the framework of commercial activities must be recorded in the way set down in the implementing regulation; the records shall be saved for a period of at least three years.

*(4) The use of plant protection products labelled on the basis of the decision on their registration as **highly toxic or toxic** must be announced by the legal person or natural person using them in the framework of commercial activities to the district public health officer not later than 48 hours[3] before the beginning of their application, with the exception of cases of a sudden attack on the plants by harmful organisms when the sufficient time span for the announcement will be by the beginning of the product application. The use of these plant protection products outside closed objects must also be announced to the locally competent municipality office within the same time limit. In the case of an aerial application, the announcement must be made in writing. The announcement shall include:*

a) the exact name of the municipality and object, or municipality, cadastre and land where the product is to be used,
b) the sort, approximate amount and dosage rate or concentration of the product that is to be used,
c) the purpose of the use of the product,
d) the mode of application,
e) the day and, if possible, the hour of launch of the application,
f) the presumed duration of the activity,
g) the safety measures that will be performed,
h) the name and seat of the legal or natural person performing the application of the product, and the name of, and connection to, the person responsible[4].

Pesticide users have to record:

- entrepreneur using pesticide
- address of headquarter
- identification number of the organisation
- person responsible for record keeping
- identification of the place the pesticide was used by municipality, cadastral district, plot number, location of treated buildings (cereal stores, greenhouses etc.)
- date and hour of use
- commodity, crop
- target organism
- pesticide product number
- dose per unit

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3 National holidays, public holidays, and days of rest (non-working days) are not included in the term of 48 hours as referred to in paragraph4 [3]. In Annex 8 of the act a model of recorded data is presented.

4 Czech Republic, Collection of Laws, Volume 2002, Issue 14 of 30 January 2002: 36/2002 Coll.Act No. 147/1996 Coll., on Phytosanitary Care and Amendments of some Related Acts, as Amended by the Acts No. 409/2000 Coll. and No. 314/2001 Coll.ACT on Phytosanitary Care and Amendments of some Related Acts PART ONE PHYTOSANITARY CARE SECTION I BASIC PROVISIONS

- way of use
- extent of use in hectare or other units
- total quantity
- notes[5]

Farmers with farm larger 10ha are required to report their pesticide use. Only 27.4% of all farms are larger than 10 hectare, but they do cultivate 97.5% of the agricultural land (see Table 14).

Applying the same farm distribution to the Danube Basin in the Czech Republic, pesticide usage data are reported for over 1.1 million hectare in the Czech part of the Danube Basin.

Collected pesticide use specific to active ingredients by crop are available (see Table 15).

The annual report published by the State Phytosanitary Administration also contains information on the hectare infested with individual pest organisms by crop as well as on the use of pesticides by toxicity classification and crop. The annual report, however does not contain information on trends over time or application rate by crop.

The data recently published contain the data set for the year 2002. In 2002 some 4.7 million tons active ingredients were reported to be applied in the Czech Republic.

Sales data by the Czech Crop Protection Association are only available for 2001 and report a number of 4.35 million tons for the year 2001[6]. Reported usage in 2001 was 4.39 tonnes. The difference is most likely due to the fact that farmers used stocks or that not all sales in the Czech Republic are reported to the Czech Crop Protection Association.

Table 14: Distribution of farms by size in the Czech Republic and its parts of the Danube Basin (2000)

Size	Number of holdings Czech Republic	Number of holdings Danube Basin	% Number of holdings	Hectare of agriculture land Czech Republic	Hectare of agriculture land Danube Basin	% of ha
<10 ha	41,012	13,181	72,6	90,259	29,009	2.5
10-50 ha	9,724	3,125	17,2	209,213	67,241	5.7
50-100 ha	1,844	593	3,3	128,596	41,331	3.5
100-500 ha	2,007	645	3,6	444,410	142,833	12.2
< 500 ha	1,900	611	3,4	277,0691	890,497	76.1
Total	**56,487**	**18,155**	**100**	**3,643,168**	**1,170,911**	**100**

5 Annex No. 8 to the Decree No. 91/2002 Collection of Laws, Model of Recorded Data on the Uses of Plant Protection Products in Frame of Business

6 Personal communication with Ivan Dostal, ECPA, Czech Crop Protection Association

Table 15: Pesticide use and intensity of use by crops and crop group

Arable Crops	**kg pesticide use**	**hectare**	**kg/ha**
cereals	1,802,406	1,623,600	1.11
fodder crops	33,148	668,200[7]	0.05
legumes (pulses)	57,694	37,200	1.55
maize	490,222	61,900	7.92
other arable crops	488,053	472,100[8]	1.03
potatoes	228,618	54,100	4.23
rape	777,412	343,000	2.27
sugar beet	294,172	77,700	3.79
Total arable crops	*4,171,725*	*3,337,800*	*1.25*
Specialty crops			
grapevine	151,714	11,300	13.43
hops	163,709	6,100	26.84
orchards	141,766	30,600	4.63
vegetables	51,441	26,000	1.98
Total specialty crops	*508,630*	*74,000*	*6.87*
Pasture and Meadows			
meadows	n.a,	656,600	n.a.
pasture land	n.a,	283,600	n.a.
Total pasture and meadows	*n.a,*	*940,200*	*n.a.*
Total Agricultural Land	4,680,355	4,352,000	1.08

Over the last few years there has been a steady increase in the usage of pesticides in the Czech Republic, in 1993 reported usage was about 3.5 million tonnes. This increase is owed to the fact that after the political change in 1989 pesticide usage in the Czech Republic dropped significantly and is now recovering.

The highest total use is associated with the cultivation of cereals, while the highest intensity is associated with the cultivation of hops.

Table 16 shows the usage of the Top 25 pesticides in the Czech Republic in 2001 and 2002. In 2002 the top 25 pesticides account for 73% of the total use. Seven of the top 25 pesticides (bold) are Danube priority pesticides.

The changes between the two years cannot be interpreted as a trend since climatic conditions and/or changes in crop areas may also be responsible for such changes.

7 Fodder root crops: 6.000ha; annual fodder crops: 288.700ha; perennial fodder crops (hay): 373.500ha

8 Poppy: 33.200 ha; Flax (stems): 6.600ha; Oilseed crops: 432.300ha

Table 16: Usage of the Top 25 Pesticides in 2001 and 2002 in the Czech Republic

	Active Ingredient	2001 Total kg or l	Total 2002 kg or l	% change
1	Chlormequat-chloride	496,862	597,770	20.3
2	Glyphosate-IPA	313,167	293,321	-6.3
3	**Alachlor**	**278,002**	**255,141**	**-8.2**
4	Acetochlor	233,037	241,174	3.5
5	Mancozeb	181,131	186,817	3.1
6	MCPA	189,365	176,619	-6.7
7	**Atrazine**	**131,321**	**144,919**	**10.4**
8	Glyphosate-trimesium (sulfosat)	95,168	131,517	38.2
9	**Isoproturon**	**158,178**	**129,961**	**-17.8**
10	**Copper oxycloride**	**137,126**	**128,757**	**-6.1**
11	**Chlorpyrifos**	**100,900**	**111,031**	**10.0**
12	Carbendazim	92,290	109,516	18.7
13	**Trifluralin**	**88,654**	**99,950**	**12.7**
14	Glyphosate	40,443	95,608	136.4
15	Metazachlor	97,923	89,395	-8.7
16	**2,4-D**	**89,465**	**83,123**	**-7.1**
17	Fenpropimorph	66,844	75,035	12.3
18	Thiram	61,149	74,087	21.2
19	Chlorotoluron	106,736	72,256	-32.3
20	Chloridazon	56,409	64,561	14.5
21	Carboxin	46,437	56,806	22.3
22	Sulphur	51,785	56,078	8.3
23	Pendimethalin	52,864	54,319	2.8
24	Metamitron	49,501	50,120	1.3
25	Dimethachlor	46,462	47,883	3.1
	Total Top 25	**3,261,219**	**3,425,764**	**5.0**

Usage of Danube Priority Pesticides in the Czech Republic and the Danube Basin

The report on pesticide use for the year 2002 presents data about 14 active ingredients which are priority substances. Usage data for two additional compounds, one copper compound Oxine Cu and one compound belonging to the 2,4-D esters 2,4-D-EHE are available as well. Table 17 shows that Alachlor is the compound with the highest total use followed by Atrazine and Trifluralin.

Altogether the priority pesticides represent 22.3% of the total pesticide use in the Czech Republic.

Table 17: Usage of Priority Substance in the Czech Republic in 2002

Priority Substance	kg used in 2002
2,4-D	83,123
2,4-D EHE	5,861
Alachlor	255,141
Atrazine	144,919
Chlorpyrifos	111,031
Copper hydroxide	36,737
Copper oxychloride	128,757
Copper oxyquinolate (Oxine Cu)	43
Copper sulphate (basic)	47,251
Isoproturon	129,961
Simazine	164
Trifluralin	99,950
Zinc phosphide	3,356
Total Usage ICPDR substances	**1,046,294**

Table 18 and Table 19 show the use of priority pesticide by crop. Highest total use is in rape, cereals and hops.

Applying the areas by crop listed in the intensity of pesticide use by crop can be calculated. Because some numbers are very small the unit used is g/ha. Figures below 0.1 g/ha were deleted from the table.

Table 18: Use of Priority Pesticides in Arable Crops in the Czech Republic in 2002 (kg)

Active substance	Cereals	Maize	Sugar beet	Legumes	Potatoes	Fodder Crops	Rape
2,4-D	75,899	6,974				218	
2,4-D EHE	4,434	443				33	
Alachlor	360	2,112		310	36	58	248,790
Atrazine		144,870					
Chlorpyrifos	4,863	68	6,561	2,202	3,454	77	90,354
Copper hydroxide			65		67		
Copper oxychloride			427	125	4,952		
Copper oxyquinolate (Oxine Cu)	43						
Copper sulphate (basic)							
Isoproturon	121,991	3					
Simazine		39					
Trifluralin	58,959	214	346	572		43	14,031
Zink phosphide	1,035	30	1			859	598
Total Use (kg)	**267,584**	**154,753**	**7,400**	**3,209**	**8,509**	**1,288**	**353,773**

Table 19: Use of Priority Pesticides in Specialty Crops in the Czech Republic in 2002 (kg)

Active substance	Hops	Vegetables	Orchards	Vine	Other Crops
2,4-D					26
2,4-D EHE					951
Alachlor		752			2.723
Atrazine					42
Chlorpyrifos		233	638	3	2.577
Copper hydroxide	8,440	1,997	15,584	10,566	18
Copper oxychloride	83,221	3,189	8,556	27,449	837
Copper oxyquinolate (Oxine Cu)					
Copper sulphate (basic)	39,968	30		7,252	
Isoproturon					7,966
Simazine			16	8	101
Trifluralin		3,370	1		22,413
Zink phosphide			32		790
Total Use (kg)	**131,629**	**9,571**	**24,827**	**45,278**	**38,444**

Table 20: Intensity of Priority Pesticide Use in Arable Crops (g/ha)

Active substance	Cereal	Maize	Legumes	Sugarbeet	Potatoes	Forage Crop	Rape
2,4-D	46.7	112.7				0.3	
2,4-D EHE	2.7	7.2					
Alachlor	0.2	34.1	8.1		0.7	0.1	723.0
Atrazine		2.340.4					
Chlorpyrifos	3.0	1.1	57.3	84.3	63.6	0.1	262.6
Copper hydroxide				0.8	1.2		
Copper oxychloride			3.3	5.5	91.2		
Copper sulphate (basic)							
Isoproturon	75.0	0.5					
Oxine Cu (copper oxyquinolate)							
Simazine							
Trifluralin	36.2	0.6	14.9	4.4		0.1	40.8
Zinc phosphide	0.6	3.5				1.3	1.7
Total Intensity (g/ha)	**164.5**	**2500.0**	**83.6**	**95.1**	**156.7**	**1.9**	**1.028.1**

Table 21: Intensity of Priority Pesticide Use in Speciality Crops (g/ha)

Active substance	Hops	Orchards	Vine	Other crops
2,4-D				
2,4-D EHE				0,66
Alachlor				1,88
Atrazine				
Chlorpyrifos		20.8	0.3	1.78
Copper hydroxide	1,383.6	509.3	935.0	0.58
Copper oxychloride	13,642.8	279.6	2,429.1	
Copper sulphate (basic)	6,552.1		641.8	0.55
Isoproturon				
Oxine Cu (copper oxyquinolate)				
Simazine		0.5	0.7	5.50
Trifluralin				
Zinc phosphide		1.0		15.46
Total Intensity (g/ha)	**21,578.5**	**811.3**	**4,006.9**	**26.4**

Copper compounds contribute to the highest use per ha in hops and wine. For these two crops priority compounds contribute to 80% and 86%, respectively, of the total use.

However, the data in Table 20 and Table 22 have to be interpreted with caution. Presumably, not all fields in the Czech Republic received the same amounts, this means that the mean application rates (g/ha) are most likely an underestimation for the treated areas. Pesticide use data, which present only treated fields are so far not available. These data are only available on farm level. Farmers are legally required to list the extent of use in hectares in their spray records.

In order to calculate pesticide use in the Danube Basin, crop areas (Table 22) in the Czech part of the Danube Basin were multiplied with the intensities from Table 20 and Table 21. Actual usage data are not available for the Danube Basin. The pesticide use reporting system in the Czech Republic does not process data on regional level. Theoretically, this should not be a problem, data could be collected/processed by postal code, district or municipality of the reporting farmer to achieve low resolution reporting.

Table 22: Land use in the Czech part of the Danube River Basin

Crop/ Crop group	Total Czech (ha)	DRB (ha)	% share DRB
Speciality crops			
vegetables	26,000	n.a,	n.a.
hops	6,100	1,146	18.8
orchards (fruits together)	30,600	15,801	51.6
Grapevine	11,300	10,735	91.8
Sum specialty crops	*74,000*	*31,782*	*42.9*
Pasture and Meadows			
meadows	656,600	113,105	17.2
pasture land	283,600	72,862	25.7
Sum pasture and meadows	*940,200*	*185,967*	*19.8*
Arable Crops			
maize (grain)	61,900	38,594	62.3
cereals	1,623,600	471,652	29.0
legumes (pulses)	37,200	10,570	28.4
potatoes	54,100	8,350	15.4
sugar beet	77,700	26,869	34.6
rape	343,000	95,022	27.7
fodder crops	668,200	158,918	23.8
other arable crops	472,100	33,545	7.1
Sum arable crops	*3,337,800*	*910,500*	*27.3*
Total agricultural land	**4,352,000**	**1,128,249**	**25.9**
Other land use (gardens)		42,663	

Problems Associated with Pesticide Use

The national expert identified three specific issues:

- Continued use of unauthorised POPs (notably lindane) by farmers, including the unverified claim that some banned POPs (e.g. DDT) are still in use
- Increasing resistance to triazines (atrazine, simazine etc.) notably in Lambsquarters (*Chenopodium album*) a dicotolydenous weed in the *Chenopodiaceae* family that is a particular problem in maize and sugarbeet in the Czech Republic. There is also some evidence of cross-resistance to other herbicide groups
- DDT residues in soil are still reported to be a problem in some areas (Karlovy Vary and Milovice)

Table 23: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides in the Czech Republic

Substance	Products	g/l or %	Maximum application rate active ingredient kg/ha or %
2,4-D	Bluster Lawn Killer	3g/l	n.a.
	Dicopur D	500g/l	0.625
	Dicopur D extra	600g/l	0.66
	Factor 365 EC	360g/l	0.54
	Lancet	450g/l	0.5625
	Mustang	300g/l	0.24
	U 46 D Fluid	500g/l	1
2,4-D EHE	Esteron	850g/l	1.275
Alachlor	Lasso MTX	480g/l	2.88
Atrazine	Atranex 50 SC	500g/l	3
	Gesaprim 500 FW	500g/l	1
	Gesaprim 90 WG	900g/l	0.9
	Guardian Extra	180g/l	1.08
Chlorpyrifos	Dursban 10 G	10%	3
	Dursban 480 EC	480g/l	0.96
	Metanion 48 EM	48%	0.96
	Nurelle D	500g/l	0.3
	Oleokol	30g/l	1%
Copper hydroxide	Modra Skalice	n.a.	1%
Copper oxychloride	Champion 50 WP	77%	3.85
	Curzate K	77,34%	0.3%
	Kuprikol 50	84%	4.2
	Ridomil Gold Plus 42,5 WP	40%	1.6
Copper sulfate (basic)	Cuproxat SC	345g/l	0.75%
Isoproturon	Affinity WG	50%	1.75
	Arelon 500 FW	500g/l	2.25
	Cougar SC	500g/l	0.75
	Foxtar D	300g/l	0.9
	Grodyl Plus	60%	1.2
	Maraton	125g/l	0.5
	Protugan 50 SC	500g/l	0.75
	Tolkan Flo	500g/l	2.25
Trifluralin	Synfloran 48 EC	480g/l	1.44
	Treflan 48 EC	480g/l	1.44
	Triflurex 48 EC	480g/l	1.2
Zinc phosphide	Stutox I	5%	0.5

Annex 6

Pesticide Usage in Hungary

Annex 6 Pesticide Usage Hungary

Hungary is one of very few countries, which maintains a sales reporting system based upon retail sales. Pesticide sales data are collected twice a year from wholesalers and local distributors. These have to submit data on the sales in kg as well as on the monetary amount on the basis individual formulated pesticide products. Sales data are publicly available in an aggregated format.

Sales data by pesticide product and the percentage active ingredient by product were submitted. Table 29 and Table 30 at the end of the Annex lists details about all registered products containing priority pesticides, and the amounts sold. Some of the products were obviously not sold in 2001. In the Annex is also the complete list of pesticide products containing information on crops, application frequency and recommended application rate.

Table 24 lists the result of calculation based upon product sales and percentage active ingredients. The usage of priority pesticide in percent by crop was estimated by the national experts. Based upon the simplifying assumption that 100% of the sold pesticide were used, amounts used per crop were calculated. The results can be found in Table 25 and Table 26.

Table 24: Sales of Priority Pesticides in Hungary 2001

Active Ingredient	Amount Sold in kg
Copper sulphate (basic)	10,093,136
Atrazine	519,569
Copper oxychloride	450,833
2,4-D	407,713
Trifluralin	111,273
Copper hydroxide	109,623
Endosulfan	82,127
Chlorpyrifos	48,371
Diuron	20,894
Alachlor	12,473
Malathion	8,579
Isoproturon	2,508
Zinc phosphide	1,986
Total	**11,869,085**

Table 25: Use of Priority Pesticides in Hungary by Crop 2001 (kg active ingredients)

	Maize	Cereal	Sun Flower	Potato	Arable crops	Alfalfa	Barley	Wheat	Legumes
2,4-D	40,771	366,942							
Alachlor	8,731		2,495						
Atrazine	363,698								
Chlorpyrifos					19,348				
Copper hydroxide				21,925					
Copper oxychloride				90,167					
Copper sulphate									
Diuron						16,715			
Endosulfan						65,702			
Isoproturon							2,006	502	
Malathion					1,716				
Trifluraline			55,637						27,818
Zinc phosphide									

Table 26: Use of Priority Pesticides in Hungary by Crop 2001 (kg active ingredients) (continued)

	Grapes	Vegetables	Orchards	Green Pepper & Tomatoes	Others
2,4-D					
Alachlor					1,247
Atrazine			51,957		103,914
Chlorpyrifos	12,093		14,511		2,419
Copper hydroxide	65,774		10,962		1,096
Copper oxychloride	270,500	40,575	45,083		4,508
Copper sulphate (basic)	8,074,509		1,513,970		504,657
Diuron			2,089		2,089
Endosulfan			8,213		8,213
Isoproturon					
Malathion	1,630	2,145	2,574		86
Trifluraline				27,818	
Zinc phosphide					

In addition to the data above, data on the areas treated with pesticides in the years 1995 - 2001 were provided by national experts as well (see Figure 3 and Figure 4). These data were submitted only by co-operatives and corporations. Data from private farmers are not collected. Figure 3 shows the distribution of farm types over time. The figure shows that the number of co-operative farms declined significantly since 1994, and that since 1997 around 60% of the farms are privately managed.

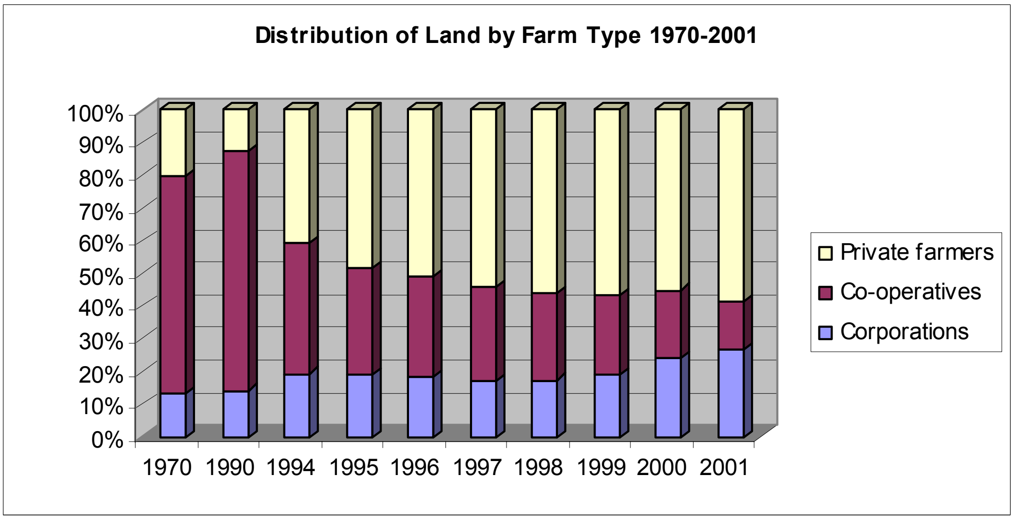

Figure 3: Distribution of land by farm type 1970 – 2001

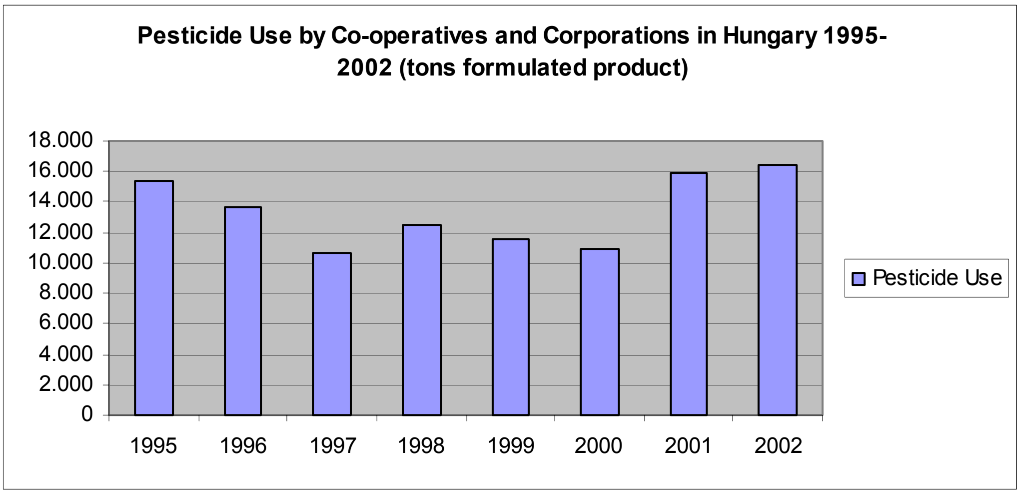

Figure 4 Pesticide use by co-operatives and corporations

Figure 4 shows that pesticide use by co-operatives and corporations between 1997 and 2000 was rather stable and rose between 2000 and 2002 by some 5000 tons of formulated products. This increase may be a consequence of bad climatic conditions, shift in crop areas or of an improved economic situation, which allowed higher usage of agrochemicals.

Table 27: Area (ha) treated with Pesticides in Hungary by Farm Type and Land Use Type in 2001

	Herbicides	Insecticides	Fungicides	Other
Field type by:	**Treated field area (ha)**			
Corporations	997,788	390,859	477,287	179,883
Arable land	977,766	366,377	456,807	170,801
Orchards	9,736	13,390	13,693	5,707
Viticulture	4,812	5,961	6,260	2,657
Meadow	1,142	37	-	202
Fish pond	1	25	10	68
Others	4,331	5,069	517	448

Co-operatives	504,656	164,250	207,714	88,805
Arable land	502,681	161,540	204,950	87,560
Orchards	931	1,501	1,532	400
Viticulture	969	1,158	1,183	794
Meadow	69	-	-	-
Fish pond	-	-	-	-
Others	6	51	49	51

Table 28: Area (ha) treated with Pesticides in Hungary by Land Use Type and Farm Type 2001

	Area 2001	Treated ha by Corporations 2001	Treated ha by Co-operatives 2001	Total Treated Area (ha)
Arable land	4,516,000	1,971,751	956,731	2,928,482
Orchards	97,400	42,526	4,364	46,890
Viticulture	83,500	19,690	4,104	23,794

Table 27 and Table 28 show the treated area of farmland under production by co-operatives and corporations in 2001. It was not indicated if multiple applications are included in these numbers.

The figure 5, 6 and 7 show summarised treated areas for co-operatives and corporations by crop group over the years. The figures show that arable areas treated with herbicides and insecticides declined between 1995 and 2001, while areas treated with fungicides or other pesticides did not change significantly.

Between 1997 and 2001 the treated areas cultivated with orchard and vineyards increased almost four times. Since the previous 4 indicates no increase of the total usage by co-operatives and corporations in the same time (rather a decrease between 1998 and 2000) this indicates that the either the intensity (kg per ha) fell or there were significant reporting errors.

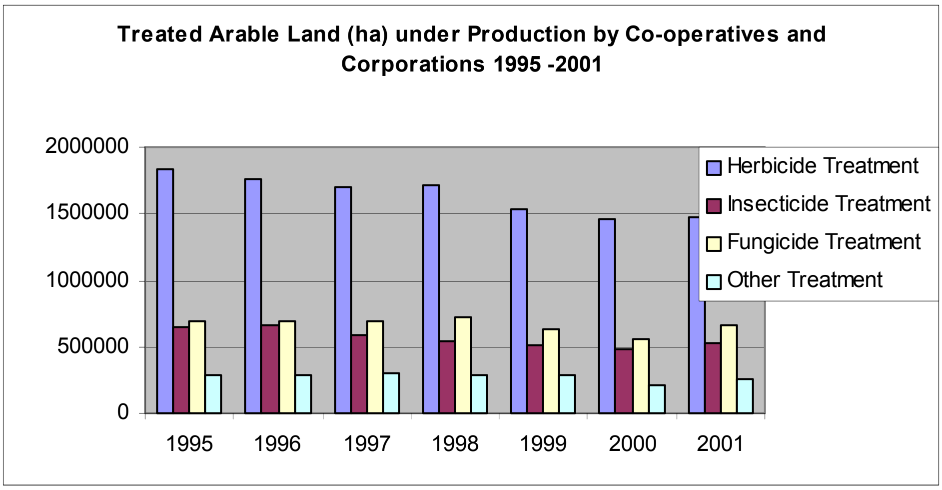

Figure 5 Treated arable land managed by co-operatives and corporations

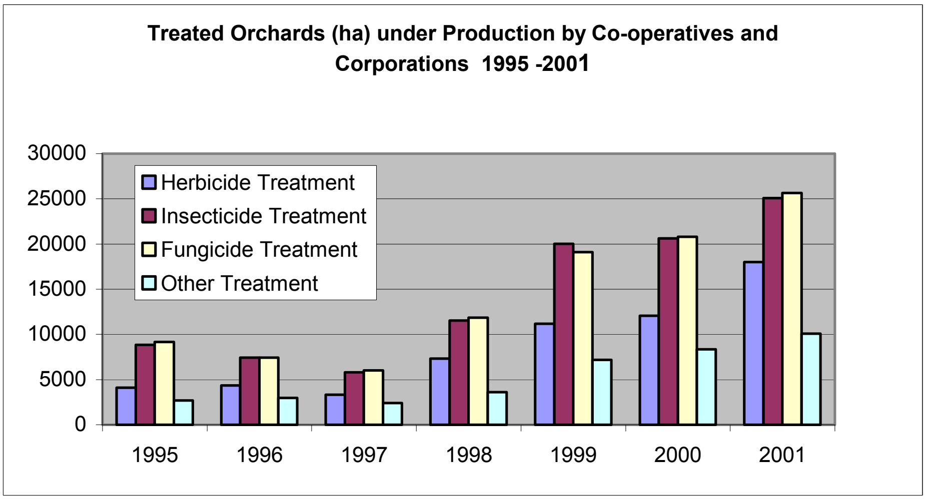

Figure 6 Treated orchards managed by co-operatives and corporations

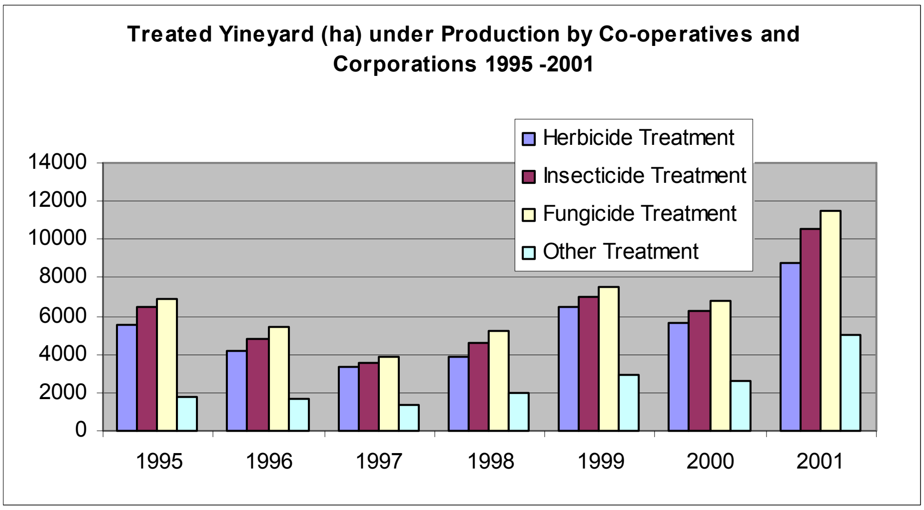

Figure 7 Treated vineyard managed by co-operatives and corporations

Problems Associated with Pesticide Use

The Plant Protection Institute conducted a water monitoring in 12 counties and with 6 water suppliers. Altogether, in 3 years (2000-2002) 14 substances were sampled 346 times in 90 locations. Survey results showed that in over 90% of the collected water sample detectable levels of pesticides were found. Atrazine was detected in 44%, Diazinion in 65%, Acetochlor in 31%, Prometryn in 18% and Terbutryn in 3% of the samples. Trifluralin, carbofuran, metribuzin, phorate and fenoxycarb were also sampled but not detected in any of the samples[9].

More general problems were described by the national experts:

1. Spray drift and unequal distribution problems due to the use of old spraying equipment.

In the early nineties the majority (75%) of the tractor driven sprayers was more than 5 years old. The stock of these machines nowadays about 33,000 pieces, the number of new machines sold is 700-800 pieces / year.

2. Use of old sprayers in the horticulture

9 Szekasc, A., Ernst, A. Juracsek, J, Darvas, B.(2003): Monitoring Water Polluting Pesticides in Hungary, Presentation at the 7th International HCH and Pesticides Forum in Kyiv, Ukraine, June 5th-7th 2003

The old machines are unable to achieve good penetration rates in the orchards and vineyards, the loss of pesticides is high, 10-25%, at the first (washing) spraying even higher, up to 60-80% if no labour is used to direct the spray to the trees.

3. The knowledge of the farmers is poor concerning the right adjustment and operating the sprayers.
4. Spraying too closely to surface waters e.g. on hilly regions

   There are obligatory distance for defence of the surface waters:
   - pesticides which are dangerous to the waters 200 m;
   - pesticides which are middle dangerous to the waters 50 (200) m;
   - pesticides which are less dangerous to the waters 20 (50) m;
   - pesticides which are not dangerous to the waters 5 (20) m;
5. Poor disposal of containers, unused chemicals

The amount of unused chemicals was calculated 10% of the total purchased amount in the past, which was in the eighties 60-80 t pesticides and 100-120 t containers for pesticides. At present the amounts are much lower, but the old pesticides and wastes stored remain to be an environmental risk.

Table 29: Amounts of Pesticides Products Containing Priority Pesticides and Sold in Hungary 2001

Active Ingredient	Product Name	% AI priority Pesticide	Product sold in kg	Active ingredient sold in kg
2,4-D	Dezormon	60	174,900	104,940
	Dikamin 720 WSC	72	129,284	93,084
	DMA-6	66.8	100,000	66,800
	U 46 D-Fluid SL	50	106,320	53,160
	Mustang	45.2	110,000	49,720
	2,4-D aminsó 450 SL	45	45,000	20,250
	Estreon 60	85	15,000	12,750
	Syrius	50	14,000	7,000
	Maton 600	60	15	9
	Dikamin D	40	0	0
	Mustang SE	45.2	0	0
	Dicopur D Prim	80	0	0
	Dikonirt	80	0	0
	Solution	97	0	0
Alachlor	Lasso	48	25,685	12,329
	Satoklor 480 EC	48	300	144
	Flexenit II. 690 EC	24	0	0
	Flexenit IV. 720 EC	24	0	0
	Atrazine 500 FW	50	219,024	109,512
	Primextra Gold 720 SC	32	300,575	96,184
	Gesaprim 90 FW	90	88,060	79,254
	Erunit Porofi	27	282,729	76,337
	Hungazin PK 500 FW	50	74,760	37,380
	Tropazin Fultime CS	19.2	170,000	32,640
	Atranex 50 SC	45	58,990	26,546
	Hungazin 90 DF	90	27,885	25,097
	Tazastomp SC	20	82,400	16,480
	Maizina 90 WG	90	7,285	6,557
	Gartoxin FW	38	15,805	6,006
	Erunit A 530 FW	20	18,535	3,707

Active Ingredient	Product Name	% AI priority Pesticide	Product sold in kg	Active ingredient sold in kg
	Titus ATG	50	6,781	3,391
	Aspect 500 SC	30	1,600	480
	Guardian Extra	18	0	0
	Laddok FW	20	0	0
	Tropazin	24	0	0
	Century	50	0	0
	Gesaprim 500 FW	50	0	0
	Maizina 500 SC	50	0	0
	Titus AT	50	0	0
	Aktikon 80 WP	8	0	0
	Maizina 80 WP	80	0	0
Chlorpyrifos	Nurelle-D 50/500 EC	50	80,000	40,000
	Pyrinex 48 EC	48	13,030	6,254
	Cyren EC	48	3,200	1,536
	Pyrinex 25 CS	25	2,323	581
	Diabro CS	25	0	0
	Dursban 480 EC	48	0	0
Copper hydroxide	Vegeso R	24	17,500	4,200
	Champion 2 FL	36	3,185	1,147
	Champion 50 WP	77	132,794	102,251
	Funguran-OH 50 WP	77	0	0
	Kocide 101	77	0	0
	Kocide 2000	53.8	0	0
	Kocide Combi	46	0	0
	Kocide DF	61		0
	Rézkénpor	20	0	0
	Vegesol eReS	15	13,500	2,025
Copper oxychloride	Forum R	40	42,730	17,092
	Galben R	33	7,300	2,409
	Kupfer Fusilan WG	83	14,000	11,620
	Mikal C 64 WP	36	55,496	19,979
	Kupfer-Phaltan	15	1,057	159
	Miltox Speciál	36	100,942	36,339
	Kusor 450 FW	44.4	0	0
	Perotox WP	34	12,220	4,155
	Pluto 50 WP	86	101,345	87,157
	Rézkén 650 FW	20	78,867	15,773
	Rézkol 400 FW	40	0	0
	Rézoxichlorid 50 WP	50	167,475	83,738
	Rézoxichlorid 50 WP (Agrospec)	50	0	0
	Rézoxichlorid 50 WP (Alboria)	50	0	0
	Ridomil Gold Plus 42,5 WP	40	29,985	11,994
	Vitra Rézhidroxid	77	14,000	10,780

Active Ingredient	Product Name	% AI priority Pesticide	Product sold in kg	Active ingredient sold in kg
	Astra Rézoxiklorid	88	90,000	79,200
	Axanit Cu 50 WP	40	17,239	6,896
	Cuprosan 50 WP	50	0	0
	Cuprosan Super D	36	32,113	11,561
	Cursate R	70	74,262	51,983
	Fixpol	0.75	0	0
Copper sulphate (basic)	Cupertine M	20	50,028,560	10,005,712
	Bordói Por Bordoeaux	71.1	33,996	24,171
	Cuprofix 30 DG	12	189,000	22,680
	Bordóilé FW	28.5	56,835	16,198
	Bordóilé+Kén FW	17.9	88,351	15,815
	Zetanil R	40	21,050	8,420
	Cupertine F	20	700	140
	Bordómix DG	20	0	0
	Cuproxat FW	35	0	0
	Rézgálic	98	0	0
	Rézgálic (Almalszkij)	98	0	0
	Rézgálic (Blue Stone)	98	0	0
	Rézgálic (Kék Kő)	98	0	0
	Rézgálic (Kistim)	98	0	0
	Rézgálic (Zorka)	98	0	0
	Rézgálic 98	98	0	0
	Scarmagnan Rézgálic	98	0	0
Diuron	Diuron 600 FW	60	24,594	14,756
	Nikesuper Combi 600 FW	22.5	27,278	6,138
	Lucenit 80 WP	80	0	0
Endosulfan	Thiodan 35 EC	35	155,760	54,516
	Thionex 35 EC	35	78,889	27,611
	Nikesuper Combi 80 WP	30	0	0
	Thionex 50 WP	50	0	0
Isoproturon	Protugan 50 SC	50	3,660	1,830
	Galition 5 G	0.3	226,000	678
	Maraton SC	12.5	0	0
	I.P. Flo	50	0	0
	IPU Stefes	50	0	0
	Affinity WG	50	0	0
	Izoguard 75 WG	76.5	0	0
	Izoguard 75 WP	76.5	0	0
Malathion	Fyfanon EW	44	19,000	8,360
	Buvatox 5 G	0.3	72,955	219
	Evershield CM	0.34	0	0
Trifluralin	Olitref 480 EC	48	148,649	71,352
	Triflurex 48 EC	48	51,560	24,749
	Ipifluor 48 EC	48	27,610	13,253
	Treflán 48 EC	48	4,000	1,920
	Triflurex 26 EC	26	0	0
Zinc phosphide	Arvalin-LR	4	49,660	1,986

Active Ingredient	**Product Name**	**% AI priority Pesticide**	**Product sold in kg**	**Active ingredient sold in kg**
TOTAL			54,487,603	11,869,086

Table 30: Registration Data of Pesticide Products Containing Priority Pesticides

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical No. of Applica-tions per Year**	**% Crops Grown Treated with Pesticide**
				Experts estimate!!
2,4-D containing products				Maize 10% Wheat etc. 90%
2,4-D aminsó 450 SL	cereals, maize, pasture	1.7; 1.5; 2.75	1	
Dezormon	cereals, maize	1.2; 1.0	1	
Dicopur D Prim	Silage maize	0.85	1	
Dikamin 720 WSC	cereals, maize, pasture	1.25 2.3	1	
Dikamin D	cereals, maize, pasture	2.6; 3.0; 4.5	1	
Dikonirt	cereals, maize	1.4	1	
DMA-6	cereals, maize, pasture	1.0 1.2	1	
Estreon 60	cereals, maize, pasture	0.7; 0.8; 1.0	1	
Maton 600	cereals, maize, pasture	0.7; 0.5; 0.85	1	
Mustang	cereals, canary-grass	0.5	1	
Mustang SE	cereals, canary-grass	0.5	1	
Solution	cereals, maize pasture	0.7 1.0	1	
Syrius	wheat, silage maize	1.1	1	
U 46 D-Fluid SL	cereals, maize	1.4	1	
Alachlor containing products				
Flexenit II. 690 EC	maize	11	1	Sunflower 20% maize 70% others 10%
Flexenit IV. 720 EC	maize	7	1	
Lasso	oil rape, mustard, oil radish	5.0	1	
Satoklor 480 EC	maize, sunflower	4.5; 4.0	1	
Atrazine containing products				
Aktikon 80 WP	maize, grape, apples, pears	3.5 3.6	1-2	Orchards 10% Maize 70% Others 20%
Aspect 500 SC	maize	2.75	1-2	
Atranex 50 SC	maize, sorghum	2.2. 1.75	1-2	
Atrazine 500 FW	maize, grape, apples, pears	2.2	1-2	
Century	maize	4.5	1-2	
Erunit A 530 FW	maize	6.0	1-2	
Erunit Porofi	maize	4.2	1-2	
Gartoxin FW	maize, sorghum, non cultivated area	2.25 3.75	1-2	
Gesaprim 500 FW	maize, sorghum	2.2; 1.75	1-2	
Gesaprim 90 FW	maize, sorghum	1.0; 1.1	1-2	
Guardian Extra	maize	5.25	1-2	
Hungazin 90 DF	maize, sorghum	1.15; 1.0	1-2	
Hungazin PK 500 FW	maize, sorghum, grape, apples, pears	1.6; 1.75; 2.5	1-2	
Laddok FW	maize, sorghum	4.5; 4	1-2	

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical No. of Applica-tions per Year	% Crops Grown Treated with Pesticide
				Experts estimate!!
Maizina 500 SC	maize, sorghum, grape, apples, pears	2.2 1.75	1-2	
Maizina 80 WP	maize, sorghum, grape, apples, pears	1.4 1.1 1.4	1-2	
Maizina 90 WG	maize, sorghum	1.75; 1.0	1-2	
Primextra Gold 720 SC	maize, sorghum	3.5; 3.5	1-2	
Tazastomp SC	maize	4.5	1-2	
Titus AT	maize	1.7;	1-2	
Titus ATG	maize	1.04	1-2	
Tropazin	maize	4.0	1-2	
Tropazin Fultime CS	maize	5.0	1-2	
Copper containing products				
Champion 2 FL	vegetables, raspberry, grape; pome fruits, stone fruits, tree nuts, garden tree pome fruits (Erwinia amylovora)	2.5 1.9 2.6	1-4	Grape 60% Orchards 10%/ Potato 20% Others 1%
Champion 50 WP	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits (Erwinia amylovora)	2.5 3.5 3.5	1-4	
Funguran-OH 50 WP	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits Erwinia amylovora)	2.5 3.5	1-4	
Kocide 101	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits(Erwinia amylovora)	2.5 3.5	1-4	
Kocide 2000	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits(Erwinia amylovora)	2.75 1.8 2.75	1-4	
Kocide Combi	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits(Erwinia amylovora)	2.5 3.5	1-4	

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical No. of Applica-tions per Year**	**% Crops Grown Treated with Pesticide**
				Experts estimate!!
Kocide DF	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits(Erwinia amylovora)	2.5 3.5	1-4	
Rézkénpor	grape, pome fruits	8.0	1-4	
Vegesol eReS	grape, cucumber, pome fruits, peach, raspberries, gooseberries, currants	4.5 4 5	1-4	
Vegesol R	grape, pome fruits, peach, gooseberries, currants pepper	2.5 3 4	1-4	
Vitra Rézhidroxid	vegetables, raspberries, grape; pome fruits, stone fruits, tree nuts, garden tree sugar-beet pome fruits (Erwinia amylovora)	2.5 3.5	1-4	
Astra Rézoxiklorid	grape; pome fruits, stone fruits, berries, tree nuts, garden tree, tomato, cucumber, onion, potato, sugar-beet pome fruits (Erwinia amylovora) green pepper, bean, peas	2.5 3.5 2.0	1-4	Grape 60% Orchards 10% Vegetables 9% Potato 20% Others 1%
Axanit Cu 50 WP	onion, potato, tomato, grape	2.75	1-4	
Cuprosan 50 WP	grape; pome fruits, stone fruits, berries, tree nuts, garden tree, tomato, cucumber, onion, potato, sugar-beet pome fruits (Erwinia amylovora) green pepper, bean, peas cumin bitter-sweet	2.5 6.0 2.0 3.0 4.75	1-4	
Cuprosan Super D	grape; pome fruits, stone fruits, tree nuts, berries bitter-sweet, marjoram poppy seed	4,25 4,75 4,25	1-4	
Cursate R	cucumber, tomato, Soya bean, peas, hop grape, onion tomato	2.75 3.0 2.25	1-4	
Fixpol	grapes, garden tree, fruit trees	-	1-4	
Forum R	potato, tomato, cucumber, onion, grape	3.25	1-4	
Galben R	onion, cucumber, garden trees, tomato grape potato	3.0 4.5 2.5	1-4	

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical No. of Applica-tions per Year**	**% Crops Grown Treated with Pesticide**
				Experts estimate!!
Kupfer Fusilan WG	cucumber, grape, onion Soya bean, peas, potato tomato	2.75 2.5 2.0	1-4	Grape 60% Orchards 10% Vegetables 9% Potato 20% Others 1%
Kupfer-Phaltan	grape	2,5	1-4	
Kusor 450 FW	grape	3,0	1-4	
Mikal C 64 WP	grape, cucumber, onion, peas, tomato, Soya bean hop potato	3.5 6.0 4.5	1-4	
Miltox Speciál	pome fruits, stone fruit, grapes, vegetables, tomato, green pepper, cucumber, potato raspberry, currants medicinal plants, marjoram, bitter-sweet poppy seed grenadine	0.4 0.35 0.5 0.42 0.35	1-4	
Perotox WP	grape, pome fruits, stone fruit, berries, potato, vegetables poppy seed hop bitter-sweet, marjoram, grenadine	4.0 4.25 4.75 5.0 3.5	1-4	
Pluto 50 WP	pome fruits(Erwinia amylovora) pome fruits, stone fruit, berries, tree nuts, cucurbits, tomato, onion, potato, sugar-beet grape green pepper, beans, peas	3.5 2.5 4.75 2.0	1-4	
Rézkén 650 FW	grape, cucumber, apiaceous apple peach	4.5 4.25 5.0	1-4	
Rézkol 400 FW	fruit trees, raspberry, vegetables, green pepper, tomato, cucumber, legumes, grape	2.75	1-4	
Rézoxichlorid 50 WP	grape, cucurbits, potato, sugar-beet, apple, pear, stone fruit, berries, tree nuts, tomato, onion cumin bitter-sweet, cucumber, green pepper, bean, peas pome fruits (Erwinia amylovora)	2.5 3.0 4.75 0.45 2.0 6.0	1-4	Grape 60% Orchards 10% Vegetables 9% Potato 20%

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical No. of Applica-tions per Year**	**% Crops Grown Treated with Pesticide**
				Experts estimate!!
Rézoxichlorid 50 WP (Agrospec)	grape, cucurbits, potato, pome fruits, stone fruit, berries, tree nuts, tomato, onion, sugar-beet cumin bitter-sweet, green pepper, bean, peas pome fruits (Erwinia amylovora)	2.5 3.0 4.75 2.0 6.0	1-4	Others 1%
Rézoxichlorid 50 WP (Alboria)	grape, cucurbits, potato, pome fruits, stone fruit, berries, tree nuts, tomato, onion, sugar-beet, raspberry cumin bitter-sweet, green pepper, bean, peas pome fruits (Erwinia amylovora)	2.5 3.0 4.75 2.0 6.0	1-4	
Ridomil Gold Plus 42,5 WP	Soya bean, peas, onion, tomato, potato grapes hop	4.0 3.75 5.0	1-4	
Zetanil R	grapes	3.0	1-4	
Bordói Por Bordoeaux	grape; pome fruits, stone fruits, berries, tree nuts, tomato, cucumber, onion, potato, sugar-beet green pepper, legumes	1 %	1-4	Grape 80% Orchards 15% Others 5%
Bordóilé+Kén FW	winter-wheat, -barley, sugar-beet, potato grape, apple fruit tree cucumber, tomato, green pepper	6.0 10.0 10.0 11.0 9.0 8.0	1-4	
Bordóilé FW	grape pome fruits potato cucumber, bean, peas, green pepper, tomato	9.5 10.0 9.0 0.75	1-4	
Bordómix DG	tomato, green pepper, potato, cucurbits, bean, peas, sugar-beet, grape peach, plums, sour cherry, cherry, apricots, pome fruits	4.5 5.0	1-4	

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical No. of Applica-tions per Year	% Crops Grown Treated with Pesticide
				Experts estimate!!
Cupertine F	pome fruits (Erwinia amylovora) pome fruits peach, plums, sour cherry, cherry, apricots peach, plums, sour cherry, cherry, apricots, grapes, tomato, onion, cucumber, potato	5.0 4.5 10.0 2.5	1-4	
Cupertine M	pome fruits (Erwinia amylovora) pome fruits peach, plums, sour cherry, cherry, apricots grapes, tomato, onion, bean, peas, cucumber, potato	5.0 4.5 10.0 4.5	1-4	
Cuprofix 30 DG	grapes, raspberry, potato, sugar-beet, tomato, green pepper, cucurbits, bean, peas, onion Peach, plum, sour cherry, apricot, cherry, pome fruits, tree nuts	3.5 4.0	1-4	
Cuproxat FW	grapes potato, sugar-beet, tomato, green pepper, cucurbits, bean, peas, onion, pome fruits pome fruits (Erwinia amylovora)	4.0 4.5 5.0	1-4	Grape 80% Orchards 15% Others 5%
Rézgálic	stone fruit, pome fruits, grapes potato vegetables	10.0 12.5 1.25 3.75	1-4	
Rézgálic (Almalszkij)	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	
Rézgálic (Blue Stone)	stone fruit, pome fruits, grapes potato vegetables	10.0 12.5 1.75 3.75	1-4	
Rézgálic (Kék Kő)	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	
Rézgálic (Kistim)	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	
Rézgálic (Zorka)	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	Grape 80%

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical No. of Applica-tions per Year	% Crops Grown Treated with Pesticide
				Experts estimate!!
Rézgálic 98	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	Orchards 15% Others 5%
Scarmagnan Rézgálic	stone fruit, pome fruits grapes potato vegetables, cucumber, bean, peas, green pepper, tomato	10.0 12.5 1.75 3.75	1-4	
Chlorpyrifos containing products				
Cyren EC	pome fruits grapes maize, sugar-beet, sunflower empty store	1.75 1.0 2.0 0.85	1-3	Orchards 30% Grape 25% Arable crops 40% Others 5%
Diabro CS	maize	1.75		
Dursban 480 EC	cereals, sugar-beet maize, sugar-beet(soil pests-spraying) maize, sugar-beet (soil pests line treatment)	1.5 5.5 .0	1-2 1 1	
Nurelle-D 50/500 EC	sugar-beet potato peas, cereals apple pear oil rape	1.5 1.0 0.5 0.9 1.42 0.6	1-3	
Pyrinex 25 CS	pome fruits grapes	2.5 1.5	2-3	Orchards 30% Grape 25% Arable crops 40% Others 5%
Pyrinex 48 EC	maize cereals sunflower sugar-beet pome fruits grapes	2.0-5.0 1.5 2.0-5.0 1.5-5.0 2.0 1.5	1-3	
Diuron containing products				
Diuron 600 FW	pome fruits, grapes alfalfa non cultivated area	4.01 4.5 7.0	1	
Lucenit 80 WP	alfalfa sainfair raspberry hops gooseberries	1.5-7.0 1.5-3.0 2.0 3.5 1.0	1	Alfalfa 80% Orchards 10% Others 10%
Nikesuper Combi 600 FW	pome fruits non cultivated area	6.01 7.0	1	
Nikesuper Combi 80 WP	pome fruits, grape non cultivated area	5.0 6.0	1	
Endosulfan containing products				

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical No. of Applica-tions per Year	% Crops Grown Treated with Pesticide
				Experts estimate!!
Thiodan 35 EC	potato sugar-beet oil rape, alfalfa, cereals pome fruits, berries strawberry, grapes vegetables	0.8 1.01 1.2 1.25 1.0	1-2	Alfalfa 80% Orchards 10% Others 10%
Thionex 35 EC	potato sugar-beet oil rape, alfalfa, cereals, tobacco, pome fruits, berries strawberry, grapes maize	0.8 1.01 1.2 1.6 1.25 2.0	1-2	
Thionex 50 WP	alfalfa strawberry, raspberry, garden trees sugar-beet	1.5 0.9 5.0	1-2	
Malathion containing products				
Buvatox 5 G	vegetables garden-trees maize	30; 2.25 2.25 35	1	Orchards 30% Vegetables 25% Arable crops 25% Grape 19% Others 1%
Evershield CM	maize	1.0	1	
Fyfanon EW	stone fruit, cucurbits, cabbage, peas, green pepper, tomato grapes oil rape, mustard sunflower garden-tree, empty store currant, gooseberries	1.5 1.25 1.2 1.25 0.15 1.0	1-3	
Galition 5 G	garden-tree, pepper, maize, cabbage, legumes	35	1	
Isoproturon containing products				
Affinity WG	winter wheat	2.25	1	Barley 80% wheat 20%
I.P. Flo	winter wheat, -barley	2.75	0	
IPU Stefes	winter wheat, barley	2.75	1	
Izoguard 75 WG	wheat, barley	1.8	1	
Izoguard 75 WP	winter wheat	3.5	1	
Maraton SC	winter wheat	3.0	1	
Protugan 50 SC	wheat, barley	2.75	1	
Trifluralin containing products				
Ipifluor 48 EC	sunflower, bean, green pepper, tomato, soya bean, mustard, bitter-sweet, carrot	1.70	1	Sunflower 50% Green pepper+ Tomato 25% Leguminosae 25%
Olitref 480 EC	green pepper, tomato sunflower, bean, soya bean, mustard, bitter-sweet, oil rape, oil radish	1.9 1.70	1	
Treflán 48 EC	green pepper, tomato sunflower, bean, soya bean, mustard, bitter-sweet, oil rape, oil radish	1.7	1	

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical No. of Applica-tions per Year**	**% Crops Grown Treated with Pesticide**
				Experts estimate!!
Triflurex 26 EC	tomato, green pepper, cabbage bean, sunflower bitter-sweet, mustard	3.5 3.4 5.25	1	
Triflurex 48 EC	green pepper, tomato sunflower, bean, soya bean, mustard, bitter-sweet, oil rape, oil radish carrot	1.7 1.5	1	
Zinc containing products				
Arvalin-LR	cultivated area outskirts living area	20-30 g/m^2 2-3 pellet/hole	1-2	

Annex 7

Pesticide Usage in Moldova

Annex 7: Pesticide Usage in Moldova

Pesticide usage in Moldova has dropped significantly since the mid 1980s. Reported usage in 1984 was about 38,400 tons and in 1989 about 11,200 tons. Table 28 shows that use in 2002 was about 2,600 tons.

While the total usage decreased between 2000 and 2002 from ca. 2,800 tons to ca. 2,600 tons the treated area rose from 563,000 ha to ca 715,100 ha. This is an increase of 27%. This could mean that farmers used reduced application rates, or that there were considerable reporting errors and/or illegal trade contributed to erroneous sales figures.

However, the 715,100 ha represent only 28% of the total 2.54 million ha total agricultural land.

The State Inspectorate for Plant Protection of the Ministry of Agriculture and the Food Industry estimated the quantity of priority pesticides which were used by farmers in the 2000 – 2002 period.

Table 31 shows the use of priority pesticides in kg or litre active ingredient in the years 2000 – 2002. The data clearly indicate an increasing usage of synthetic pesticides and a decline in the use of copper. Use of priority pesticides, however account for almost the half of the total pesticide use.

The detailed results can be found in Table 33 at the end of the Annex.

Table 31: Pesticides Use (active ingredient) in Moldova 2000-2002

	2000			**2001**			**2002**		
Use Type	**Tons Applied**	**Treated Area (ha)**	**kg/ha**	**Tons Applied**	**Treated Area (ha)**	**kg/ha**	**Tons Applied**	**Treated Area (ha)**	**kg/ha**
Fungicides	2,352	341,900	6.88	2,343	418,342	5.60	2,001	390,656	5.12
Insecticides	248	162,200	1.53	225	201,419	1.11	239	209,091	1.14
Herbicides	134	58,900	2.28	171	64,540	2.65	224	115,352	1.94
Total	2,872	563,000	5.10	2,872	684,300	4.20	2,619	715,100	3.66

Table 32: Use of Priority Pesticides in Moldova 2000-2002

	Use in kg or litre active ingredient		
Pesticide	**2000**	**2001**	**2002**
Atrazine	-	-	-
2,4-D	30,229	35,716	39,772
Chlorpyrifos	238	4,413	7,608
Copper hydroxide	-	-	20,983
Copper oxychloride	54,969	66,941	45,159
Copper sulphate	1,629,790	1,546,588	1,129,530
Malathion	-	-	4,526
Trifluralin	300	125	3,560
Total	1,715,526	1,653,783	1,251,138

Estimations on the use density (see Table 33) suggest that only a small percentage of the crops are sprayed. The given estimations are, however hard to interpret, because one farmer may use different products on the same field over the season.

Problems Associated with Pesticide Use

Problems associated with pesticide use were generally described as:

- Cleaning of spray equipment in the environment, near or in ponds and rivers
- Poor storage of pesticides

- Spray drift problems due to the use of old spraying equipment, and
- Application too closely to water sources, especially in case of field vegetable treatment.
- Stocks of obsolete pesticides are a major thread to ground and surface waters in Moldova, approximately 6.000 tons obsolete pesticide are stored in various location in Moldova

Table 33 : Pesticide Registration and the Percentage Treated Crops in Moldova

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year	% Crops Grown Treated with Pesticide
2,4-D containing products				
Buctril D	Wheat, barley, maize	1.25 – 1.5 litres formulated product per ha according to crop	1	Currently only 0.5-1.5%
2,4-D “BASF”	Wheat, barley, maize	1.2 – 2 litres formulated product per ha	1	Currently only 4- 6%
Dezormone	Wheat, barley, maize	0.7–1.5 litres formulated product per ha	1	Currently only 0.01%
Dialen	Wheat, barley, maize	1.5 – 2 litres formulated product per ha	1	Currently only 1-2%
Dialen Super SC	Wheat, barley, maize	0.5-1.5 litres formulated product per ha	1	Currently only 5%
Dicopur F 60	Wheat, barley, maize	0.7-1.2 litres formulated product per ha	1	Currently only 1-2%
Pilar	Wheat, maize	0.8 – 1.25 litres formulated product per ha	1	Currently only 0.1%
SDMA-6	Wheat	1.2 litres formulated product per ha	1	Currently only 1%
Valsamin 720	Wheat, barley	1 - 1.4 litres formulated product per ha	1	Currently only 2%
Atrazine containing products				
Laddok	Maize	3 – 4 litres formulated product per ha	1	Currently not treated
Lentagran-combi	Maize	3.5 –5 litres formulated product per ha	1	Currently not treated
Copper containing products				
Champion WP	Vineyards	3 kg formulated product per ha	4	Currently only 3-5%
Kocide 2000	Fruit trees, vineyards	2 – 3 kg formulated product per ha	2 - 4	Currently only 3%
Copper oxychloride WP	Fruit trees, vineyards, potatoes, field vegetables	3 – 6 kg formulated product per ha	2 - 4	Currently only 5-7%
Oxihom WP	Vineyards, potatoes, field and glasshouse vegetables	1.9 - 2.1 kg formulated product per ha	3 - 4	Currently only 5-7%
Bouillie Bordelaise	Fruit trees, vineyards, field and glasshouse vegetables	5 – 10 kg formulated product per ha	2 - 5	Currently only 1-9%
Copper sulphate (basic)	Fruit trees, vineyards, potatoes, field and glasshouse vegetables	3 – 20 kg formulated product per ha	2 - 6	Currently only 20 – 30%
Cuproxat SC	Fruit trees, vineyards, tobacco	3 – 7 kg formulated product per ha	2 - 6	Currently only 8-16%

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year	% Crops Grown Treated with Pesticide
Chlorpyrifos containing products				
Cipi Plus EC	Fruit trees	0.7 litres formulated product per ha	2	Currently only 4%
Dursban E-48	Sugar beet, fruit trees	0.8–2.5 litres formulated product per ha		Currently only 4-7%
Nurelle D 50/500 EC	Fruit trees	0.5- 0.7 litres formulated product per ha	3	Currently only 7-10%
Phenomen 530 EC	Fruit trees	1.0 litre formulated product per ha	2 - 3	Currently only 0.5%
Pyrinex 48 EC	Fruit trees	2 – 2.5 litres formulated product per ha	2	Currently only 0.1 – 1%
Pyrinex 250 ME	Sugar beet, fruit trees	3.5 – 4 litres formulated product per ha		Currently only 1%
Fufanon 570 EC	Fruit trees	1 – 2 litres formulated product per ha	3 - 4	Currently only 8%
Trifluralin Tcontaining products				
Treflan	Sunflower, tobacco, field vegetables	2 – 4 litres formulated product per ha	1	Currently only 1.5%
Triflurex	Sunflower, tobacco, field vegetables	1.5 – 4 litres formulated product per ha	1	Currently only 0.3%

Table 34: Amounts of Pesticide Products Sold in Moldova 2000 - 2002

Pesticide	Product Name	% Active ingredient	Amounts Use per Year in Moldova
2,4-D	Buctril D	22.5%	5,810 litres (2000) 10,180 litres (2001) 4,005 litres (2002)
2,4-D	2,4-D “BASF”	50%	50,950 litres (2000) 45,340 litres (2001) 38,760 litres (2002)
2,4-D	Dezormone	72%	70 litres (2002)
2,4-D	Dialen	36%	3,840 litres (2000) 16,460 litres (2002)
2,4-D	Dialen Super SC	29%	22,290 litres (2001)
2,4-D	Dicopur F 60	60%	3,440 litres (2000) 8,050 litres (2001) 4,970 litres (2002)
2,4-D	Pilar	72%	420 litres (2002)
2,4-D	SDMA-6	60%	5,450 litres (2002)
2,4-D	Valsamin 720	72%	8,920 litres (2002)
Atrazine	Laddok	20%	0.0
Atrazine	Lentagran-combi	15%	0.0
Copper carbonate, basic			
Copper hydroxide - $Cu(OH)_2$	Champion WP	77%	13,650 kg (2001) 21,600 kg (2002)
Copper hydroxide	Kocide 2000	35%	12,430 kg (2002)
Copper oxychloride – $Cu_2 Cl(OH)_3$	Copper oxychloride WP	90%	53,310 kg (2000) 51,280 kg (2001) 38,460 kg (2002)

Copper oxychloride	Oxihom WP	66,7%	10,480 kg (2000) 15,410 kg (2001) 15,810 kg (2002)
Copper sulphate (basic) – $CuSO_4$ $5H_2O$	Bouillie Bordelaise	26,4%	8,100 kg (2001) 69,770 kg (2002)
Copper sulphate (basic)	Copper sulphate (basic)		1,607,500 kg (2000) 1,511,450 kg (2001) 1,066,690 kg (2002)
Copper sulphate (basic)	Cuproxat SC	34,5%	64,610 kg (2000) 95,650 kg (2001) 128,755 kg (2002)
Chlorpyrifos	Cipi Plus EC	48%	100 litres (2001) 2,660 litres (2002)
Chlorpyrifos	Dursban E-48	48%	240 litres (2000) 3,490 litres (2001) 5,430 litres (2002)
Chlorpyrifos	Nurelle D 50/500 EC	50%	0,030 litres (2000) 3,940 litres (2001) 6,200 litres (2002)
Chlorpyrifos	Phenomen 530 EC	48%	370 litres (2002)
Chlorpyrifos	Pyrinex 48 EC	48%	224 litres (2000) 1,500 litres (2001)
Chlorpyrifos	Pyrinex 250 ME	25%	1,790 litres (2002)
Malathion	Fufanon 570 EC	57%	7,940 litres (2002)
Trifluralin	Treflan	24%	1,250 litres (2000) 400 litres (2001) 14,335 litres (2002)
Trifluralin	Triflurex	24%	120 litres (2001) 500 litres (2002)

Annex 8

Pesticide Usage in Romania

Annex 8: Pesticide Usage in Romania

There are no detailed pesticide use data in Romania. The percentage of the crop treated by individual crop was estimated as follows:

2,4-D: In 2001, 35-40 % from the cereal crops were treated with 2,4 D products.

Alachlor: 20-30 % of the crops are treated with Alachlor.

Atrazine: 25-30 % of the maize crops.

Cooper hydroxide: 5-10 % of the fruit trees crops, 15-20 % of vegetables crops.

Cooper oxychlorides: 60-70 % of the vineyards, 30-35 % of the vegetables crops.

Chlorpyrifos: 15-20 % of the cereal crops and 10-15 % of fruit trees.

Diuron: 1-5 % vineyard and fruit trees

Lindane: 60-70 % of seed of cereal crops are treated with a lindane product.

Endosulfan: 7-10 % of vineyard and fruit trees area

Malathion: 5-10 % of fruit trees

Isoproturon: 1-3 % of the wheat and barley crops

Simazine: 3-5 % of the fruit trees and vineyards

Trifluralin: 60-70 % of sunflower crops and vegetables

Registration data for products containing priority pesticides and information on the treated area by crop can be found in Table 36 and Table 37.

Problems Associated with Pesticide Use

- Affecting the neighbouring crops due to pesticide application in unfavourable meteorological conditions, like wind stronger than 4 m/s. (e.g. 2,4-D).
- The pesticides which are not applied during the most favourable crop vegetation periods.
- Certain herbicides remain in the soil and affect post emergently crops (e.g. Atrazine).
- The use of some products out of the guarantee period (expired).
- The use of some larger doses of pesticides in order to increase their efficiency.
- The use of some pesticides from toxicity groups 2 and 3 for some crops, especially vegetable, close to running waters or lakes (e.g. Malathion).
- The use of some non-recommended pesticides, especially insecticides from toxicity groups 2 and 3, for vegetables crops (e.g. Lindane or Carbofuran).
- Lindane utilization for seeds or other crops treatments where it was prohibited. At present, the products containing Lindane are accepted in Romania only for wheat and barley seeds treatments, very efficient in wireworms (Agriotes SPP).
- The pesticides applied by non-instructed persons in this field.
- The cleaning of the pesticide equipments in lakes and running waters.

Table 35 shows that a large percentage of the agricultural land is limited by several factors. Drought, waterlogging, erosion and low content of nutrients/humus are major problems. 6.1% of the agricultural land is limited for agricultural production due to chemical pollution.

Especially organochlorine insecticides of DDT and HCH types seem to contribute to this soil pollution with chemicals. In Romania, they have been prohibited since 1985. However, their occurrence, but also their **illicit use in the last years**, determined their presence in soil at content levels higher than the allowable maximum limits. Research carried out in two vegetable growing areas emphasized the high contents in soil and ground water, as well as in vegetables.

For instance, the total HCH contents detected in the Vidra area reached values up to 41 times higher than Maximum Allowed Level (MAL), as the mean value in the two areas was only 1.4 times higher than MAL. The maximum values of the two HCH isomers (α-HCH and β-HCH) are over 70 times higher than MAL, and the mean values - over twice.

High contents of pesticide residues were also detected in the drinking water wells being 28 times higher than MAL in the Brăneşti-Islaz and over 3 times in the Vidra area[10].

Table 35: Limiting Factors for Agricultural Production

	Affected Agricultural Land Area	
Limiting Factor	Thousand ha	% of agricultural land area[11]
Drought	7,100	47.8
Temporary moisture excess (waterlogging)	3,781	25.4
Water soil erosion	6,300	42.4
Wind soil erosion	378	2.5
Excessive gravel at soil surface	300	2
Soil salinisation	614	4.1
Strong and moderate acidity	3,424	23
Strong alkalinity	223	1.5
Low to extremely low humus reserve	7,485	50.4
Low nitrogen supply	5,110	34.4
Low and very low mobile phosphorus supply	6,330	42.6
Low and very low mobile potassium supply	787	5.3
Deficiency of microelements (especially Zn)	1,500	10.1
Chemical pollution, of which:	900	6.1
Excessive pollution	200	1.3

10 Lăcătuşu R., Cârstea, S., Lung, M. (2001): Soil Quality - Guiding Factors of Food Quality, Research Institute for Soil Science and Agrochemistry, Bucharest, Romania

11 Agricultural land area of Romania on December 31, 2000 14.856.845 ha

Table 36: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D containing products			
2,4 D SARE DIMETILAMINA	Wheat , barley, maize	1	1
2,4 D SARE DMA 600	Wheat, maize	1	1
2,4 D DMA 810 SL	Wheat, barley	0.8-1	1
2,4 D SARE DE AMINE	Wheat, barley, maize	1.5-2	1
DICOPUR D	Wheat, maize	1	1
DICOPUR M	Wheat, barley	1	1
DMA 6	Wheat, maize	1	1
OLTEST	Maize, wheat	1.5	1
ICEDIN SUPER RV	Wheat, barley	1	1
ICEDIN SUPER	Wheat	1	1
LANCET	Maize, wheat	1-1.25	1
LANCET RV	Maize, wheat	1-1.5	1
LOTUS D	Wheat	0.6-1	1
LOGRAN D/RV	Wheat	1	1
MUSTANG	Wheat, barley	0.4-0.6	1
OLTIDIN SUPER	Wheat, barley, maize	1	1
OLTISAN M	Wheat, barley, maize	1	1
SANROM 375	Maize	1	1
WEEDMASTER	Wheat, barley, maize	0.9-1	1
Alachlor containing products			
ALANEX 48 EC	Maize, sunflower, soia	4-6	1
LACORN 48 EC	Maize	6-10	1
LASSO 48 CE RV	Maize, sunflower, soia	4-6	1
MECLORAN 35 CE	Maize, soia	8-14	1
MECLORAN 48 CE	Soia, sunflower, maize	4-10	1
AGROCHLOR	Maize	4-6	1
ALAZINE 33/14 SE	Maize	4-6	1
LACORN COMBI	Maize	6	1
Atrazine containing products			
ALANEX 48 EC	Maize, sunflower, soia	4-6	1
LACORN 48 EC	Maize	6-10	1
LASSO 48 CE RV	Maize, sunflower, soia	4-6	1
AGROCHLOR	Maize	4-6	1
ALAZINE 33/14 SE	Maize	4-6	1
LACORN COMBI	Maize	6	1
BUTIZIN 40 SC RV	Maize	6-10	1
BUTIZIN 60 SE	Maize	6-10	1
PRIMEXTRA GOLD	Maize	2-3.5	1
SANOLT COMBI	Maize	1-1.5	1
TAZASTOMP 500 WP	Maize	4-5	1
Copper containing products			
CHAMPION 50 WP	Fruit trees, vineyards, and	3	2
FUNGURAN OH 50 WP	Field vegetables	4	2
KOCIDE 101	Idem	4	1
SUPER CHAMP FL	Idem	3	1
OXICIG 50 PU	Vineyards and fields vegetables	6	1
TURDACUPRAL 50 PU	Idem	4	1
ALIETTE C	Fruit trees	5	1
CUPROZIR 50 PU	Vineyards and vegetable	2-4	2
CURZATE CUMAN	Idem	3.5	2
CURZATE MANOX	Idem		

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
CURZATE PLUS T	Idem	2.5-3	2
GALBEN M	Vineyards	2.5-3	1
MANCUVIT PU	Vineyards and vegetable	2	1
MICAL B		3	1
RIDOMIL GOLD PLUS 42,5		3	1
RIDOMIL PLUS 48 WP		2.5	2
BOILLIE BORDELAISE	Vineyards and fruit trees	5	1
CUPROFIX F		5	1
Chlorpyrifos containing products			
CHLOROFET 480 EC	Potatoes	1.5	1
DURSBAN 48 CE	Potatoes	1.5	1
DURSBAN 480 EC	tatoes, fruit trees	1.5-2	1
PILOT 480 EC	Vineyards, sugar beet	1.5	1
PYRINEX 20 EC	Potatoes	3	1
PYRINEX 48 EC	Fruit trees, vegetables	1.5	1
RELDAN 40 EC	Fruit trees	1	1
Diuron containing products			
VEGEPRON DS	Vineyards and fruit trees	6	1
Endosulfan containing products			
THIODAN 35 EC	Fruit trees vegetables	1.5	1
THIONEX ULV	Wheat ,barley, potatoes	2-3	1
THIONEX 35 EC	Glasshouse vegetables	1-2	1
THIONEX 50 WP		1.5	1
Lindane containing products			
LINDAN HC	Wheat, barley	1.35/t	1
LINDAN 400 SC	Wheat,barley	2.25/t	1
LORSBAN L 16 EC	Maize	5	1
SINOLINTOX 5 G	Vegetable	30	1
SUMIDAN	Wheat, barley	1.8/t	1
CHINODINTOX 55 PTS	Wheat	2.5/t	1
GAMAVIT	Wheat, barley	3/t	1
MASTERLIN	Wheat, barley	2/t	1
MICLODAN 50 PTS	Wheat	2.5/t	1
MICLODAN EXTRA 45 PTS	Wheat	2.5/t	1
MICLODAN EXTRA 45 PUS	Wheat, barley	2.5/t	1
PROCARB L	Wheat	3/t	1
PROTILIN AL 81 PUS	Wheat, barley	3/t	1
PROTILIN 81 PTS	Wheat	3/t	1
SUPERCARB T 585 SC	Wheat	3.75/t	1
SUPERCARB T 80 PSU	Wheat	3/t	1
TIRAMETOX 625 SC	Wheat	3.75/t	1
TIRAMETOX 90 PTS	Wheat	3.75/t	1
TRIALIN 50	Barley	2.5/t	1
TRIALIN MT	Wheat	2.5/t	1
VITALIN 85 PTS	Wheat, barley	3/t	1
Malation containing products			
CARBETOX 37 CE	Fruit trees, vegetables	3-4	1
CARBETOVUR 50 EC	Fruit trees	2	1
CARBETOX 50 CE	Fruit trees	3	1
ODORIZAT	Fruit trees	2	1
CARBETOX 50 CE	Fruit trees, vegetables	2-3	1
DIGRAIN STOCK	Storage products	4/100t	1
PROSTORE 157 UL	Storage products	4/100t	1
PROSTORE 210 EC	Storage products	12.5/1000m^2	1

Name of Product containing Active Ingredients	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical Number of Applications per Year**
PROSTORE 420 EC	Storage products	10/1000m^2	1
SINTOGRIL 5 G	Vegetables	30	1
Isoproturon containing products			
ARELON 75 WP	Wheat	3	1
ISOFLO 500 SC	Wheat	3-5	1
IZOGUARD 500 SC	Wheat, barley	5	1
TURONEX 500 SC	Wheat	3-5	1
Simazine containing products			
SIMADON 50 PU	Fruit trees	8-10	1
SIMANEX 50 SC	Fruit trees, vegetables	3.5	1
SIMANEX 50 WP	Fruit trees	4.5	1
SIMANEX 80 WP	Fruit trees, vineyards	6-8	1
Trifluralin containing products			
DIGERMIN 24 EC	Vegetables	3.5-5	1
EFLURIN 24 EC	Sunflower	3.5-5	1
EFLURIN 48 EC	Sunflower	2	1
TREFLAN 24 EC	Vegetables,Sunflower	3.5-5	1
TREFLAN 24 CE	Vegetables, Sunflower	3.5-5	1
TREFLAN 48 CE	Soia, Sunflower	1.5-2	1
TREFLAN 48 EC	Sunflower, soia	1.75-2.5	1
TRIFLUREX 24 CE	Soia	3.5-5	1
TRIFLUREX 48 CE	Soia, sunflower	1.75-2.5	1
TRIFLUREX 48 EC	Sunflower, vegetable	1.75-2.5	1
TRIFLUROM 24 CE	Sunflower, soia	3.5-4	1
TRIFLUROM 48 CE	Soia, sunflower	1.75-2.5	1
TRIFSAN 480 EC	Sunflower, vegetable	1.75-2.5	1

Table 37: With Priority Pesticides Treated Areas by Crop in 2001 in Romania

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
2,4-D containing products		
2,4 D SARE DIMETILAMINA tip 600	50	
2,4 D SARE DMA 600		In 2001, 35-40 % from the cereal crops were treated with 2,4 D products.
2,4 D DMA 810 SL	60	
2,4 D SARE DE AMINE	67.5	
DICOPUR D	33	
DICOPUR M	60	
DMA 6	75	
OLTEST	66	
ICEDIN SUPER RV	50	
ICEDIN SUPER	30	
LANCET	28	
LANCET RV	45	
LOTUS D	45	
LOGRAN D/RV	42	
MUSTANG	59.6	
OLTIDIN SUPER	30	
OLTISAN M	30	
SANROM 375	32.5	
WEEDMASTER	10	
	33.4	
Alachlor containing products		
ALANEX 48 EC	48	Currently, only 20-30 % of the crops.
LACORN 48 EC	48	
LASSO 48 CE RV	48	
MECLORAN 35 CE	35	
MECLORAN 48 CE	48	
AGROCHLOR	33.6	
ALAZINE 33/14 SE	33.6	
LACORN COMBI	33.6	
Atrazine containing products	-	
ALANEX 48 EC	48	25-30 % of the maize crops.
LACORN 48 EC	48	
LASSO 48 CE RV	48	
AGROCHLOR	14.4	
ALAZINE 33/14 SE	14.4	
LACORN COMBI	14.4	
BUTIZIN 40 SC RV	20	
BUTIZIN 60 SE	20	
PRIMEXTRA GOLD	32	
SANOLT COMBI	10	
TAZASTOMP 500 WP	20	
Copper containing products	-	-
CHAMPION 50 WP	50	5-10 % of the fruit trees crops with a Cooper hydroxide
FUNGURAN OH 50 WP	50	
KOCIDE 101	50	15-20 % of vegetables crops with Cooper hydroxide
SUPER CHAMP FL	25	
OXICIG 50 PU	50	60-70 % of the vineyard crops with a Cooper oxychlorides
TURDACUPRAL 50 PU	50	
ALIETTE C	25	30-35 % of the vegetables crop with a Cooper oxychloride products
CUPROZIR 50 PU	34	
CURZATE CUMAN	19.3	
CURZATE MANOX	50	
CURZATE PLUS T	40	
GALBEN M	33	
MANCUVIT PU	46	

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
MICAL B	25	
RIDOMIL GOLD PLUS 42,5	40	
RIDOMIL PLUS 48 WP	40	
BOILLIE BORDELAISE	20	5-10 % of the fruit trees crops
CUPROFIX F	12	3-5 % of the vegetables crops
Chlorpyrifos containing products	-	-
CHLOROFET 480 EC	48	15-20 % of the cereal crops and 10-15 % of fruit trees area
DURSBAN 48 CE	48	
DURSBAN 480 EC	48	
PILOT 480 EC	48	
PYRINEX 20 EC	20	
PYRINEX 48 EC	48	
RELDAN 40 EC	40	
RELDAN 50 EC	50	
Diuron containing products	-	-
VEGEPRON DS	16.5	1-5 % vineyard and fruit trees
Endosulfan containing products		
THIODAN 35 EC	35	7-10 % of vineyard and fruit trees area
THIONEX ULV	25	
THIONEX 35 EC	35	
THIONEX 50 WP	50	
Lindane containing products		
LINDAN HC	66.6	60-70 % of seed of cereal crops are treated with a lindane products
LINDAN 400 SC	40	
LORSBAN L 16 EC	16	
SINOLINTOX 5 G	5	
SUMIDAN	50	
CHINODINTOX 55 PTS	40	
GAMAVIT	35	
MASTERLIN	50	
MICLODAN 50 PTS	40	
MICLODAN EXTRA 45 PTS	40	
MICLODAN EXTRA 45 PUS	40	
PROCARB L	33	
PROTILIN AL 81 PUS	35	
PROTILIN 81 PTS	35	
SUPERCARB T 585 SC	25	
SUPERCARB T 80 PSU	35	
TIRAMETOX 625 SC	25	
TIRAMETOX 90 PTS	35	
TRIALIN 50	40	
TRIALIN MT	40	
VITALIN 85 PTS	35	
Malathion containing products	-	
CARBETOX 37 CE	37	5-10 % of fruit trees
CARBETOVUR 50 EC	50	
CARBETOX 50 CE ODORIZAT	50	
CARBETOX 50 CE	50	
DIGRAIN STOCK	50	
PROSTORE 157 UL	20	
PROSTORE 210 EC	15	
PROSTORE 420 EC	20	
SINTOGRIL 5 G	40	
	0.3	
Isoproturon containing products		
ARELON 75 WP	75	1-3 % of the wheat and barley crops

Name of Formulated Product containing AI	% AI contained in Product	Treated Area (Estimate)
ISOFLO 500 SC IZOGUARD 500 SC TURONEX 500 SC	50 50 50	
Simazine containing products	-	-
SIMADON 50 PU SIMANEX 50 SC SIMANEX 50 WP SIMANEX 80 WP	50 50 50 80	3-5 % of the fruit trees and vineyards
Trifluralin containing products		
DIGERMIN 24 EC EFLURIN 24 EC EFLURIN 48 EC TREFLAN 24 EC TREFLAN 24 CE TREFLAN 48 CE TREFLAN 48 EC TRIFLUREX 24 CE TRIFLUREX 48 CE TRIFLUREX 48 EC TRIFLUROM 24 CE TRIFLUROM 48 CE TRIFSAN 480 EC	24 24 48 24 24 48 48 24 48 48 24 48 48	60-70 % of sunflower crops and vegetables

Annex 9

Pesticide Usage in Serbia & Montenegro

Annex 9: Pesticide Usage in Serbia & Montenegro

The sales data provided by the national experts are summarised in Table 38. These data show that copper is the priority pesticide with the highest use in Serbia & Montenegro.

More detailed use information was not available. Registration data and amounts sold by product can be found in Table 39.

Table 38: Amounts of Priority Pesticides Sold in 2002 in Serbia & Montenegro

Pesticide	Sold amounts in kg (active ingredient)	Sold amounts in kg (product)
Copper oxychloride	162,500	
Malathion	123,600	
Atrazine	114,850	
Trifluralin	96,000	
Copper hydroxide	10,000	
Simazine	10,000	
Endosulfan	7,000	
Chlorpyrifos		80,000
Zinc phosphide		50,000

Problems Associated with Pesticide Use

Regarding problems associated with pesticide use following information was given:

2,4-D: Farmers don’t respect time of application given in instructions, they apply pesticides after deadline given in instructions.

Atrazine: Farmers apply higher dosage than the proposed one, even 2-3 times higher in some cases. They do not respect proposed time of application, they apply pesticides later than it is proposed.

Trifluralin: Farmer use pesticide in production of early vegetables: (root vegetables, tuberous vegetables, bulbiferous vegetables). There is restriction because of the crop rotation.

Pesticides in general: Very often farmers don’t respect time of application given in instructions and they apply pesticides later than it is proposed. They apply higher dosage than it is proposed in instruction. This common bad practice among farmers is due to insufficient skill and education concerning pesticides application.

Table 39: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides, Percentage Treated Crops and Amounts Sold in Serbia & Montenegro

<table>
<tr><th>Name of Formulated Product containing AI</th><th>AI contained in Product</th><th>National Sales (kg or lres) of Formulated (2002)</th></tr>
<tr><td colspan="3">2,4-D containing products</td></tr>
<tr><td>DIKAMIN-600</td><td>600 g/l</td><td rowspan="15">1,000,000 kg</td></tr>
<tr><td>HERBOXONE</td><td>500 g/l</td></tr>
<tr><td>DEHERBAN-A</td><td rowspan="11">464 g/l</td></tr>
<tr><td>AGROSAN</td></tr>
<tr><td>DIKOCID</td></tr>
<tr><td>DIHLORIN</td></tr>
<tr><td>HERBISAN</td></tr>
<tr><td>HERBIZOR</td></tr>
<tr><td>KOROVICID</td></tr>
<tr><td>MONOSAN HERBI</td></tr>
<tr><td>MONOZOR SL-50</td></tr>
<tr><td>POLJOSAN 2,4-D</td></tr>
<tr><td>TIMKOR</td></tr>
<tr><td>MATON</td><td>600 g/l</td></tr>
<tr><td>HERBITON</td><td>600 g/l</td></tr>
<tr><td>ESTERON</td><td>564 g/l</td><td>20,000 l</td></tr>
<tr><td>LENTEMUL-D</td><td>449,5 g/l</td><td>17,600 l</td></tr>
<tr><td>LANCET (2,4-D + FLUROKSIPIR-BUTOKSIPROPIL)</td><td>450g/l</td><td>-</td></tr>
<tr><td>MUSTANG (2,4-D+ FLORASULAM)</td><td>300g/l</td><td>6,000 l</td></tr>
<tr><td colspan="3">Alachlor containing products</td></tr>
<tr><td>AGROHLOR 480-EC</td><td rowspan="11">480 g/l</td><td rowspan="11">80,000 tons</td></tr>
<tr><td>ALAHERB EC-48</td></tr>
<tr><td>ALAHLOR-48</td></tr>
<tr><td>ALAHLOR-480</td></tr>
<tr><td>ALAHLOR E-48</td></tr>
<tr><td>ALAHLOR-EC</td></tr>
<tr><td>ALAHLOR 48-EC</td></tr>
<tr><td>ALAHLOR EC-48</td></tr>
<tr><td>ALANEX 48-EC</td></tr>
<tr><td>SAVAHLOR</td></tr>
<tr><td>ZORAL 48-EC</td></tr>
</table>

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
Alachlor & Atrazine containing products		
ALAZINE-LM	336+144 g/l	-
ALAHLOR-ATRAZIN KS	336+144 g/l	50,000 l
LINUCHLOR 367-EC		
ALAHOR KOMBI	262+105 g/l	90,000 l
Alachlor & Linuron containing products		
GALOLIN KOMBI		
LIRON KOMBI		
LASSO LINURON	300+100 g/l	
ATRAZIN S-50		
ATRAZIN-500		
ATRAZIN-SC		200,000 tons
ATRAZIN SC-50		
ATRAZIN-TS ZUPA	500 g/l	
Atrazine containing products		
ATRAZOR 500-SC		
RADAZIN T-50		4,600 l
ATRANEX 50-SC		-
ATRANEX 80-WP	800 g/l	-
GESAPRIM 90-WG	900 g/l	-
ATRANEX 90-WDG	900 g/l	33,300 l
Atrazine, Amthrin & Amitrol containing products		
ZORAMAT S-47	270+120+80 g/kg	
ATPROM-500		33,000 kg
ATRAPROM	340+160 g/l	
Atrazine & Prometryne containing products		
INAKOR		
INACOR-T		4,000 l
Copper carbonate containing products		
SEMESAN PRAH	200 g/kg	
SEMESAN PASTA		
BAKAR BLAU WP-50		-
BLAUVIT	500 g/l	20,000 l
FUNGURAN-OH		-

<table>
<tr><th>Name of Formulated Product containing AI</th><th>AI contained in Product</th><th>National Sales (kg or lres) of Formulated (2002)</th></tr>
<tr><td colspan="3">Copper hydroxide containing products</td></tr>
<tr><td>SAMPION</td><td>250 g/l</td><td rowspan="4">-
-</td></tr>
<tr><td>BLAUVIT TECNI</td><td>240 g/l</td></tr>
<tr><td>KOCIDE-2000</td><td>538 g/l</td></tr>
<tr><td>CUPRABLAU-Z</td><td>350 g/l</td></tr>
<tr><td colspan="3">Copper oxychloride containing products</td></tr>
<tr><td>BAKARNI KREC-25</td><td rowspan="3">250 g/kg</td><td rowspan="3"></td></tr>
<tr><td>BAKARNI OKSIHLORID-25</td></tr>
<tr><td>BAKROCID S-25</td></tr>
<tr><td>BAKARNI KREC-50</td><td rowspan="5">500 g/kg</td><td rowspan="5">280,000 kg</td></tr>
<tr><td>BAKROCID-50</td></tr>
<tr><td>BAKARNI OKSIHLORID-50</td></tr>
<tr><td>BORSKI BAKARNI KREC S-50</td></tr>
<tr><td>BEVEBLAU KREC</td></tr>
<tr><td>CURZATE R-WG (Copper oxychloride + Cimoksanil)</td><td>397,5+42 g/kg</td><td>40,000 kg</td></tr>
<tr><td>TIOZIN-A (Copper oxychloride + Zineb)</td><td>360+140 g/kg</td><td></td></tr>
<tr><td>BAKARNI KREC SUPER (Copper oxychloride + Cimoksanil)</td><td></td><td></td></tr>
<tr><td>BEVEBLAU SUPER (Copper oxychloride + Zineb)</td><td>330+90 g/kg</td><td>-</td></tr>
<tr><td>BAKARNI EKSTRA KREC (Copper oxychloride + Zinc carbonate)</td><td>330+90 g/l</td><td>20,000 kg</td></tr>
<tr><td colspan="3">Copper sulphate (basic) containing products</td></tr>
<tr><td>CUPROXAT</td><td>190 g/l</td><td></td></tr>
<tr><td colspan="3">Chlorpyrifos containing products</td></tr>
<tr><td>PIRICID</td><td rowspan="2">480g/l</td><td></td></tr>
<tr><td>PYRINEX 48-EC</td><td>80,000 l</td></tr>
<tr><td>CHROMOREL-D</td><td>18 g/kg</td><td></td></tr>
<tr><td>CHROMOREL P-2</td><td></td><td></td></tr>
<tr><td>HLORPIRIFOS G-7,5</td><td>75 g/kg</td><td></td></tr>
<tr><td>PIRICID G-7,5</td><td></td><td></td></tr>
<tr><td colspan="3">Endosulfan containing products</td></tr>
<tr><td>BEVETICID</td><td rowspan="4">350 g/l</td><td rowspan="4">20,000 l</td></tr>
<tr><td>TIOCID E-35</td></tr>
<tr><td>THIODAN E-35</td></tr>
<tr><td>TIONEX E-35</td></tr>
</table>

Name of Formulated Product containing AI	AI contained in Product	National Sales (kg or lres) of Formulated (2002)
Malathion containing products		
DASTICID PRAH	50 g/kg	
ETIOL PRAH-5		2,000 kg of FP
ETIOL TECNI	500 g/l	
INSEKTIN		2,000 kg
MALATION E-50		150,000 l
ETIOL -ULV		
INSEKTIN-ULV		
MALATION-ULV	950 g/l	50,000 l
WEBETION-ULV		
DASTICID SPECIAL		
ETIOL SPECIAL	10 g/kg	
AMBARIN		100,000 kg
Isoproturon containing products		
no products registered		
Simazine containing products		
SIMAZIN S-50	500g/kg	20,000 kg
TETEZIN		
Trifluralin containing products		
AGROTREF	480 g/l	96,000 l
HERBITREF EC-48		
LALAZIN		
POLJOTREF EC-48		
SUTREF-48		
TREFGAL		
TREFLAN-EC		
TRIFLUREX 48-EC		
ZUPILAN		
Zinc phosphide containing products		
CINKOSAN	20 g/kg	50,000 kg
CINKFOSFID MAMAK		
CINKFOSFID PRAH	840 g/kg	
FACIRON PRAH		

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D	DIKAMIN-600	Wheat, Barley, Maize	0.75-2.5	1
	HERBOXONE			
	DEHERBAN-A			
	AGROSAN			
	DIKOCID			
	DIHLORIN			
	HERBISAN			
	HERBIZOR			
	KOROVICID			
	MONOSAN HERBI			
	MONOZOR SL-50			
	POLJOSAN 2,4-D			
	TIMKOR			
	MATON			
	HERBITON			
	ESTERON			
	LENTEMUL-D			
2,4-D + FLUROKSIPIR-BUTOKSIPROPIL	LANCET	Wheat, Barley, Maize	1-1.2	1
2,4-D+ FLORASULAM	MUSTANG	Wheat, Barley, Maize	0.4-0.6	1
Alachlor	AGROHLOR 480-EC	Maize, Sunflower, Soyabean	4-6	1
	ALAHERB EC-48			
	ALAHLOR-48			
	ALAHLOR-480			
	ALAHLOR E-48			
	ALAHLOR-EC			
	ALAHLOR 48-EC			
	ALAHLOR EC-48			

Active Ingredients (AI)	**Name of Product containing Active Ingredients**	**Main Crops Applied to**	**Typical Application Rate (kg or litre per ha)**	**Typical Number of Applications per Year**
	ALANEX 48-EC			
	SAVAHLOR			
	ZORAL 48-EC			
Alachlor + ATRAZIN	ALAZINE-LM	Maize	5-7	1
	ALAHLOR-ATRAZIN KS			
Alachlor + LINURON	LINUCHLOR 367-EC	Maize	6-9	1
	ALAHOR KOMBI	Sunflower		
	GALOLIN KOMBI	Soyabean		
	LIRON KOMBI			
	LASSO LINURON			
Atrazine	ATRAZIN S-50	Maize	2	1
	ATRAZIN-500			
	ATRAZIN-SC	Fruit trees	4-6	
	ATRAZIN SC-50	Vineyards		
	ATRAZIN-TS ZUPA			
	ATRAZOR 500-SC			
	RADAZIN T-50			
	ATRANEX 50-SC			
	ATRANEX 80-WP			
	GESAPRIM 90-WG			
	ATRANEX 90-WDG			
Atrazine+AMETRIN+AMITROL	ZORAMAT S-47	Maize	2.5-3	1
Atrazine+PROMETRIN	ATPROM-500		2-3	1
	ATRAPROM			
	INAKOR			
	INACOR-T	Maize		
Copper carbonate, basic	SEMESAN PRAH	Wheat	200gr on 100kg of seed	1
	SEMESAN PASTA			
Copper hydroxide	BAKAR BLAU WP-50	Fruit trees	1-7	2
	BLAUVIT	Vineyards	1-4	
	FUNGURAN-OH	Potatoes	1-4	
	SAMPION	Field vegetables	3-5	

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	BLAUVIT TECNI KOCIDE-2000			
Copper hydroxide + KALCIJUM HLORID DVOJNA SO	CUPRABLAU-Z	Vineyards	3	2
Copper oxychloride	BAKARNI KREC-25 BAKARNI OKSIHLORID-25 BAKROCID S-25 BAKARNI KREC-50 BAKROCID-50 BAKARNI OKSIHLORID-50 BORSKI BAKARNI KREC S-50 BEVEBLAU KREC	Fruit trees Vineyards Potatoes Field vegetables	5-15	2
Copper oxychloride + CIMOKSANIL	CURZATE R-WG			
Copper oxychloride + CINEB	TIOZIN-A	Vineyards Potatoes	3	1
Copper oxychloride + CINK-KARBONAT	BAKARNI KREC SUPER BEVEBLAU SUPER BAKARNI EKSTRA KREC	Fruit trees Vineyards Potatoes Field vegetables	4-5	1
Copper sulphate (basic)	CUPROXAT	Fruit trees Vineyards Potatoes Field vegetables	4-6 2.5-3.5 2	1
Chlorpyrifos	PIRICID PYRINEX 48-EC	Wheat Maize Potato	1-1.5 lit foliarly 6-8 lit through soil	2 1

Active Ingredients (AI)	Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	CHROMOREL-D	Sugar beet	20-35 kg through dusting	1
	CHROMOREL P-2	Sunflower		
	HLORPIRIFOS G-7,5	Fruit trees		
	PIRICID G-7,5	Vegetables		
Endosulfan	BEVETICID	Fruit trees	1-3	1
	TIOCID E-35	Sugar beet	2.5-3.5	
	THIODAN E-35	Potatoes	1.5-2	
	TIONEX E-35			
Malathion		Fruit trees	1.5-3	2
		Vineyards		
	ETIOL TECNI	Wheat, Barley		
		Sugar beet		
	INSEKTIN	Vegetables		
	MALATION E-50			
Isoproturon	-	-	-	-
Simazine	SIMAZIN S-50	Fruit trees	4-6	1
	TETEZIN	Vineyards		
Trifluralin	AGROTREF	Soyabean	1-2.5	1
	HERBITREF EC-48	Sunflower		
	LALAZIN	Vegetables		
	POLJOTREF EC-48			
	SUTREF-48			
	TREFGAL			
	TREFLAN-EC			
	TRIFLUREX 48-EC			
	ZUPILAN			
	CINKOSAN	Fruit trees	5-10gr/per bait hole	2
	CINKFOSFID MAMAK	Wheat		

Annex 10

Pesticide Usage in Slovakia

Annex 10: Pesticide Usage in Slovakia

The Republic of Slovakia is one of very few countries that maintain a Pesticide Use Reporting System. Article 3 of Law on Plant Health Care states:

'Anyone who works either agricultural land to produce food of plant origin intended for public consumption and feeding stuffs to be placed on the market or works forest land for the purpose of enterprising while using thereby plant protection products shall, apart from the duties referred to in the first paragraph of the present Article, keep records on the consumption and ways of application thereof and on official request to submit them to the Central Control and Testing Institute of Agriculture).

Details on the keeping records on the consumption and on the manner of application of plant protection products according to the second paragraph of the present Article will be dealt with in a generally binding regulation that will be issued by the Ministry of Agriculture of the Slovak Republic (hereinafter referred to as "the Ministry").'

In Decree 3322/3/2001-100 the details are described:

Article 2

Keeping of records on the applied amount(s) and the method(s) of application of products

(1) The records concerning the applied amount(s) and the method (s) of application of products shall be kept by persons as referred to in Article 3 (2) of the Act.

(2) The records as referred to in the first paragraph of the present Article shall be archived for ten years from the end of the year of their application. A model form for the keeping of records is given in Annex 3 to the Decree.

(3) The cumulative data on the applied amount(s) of products in course of a given calendar year recorded in the form whose model is given in Annex 4 to the Decree shall be submitted to the Central Control and Testing Institute of Agriculture (hereinafter referred as "the Control Institute") by the person accountable for keeping records on the applied amount(s) and the method (s) of application of products through competent officials of plant health care bodies (hereinafter referred to as "phytosanitary inspector(s)") no later than by 15th November of the relevant calendar year. The natural persons and legal persons carrying out the treatment of ware potatoes, seeds and planting stock shall submit the required data no later than by 20th December of the relevant calendar year.

In addition to the PUR system, the Slovak Republic started a pesticide sales reporting system in 1999. All traders manufacturer, importer, distributors and retailers are required to report annually sales data. They are required to report name and amounts of formulated products for agricultural and for non-agricultural pesticides. Sales data are supposed to be publicly available by amounts active ingredient, chemical class, use type and by postal code[12].

Overall usage data are shown in the next figure. Figure 8 shows that usage between 1997 and 2001 was around 3,500 ton active ingredients per years. Only in 1999 usage was below 3000 tons. Data for 2000 were not provided.

[12] Communication with Martin Hajas (Central Control and Testing Institute of Agriculture) and Jozef Kotleba (Ministry of Agriculture)

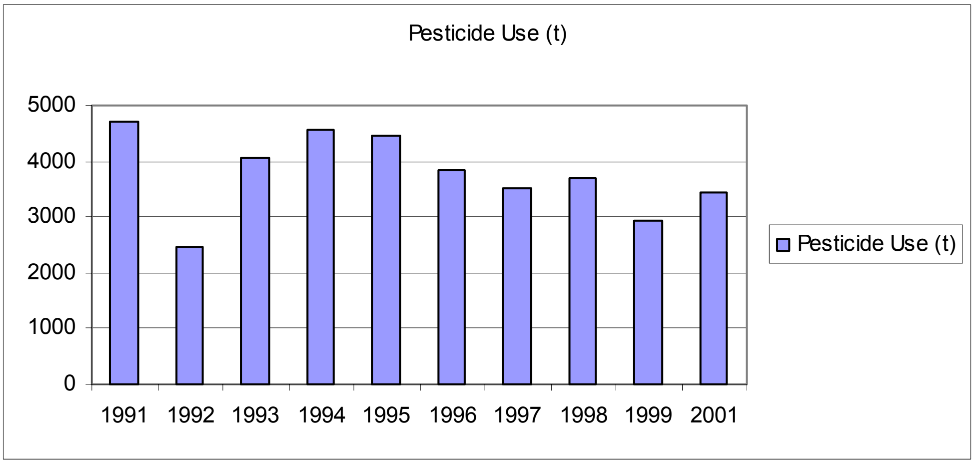

Figure 8 Pesticide Use in Slovakia (tons AI) 1991-2001

The intensity of pesticide use is presented in Figure 9 below. In 1996, 1997, 1998 and 2001 around 1.5 kg/ha pesticide were applied on average. In 1999 intensity was lower. Data for 2000 were not provided.

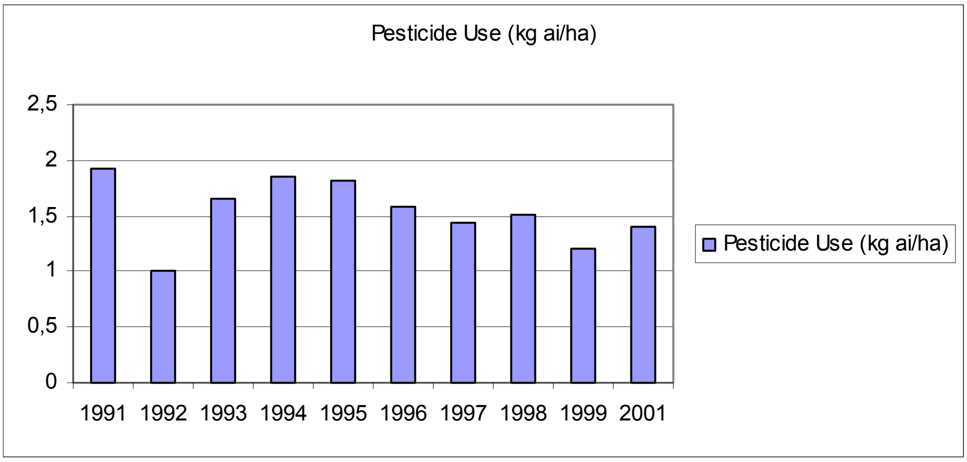

Figure 9: Intensity of Pesticide Use 1991-2002 (kg/ha)

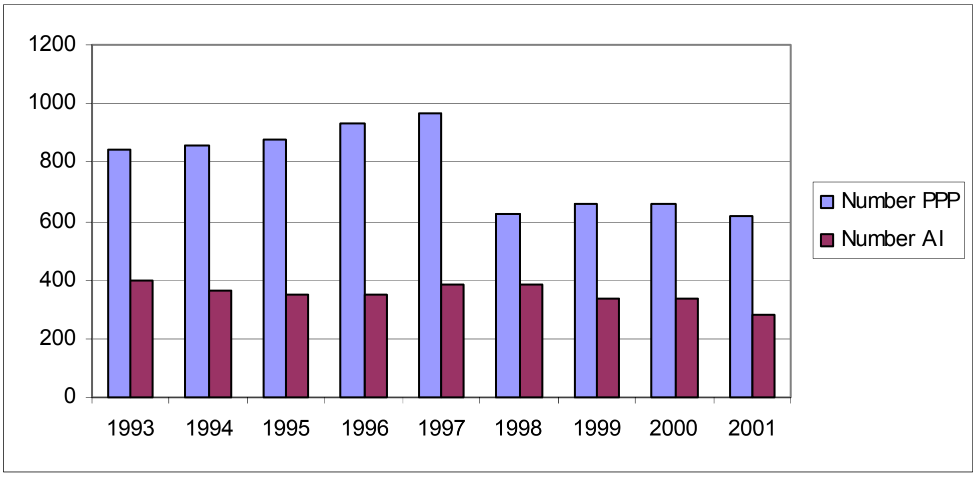

Figure 10 Number of Authorised Plant Protection Products and Active Ingredients in Slovakia

Figure 11 shows the total pesticide use by county. Nitra, Trnava and Kosice are the county with the highest pesticide use. These figures shows separately biological agents such as Bacillus thuringensis, Trichoderma spec. and Amblyseius cucumeris.

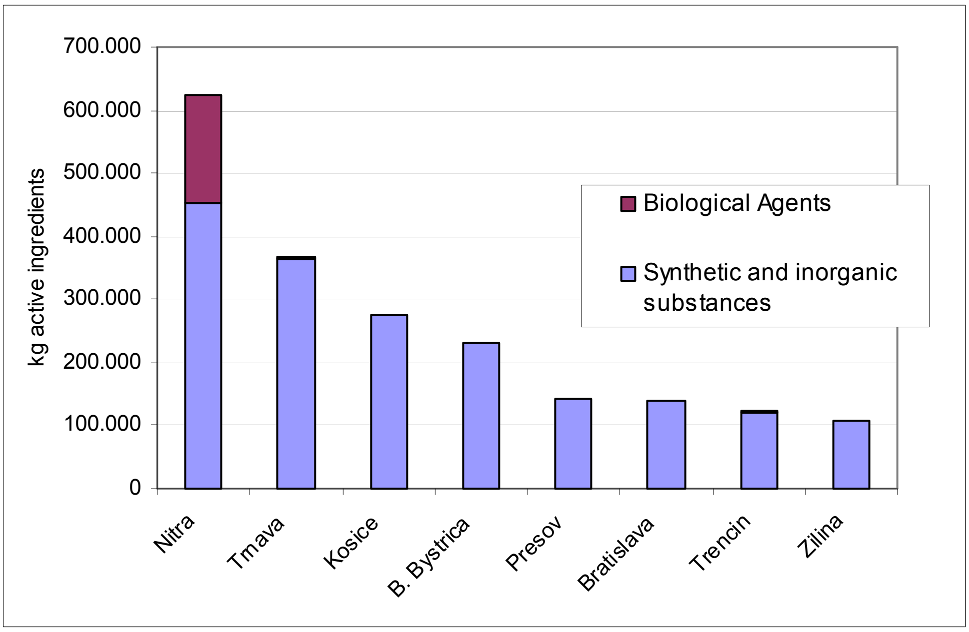

Figure 11 Pesticide Use in 2002 by County

The next table shows the Top 25 pesticides used in Slovakia in 2002. Six priority pesticides belong to the Top 25 pesticides (bold).

Table 40: Top 25 Pesticides Used in Slovakia in 2002

No.	Active ingredient	kg Used in Slovakia
1	ACETOCHLOR	211,008
2	REPELENTNE LATKY	148,098
3	GLYPHOSATE	87,963
4	MCPA	86,747
5	**ATRAZINE**	**84,964**
6	**ALACHLOR**	**80,297**
7	CHLORMEQUAT	67,402
8	CARBOXIN	61,221
9	THIRAM (TMTD)	59,387
10	MANCOZEB	59,101
11	SULFUR	47,953
12	**CHLORPYRIFOS**	**38,349**
13	**2,4-D-EHE**	**35,824**
14	CHLORIDAZON	29,899
15	CARBENDAZIM	29,474
16	METOLACHLOR	28,036
17	**TRIFLURALIN**	**25,274**
18	PROMETRYN	21,546
19	METAZACHLOR	20,712
20	PENDIMETHALIN	18,654
21	**COPPER OXYCHLORID**	**18,523**

No.	Active ingredient	kg Used in Slovakia
22	MON 4660	14,977
23	PINOLENE	14,744
24	MCPA-NA-K-DMA	14,018
25	PROPISOCHLOR	13,954

Priority Pesticide Use

Table 41 shows the amounts priority substances use in Slovakia counties in 2002. Atrazine and Alachlor are the pesticides with the highest amounts used. Altogether priority pesticides account for 17% of the total pesticide use in 2002 (without biological agents). Nitra, Trnava and Kosice are the county with the highest use of priority pesticides.

Table 41: Amounts Use of Priority Pesticide in Slovakia Counties 2002 in kg

Active ingredient	Slovakia	Nitra	Trnava	Kosice	Bystrica	Presov	Trencin	Bratislava	Zilina
Atrazine	84,964	19,241	22,489	10,251	14,061	5,695	5,727	4,025	3,476
Alachor	80,297	8,436	8,894	27,740	12,798	18,183	2,088	259	1,898
Chlorpyrifos	38,349	11,904	9,052	4,533	4,504	3,199	3,321	1,251	585
2,4-D-EHE	35,824	8,470	6,713	4,713	3,174	4,769	4,758	1,263	1,965
Trifluralin	25,274	11,980	5,236	2,496	2,928	257	714	1,496	168
Copper oxychloride	18,523	3,998	2,211	1,425	547	85	1,636	8,494	128
Copper hydroxide	9,096	5,371	891	811	244	55	378	1,343	3
Isoproturon	8,598	1,241	823	588	2,034	796	1,934	824	359
2,4-D	7,148	2,287	2,853	168	240	1,074	118	213	194
2,4 D-DMA	4,244	705	1,597	292	732	75	448	141	256
Zinc phosphid	1,508	920	272	23	0	172	122	0	0
Simazine	213	93	50	2	0	5	46	0	18
Chlorpyrifos-ethyl	5	0	0	0	0	0	0	0	4
Total	**314,043**	**74,646**	**61,081**	**53,042**	**41,262**	**34,365**	**21,290**	**19,309**	**9,054**

Problems Associated with Pesticide Use

According to the national authorities there are some problems with trade of non-authorised products across the Hungarian border.

Annex 11

Pesticide Usage in Slovenia

Annex 11: Pesticide Usage in Slovenia

Arable land and permanent crops in Slovenia occupy 285,000 ha; permanent pastures 502,000 ha and forests 1.1 million ha. Main crops are maize 44,401 ha, wheat 31,615 ha, potatoes 9,840 ha, fruits 37,514 ha, vegetables 3,941 ha and hops 1,803 ha.

According to the International Society for Horticultural Science, there are 5,000 ha of intensive orchards (mainly apples, pears, peaches, olives and strawberries). By cadastre there are also 31,000 ha of extensive old orchards. The acreage of vineyards is 25,000 ha. Annually 3,000,000 wine grafts and 700,000 maiden fruit trees are produced. Vegetables are grown on 11,500 ha of which 1,000 ha under cover.

The yearly production of ornamentals is about 30,000,000 trees, bushes, and cut and pot plants.

Pesticide use data from available for Slovenia from the FAO are not up to date and rather raw, since they based upon sales data by formulated products and they do not present specific use data by crop or active ingredients. The FAO database provides trends of sales by chemical class only for the last two years (1997, 1998), which does not allow to evaluate a trend. The overall use, however, declined by 30% in 1995-1998 years.

The agrochemical journal Agrow states in January 2003 that: *"In contrast to the declining western European market, there has been steady growth over the past two years in the crop protection markets of the ten EU accession countries. This is attributed to EU aid and high disease pressure in 2001*"[13]. Numbers for Slovenia were, however, not published.

Using the 1998 usage data and the 285.000 hectares for arable land and permanent crop an average use of 3,8kg/ha applies. Since this number presents the use of formulated products it cannot be compared with other countries. In addition, such numbers have to be interpreted with caution. There are approximately 92.000 small farmers in Slovenia, most of them may not use pesticides at all[14].

Table 42 shows sales data of formulated products containing priority pesticides. These data were provided by national experts.

The sum of some 200,000 kg represents ca. 20% of the national sales (based upon 1998 total). These numbers are possibly underestimated considering the large areas with specialty crops such as grapes, orchards and hops.

Information on treated areas are not available.

Table 42: Amounts Priority Pesticides Sold in Slovenia in 2001

Pesticide	**Amount sold in 2001 (kg formulated product)**
Copper hydroxide	83,150
Isoproturon	67,000
2,4-D	20,700
Copper sulphate	12,600
Copper oxychloride	12,200
Trifluralin	2,460
Simazine	2,400
Endosulfan	2,030

13 PJB Publications Ltd (2003): Agrow No 416, January 17th 2003, page 9

14 Neumeister, L. (2003): Pesticides Registered in Eastern European Countries, Usage, Registration, Identification and Evaluation, Part 4: Slovenia , Pestizid Aktions-Netzwerk e.V. (PAN Germany), Hamburg

Chlorpyrifos	1,670
Alachlor	0

Total	**204,210**

Problems Associated with Pesticide Use

The production of maize as animal fodder occupies 40% of the arable land, which leads to narrow crop rotation with increasing environmental and agricultural problems – including the use of the herbicides Atrazine and Simazine in doses which are higher than recommended.

Excessive concentrations of the herbicide atrazine, its metabolites plus a number of other herbicides simazine, metolachlor and prometryne were detected in aquifers in central Slovenia. In this area aquifers represent water sources for 45-50% of the population. Extensive use of the maize herbicide atrazine also caused a resistance of lambs quarter (Chenopodium album) against this herbicide and possibly to other similar herbicides.

In November 2002 atrazine was banned in Slovenia.

Spreading too closely to water sources is (or it use to be) a common practice. The 'Water Act' which has been accepted in 2002 interdicts spreading fertilisers or pesticides in the 5 metre strip near smaller streams/ditches and in 15 metre strip near main watercourses.

Table 43: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides and Amounts Sold in Slovenia

Pesticide	Name of Formulated Product containing AI	Percentage AI	Amounts Sold
2,4-D	DEHERBAN A DEHERBAN COMBI-MD DICOFLUID MP COMBI DIKOCID HERBOCID	2,4-D 464 g/l mecoprop (MCPP) 400 g/l + 2,4-D 150 g/l mecoprop 430 g/l + 2,4-D 130 g/l 2,4-D 464 g/l 2,4-D 460 g/l	20,700 kg
Alachlor	ALAPIN	Alachlor 480 g/l	
Copper hydroxide	CHAMPION 50 WP CUPRABLAU-Z CUPRABLAU-Z ULTRA	Copper 50% (in form of Copper hydroxide) Copper in form of Copper hydroxide and Calcium chloride complex 35% + zinc in form of zinc sulphide 2% Copper (in form of Copper hydroxide and Calcium chloride complex: 3Cu(OH)2 x CaCl2) 35 % + zinc (in form of Zinc sulphide: ZnS) 2 %	83,150 kg
Copper oxychloride 3	BAKRENI DITHANE GALBEN C KUPROPIN RAMIN 50 RIDOMIL PLUS 48 WP	mancozeb 25% + Copper in form of Copper oxychloride 30% Copper oxychloride 33 %, benalaxyl 4 % Copper in form of Copper oxychloride 50% Copper 50% metalaxil 8% + Copper oxychloride 40%	12.200 kg
Copper sulphate (basic)	BORDOJSKA BROZGA BORDOJSKA BROZGA CAFFARO BORDOJSKA BROZGA-SCARMAGNAN MODRA GALICA MODRA GALICA-PINUS	Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 20% Copper in form of Copper sulphate 25% Copper in form of Copper sulphate 25%	12,600 kg

	MODRA GALICA- SCARMAGNAN VEDRJUL	Copper 25% Copper in form of Copper sulphate 20%	
Chlorpyrifos	CHROMOREL D CHROMOREL P-2 PYRINEX 48 EC	Chlorpyrifos 500 g/l + cipermethrin 50 g/l Chlorpyrifos 1,8% + cipermethrin 0,2% Chlorpyrifos 480 g/l	1,670 kg
Endosulfan	THIODANE E-35	Endosulfan 350 g/l	2,030 kg
Malathion			
Isoproturon	GRODYL PLUS MENTOR TOLKAN	amidosulfuron 15 g/l + isoproturon 600 g/l pendimetalin 250 g/l + isoproturon 125 g/l isoproturon 500 g/l	67,000 kg
Simazine	PIN 140-S SIMAPIN KS 50	glifosat 140 g/l + simazine 140 g/l + dissolvent polioxyethylen-alkylamin 200 g/l simazine 50%	2,400 kg
Trifluralin	TREFLAN EC TRIKEPIN	trifluralin 480 g/l trifluralin 240 g/l	2,460 kg

Table 44: Products containing Priority Pesticides Their Application Rate and Number of Application

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
2,4-D containing products			
DEHERBAN A	Grasslands and pastures Corn Cereals (except barley)	2.5 – 3 l/ha 1.5 – 2.5 l/ha 1.5 – 2.5 l/ha	1 1 1
DEHERBAN COMBI-MD	Grasslands and pastures Cereals (except barley)	4 – 5 l/ha 4 l/ha	1 1
DICOFLUID MP COMBI	Grasslands and pastures Cereals (except barley)	4 – 5 l/ha 4 l/ha	1 1
DIKOCID	Grasslands and pastures Corn Cereals (except barley)	2.5 – 3 l/ha 1.0 – 1.5 l/ha 1.5 – 2.5 l/ha	1 1 1
HERBOCID	Grasslands and pastures Corn Cereals (except barley)	2.5 – 3 l/ha 1.5 – 2.5 l/ha 1.5 – 2.5 l/ha	1 1 1
Alachlor containing products			
ALAPIN	Silage corn Sunflower and Soya Oil rape	4 – 6 l/ha 4 – 6 l/ha 3 – 5 l/ha	1 1 1
Copper containing products			
CHAMPION 50 WP	Vineyards Fruit trees *Ventuira inaequalis, Venturia pyrina* *Stigmina carpophila* *Taphrina deformans* *Monilinia laxa* Hops Vegetables *Peronospora destructor* *Xanthomonas phaseoli* *Pseudoperonospora cubensis* Potatoes and tomatoes	0.20 – 0.25 % 0.70% 0.5 – 1% 0.5% 1% 2.5 kg/ha 3.5 kg /ha 0.5% 0.3 – 0.5% 2.5 kg/ha	1-4 1 1 1 1 1 2 2 2 3 3
CUPRABLAU-Z	Vineyards Hop fields Fruit orchards	0.3% 0.25% – 0.3% 0.8%	3 3 1

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	Crops and vegetables	3 – 4 kg/ha	2
CUPRABLAU-Z ULTRA	Vineyards Hop fields Crops and vegetables: Potatoes and Tomatoes Onions, tomatoes Fruit orchards	0.25% 0.2 – 0.25% 2 – 2.5 kg/ha 2 – 2.5 kg/ha 0.70%	3 3 3 3 1
BAKRENI DITHANE	Vineyards Fruit orchards Potatoes	0.3 – 0.4 % 0.7 – 0.8% (0.3 – 0.4%) 3 – 4 kg/ha	1 3
GALBEN C	*Plasmopora viticola* *Phytophora infestans* *Peronospora destructor*	0.4 – 0.5% 5 – 6 kg/ha 4 – 5 kg/ha	4 3 3
KUPROPIN	Fruit orchards Vineyards Hop field Potatoes and tomatoes	0.5 – 0.75% 0.5 – 0.75% 0.5 – 0.75% 5 – 7 kg/ha	1 3 3 3
RAMIN 50	Fruit orchards Vineyards Hop field Potatoes and tomatoes Onions Cucumbers Beans	0.5 – 0.75% 0.5 – 0.75% 0.5 – 0.75% 5 – 7 kg/ha 0.3 – 0.5% 0.3 – 0.5% 0.5%	1 3 2-3 3 3 3 3
BORDOJSKA BROZGA	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 2 2 2
BORDOJSKA BROZGA CAFFARO	Fruit orchards Vineyards Crops and vegetables	0.95 – 1.15% 0.6 – 0.8% 1 – 1.5%	1 3 2
BORDOJSKA BROZGA-SCARMAGNAN	Fruit orchards Vineyards Crops and vegetables	0.95 – 1.15% 0.6 – 0.8% 1 – 1.5%	1 3 2
MODRA GALICA	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
MODRA GALICA-PINUS	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% 1 – 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
VEDRJUL	Fruit orchards Vineyards Hop field Crops and vegetables	1 – 1.5% (1.5 – 2%) 1.5% 1 – 2% 1 – 1.5%	1 3 3 2
Chlorpyrifos containing products			
CHROMOREL D	Aphididae; *Cydia pomonella,*	0.075 – 0.1%	2

Name of Product containing Active Ingredients	Main Crops Applied to	Typical Application Rate (kg or litre per ha)	Typical Number of Applications per Year
	Cacopsylla pyri	0.1 – 0.15%	2
	Crops:		
	Leptinotarsa decemlineata	0.5 – 0.9 l/ha	2
	Beet (*Mamestra* spp.)	1 – 1.5 l/ha	2
	Oil rape (*Meligethes aeneus*)	0.75 – 1 l/ha	2
	Leptinotarsa decemlineata	15 – 20kg/ha	2
	Fruit orchards:		
	Aphididae; *Hyphatnria cunea, Lymatria dispar*	1 – 1.5%	2
		1.5%	2
	Crops:	0.1 – 0.15%	2
	Aphididae;		
CHROMOREL P-2		0.15%	2
	Eurygater spp., *Mamestra* spp.		
PYRINEX 48 EC	Potatoes, vegetables	6 – 8 l/ha	2
Endosulfan containing products			
THIODANE E-35	Fruit trees		
	Aphididae; *Eriosoma lanigerum, Hoplocampa*	0.15 – 0.20 %	2
	spp.		2
	Anthonomus pomorum, Hyphantira cunea		
	Phyllobius oblongus	0.15%	1
	Eriophyes piri		
	Vineyards	0.1%	1
	Colomerus vitis	0.15%	1
	Industrial plants	0.15%	2
	Aphididae		
	Meligethes aenus, Ceutorhynchus assimilis		
	Forests	0.15 – 20%	2
		1.2 – 1.8 l/ha	1
		0.30 – 0.60%	1
Isoproturon containing products			
GRODYL PLUS	Cereals	1.75 – 2 kg/ha	1
MENTOR	Winter wheat, barley, triticala	3 – 4 l/ha	1
TOLKAN	Winter wheat, barley, rye	4 – 5 l/ha (autumn)	1
		2.5 – 3.5 l/ha (spring)	
Simazine containing products			
PIN 140-S	Vineyards and orchards (apples and pears)	9.0 – 12.5 l/ha	1
	Corn	2 – 3 kg /ha	1
SIMAPIN KS 50	Vineyards and orchards (apples and pears)	3kg/ha	1
Trifluralin containing products			
TREFLAN EC	Sunflower, soya, cotton, carrots, beans and oil rape	1.0 – 2.5 l/ha:	1
		1 – 1.5 l/ha light soil	
	Red pepper, eggplants , cabbage and cauliflower	2 l/ha medium heavy soil	
	Onion	2.5 l/ha heavy soil	
	Sunflower, soya, cotton, carrots, beans and oil rape	2.5 – 4.8 l/ha:	1
		2.5 l/ha light soil	
		3.6 l/ha medium heavy	
	red pepper, eggplants , cabbage and cauliflower	soil	
TRIKEPIN		4.8 l/ha heavy soil	1

Annex 12

Pesticide Usage in the Ukraine

Annex 12: Pesticide Usage in the Ukraine

In the Ukraine there are not statistics on pesticide usage.

In order to obtain the required information the national experts used the marketing database of the biggest international chemical companies operating in Ukraine and of the State Office for plant protection.

The absence of an effective pesticide control mechanism in the Ukraine is leading to the country gaining a reputation as a so-called "dumping market" whereby low quality products are entering Ukraine and being sold cheaply on the local market. According to experts, more than 50% of the products are illegal i.e. not certified or fake.

The following data are therefore just a small part of the picture.

Table 45: Top 25 Pesticides Sold in the Ukraine in 2001 (kg)

Pesticide	**kg or litre reported to be sold**
Acetochlor	248,515
MCPA	104,021
Haloxyfop	91,251
Dimethoate	55,451
Molinate	40,869
EPTC	40,167
Dimethenamid	31,530
2,4-D	**26,804**
Lambda-cyhalothrin	16,848
Mancozeb	15,039
Malathion	**14,824**
DNOC	12,639
Dimethomorph	10,290
Mefenoxam	9,809
Fluazifop-P	9,446
Carbofuran	9,051
Carbendazim	8,632
Metolachlor	7,944
Difenoconazole	7,751
Cypermethrin	6,942
Propamocarb	6,722
Diazinon	5,530
Diquat	5,371
Pendimethalin	4,602
Chloridazon	4,551
Thiophanate-methyl	4,384
Total	**798,984**

The top 25 pesticides represent 91% of the total reported sales, which account for 880.064 kg. Only two priority pesticides belong two the top 25 pesticides.

There is not a single copper compound or sulphur compound among the top 25. This is most likely an error caused by the source of information. Copper compounds and sulphur unusually belong to most heavily applied pesticides in Europe. Copper oxychloride and copper hydroxide are not authorised in the Ukraine, they are the most common fungicides in Central and Eastern European countries. The question is, whether or not Ukraine requires authorisation for inorganic compounds such as sulphur, copper oxychloride and copper hydroxide. Possibly they are on the market without authorisation.

Table 46 shows the areas treated with pesticides in the Ukraine. The data suggest that all vineyards are treated with fungicides almost 3 times a year, and that half of the vineyards are sprayed with insecticides.

Altogether, the percentage of areas treated is on average about 50%.

Table 46: Percentage of Crops Treated with Pesticides in Ukraine

	Percentage of Crops treated in 2001			
Crop	**Crop area in 1000 ha**	**Fungicides**	**Herbicides**	**Insecticides**
Cereals	15,070		19	
Fruit trees	239	49	2	64
Maize			45	
Potatoes	1,596	133	1	21
Sugar beet	932	15	67	29
Sunflower	2,769		11	3
Vegetables	480	20		20
Vineyards	103	270		50

Problems Associated with Pesticide Use

There are huge storages of banned pesticides in Ukraine and this is considered as one of the biggest ecological threats. There are around 147 centralized storages of banned pesticides all around Ukraine and around 5 000 storages on the farms and agricultural enterprises. Almost all of them are considered to be inadequate and unsafe and there are many known cases when tragedy happened.

Table 47: Pesticide Registration Data of Pesticide Products Containing Priority Pesticides and Amounts Sold in the Ukraine

Product Name	**Percent AI**	**Amount Sold in 2001**
2,4-D containing products		
2,4-D 500 WS	50	48,292
Dezormon 720 WS	72	
Luvaran 600 SL	60	
2,4-D 400 SL	40	
2,4-D 685 SL	68,5	
2.4-D 500	50	
Dicopur F 600 SL	60	4,430
2,4-D 500 WS	50	
2,4-D 685 SL	68,5	
Luvaran 600 SL	60	
2.4-D 500	50	
Dicopur F 600 SL	60	
Dezormon 720 WS	72	

Alachlor containing products		
Lasso 480 EC	48	
Chlorpyrifos containing products		
Dursban 408 EC	48	3,517
Copper sulphate containing products		
Cuproxat 34.5 TR	34,5	8,731
Blue Vitriol 98 TEC	98	
Cuproxat 34.5 TR	34,5	
Malathion containing products		
Fufanon 570 EC	57	26,007
Carbofos 500 EC	50	
Trifluralin containing products		
Treflan 240 EC	24	11,200
Herbotref 240 EC	24	

Annex 13

Example of Good Plant Protection Practice for Wheat

Annex 13

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General Principles

Wheat crops are sown in spring or in autumn. Spring crops are exposed to pests for a shorter period. Crop rotation with other cereals or field crops reduces the build-up of pest populations in the soil or in crop debris. In general, careful soil cultivation is recommended as an effective cultural control method. Minimal cultural practices such as direct drilling, though they may reduce labour costs, also favour the survival and build-up of pest populations in the soil. As wheat is mainly grown for grain, the aim of protection against pests is to ensure a good quantity and quality of grain yield. The physical and chemical characteristics of grain are particularly important when processing is involved.

Use of resistant cultivars, optimum time of sowing, good crop rotation, use of healthy seeds, well prepared seedbed, cultural operations (destroying or burying stubble) are important elements in GPP on wheat. Cultivars with good resistance to lodging should be used in areas where lodging is a major problem. Treatments with plant protection products may be necessary at any stage of development of the crop. The use of seed treatment is GPP when it is used against pests that cannot be controlled by foliar fungicides. It may also be GPP to use seed treatment against other pests, if the seed treatment results in fewer sprays and thus in a reduced amount of plant protection product early in the season. Wheat is more tolerant of attack by soil pests than, for example, maize or sugarbeet, because seedling losses can be compensated by growth of adjoining plants. The products used for seed treatment should as far as possible cover the full range of fungal or insect pests concerned. It is important that seeds should be uniformly treated with product.

Simultaneous application of two or more active substances as sprays or seed treatments is GPP only if the all pests to be controlled cross the economic threshold value or it is expected. The farmer or adviser must be familiar with the main pests, monitor fields regularly and make full use of existing early warning systems and economic threshold values. As soon as practical thresholds for weed infestation become available, these must be used. Dosages should relate to the pest spectrum observed, taking account of the individual effects and possible interactions. For fungal diseases in particular, it is GPP to select products and to time applications in an optimal way.

Except for spot application of perennial weeds and ULV-insecticide applications early in the season, boom-sprayers, mounted on or towed by tractors, are the only equipment advised for sprays. It is GPP to reduce drift and unwanted dispersal of plant protection products as much as possible by using drift-preventing covers on the nozzles or equipment that produces a good and uniform droplet spectrum across all nozzles on the spray boom.

The risk of developing resistance to fungicides, insecticides and herbicides is a real threat. It is GPP to avoid spraying a fungicide or insecticide later in the season if an active substance with the same mode of action has already been applied as a seed treatment. An active substance with a different mode of action should preferably be used. For the control of the important powdery mildew and rust diseases, active substances should be alternated or coformulations containing products with different mode of action should be used as much as practicable.

The principal wheat problems considered are the following.

Major Diseases, Pests and Weeds in Wheat and Basic Strategies

Fungus

Puccinia striiformis (yellow rust), P. recondita (brown rust), P. graminis (black rust)

General

Rust fungi are highly specialized to their hosts, and wheat is attacked by the formae speciales tritici of the three main rust fungi, Puccinia striiformis, P. recondita and P. graminis. In addition, pathotypes specialized to host resistance genotypes are common. Some of the cereal rusts have alternate hosts (Thalictrum spp. for P. recondita; Berberis vulgaris for P. graminis), but P. striiformis is a short-cycle autoecious rust. Cereals are infected in the spring by air-borne aecidiospores coming from the alternate host or by air-borne urediniospores coming from other areas. Infections with P. striiformis and P. recondita can also occur in the autumn from late tillers or volunteers. This initial air-borne inoculum is practically ubiquitous and uncontrollable. Rust epidemics on cereals develop by repeated secondary urediniospore infection, and this is the stage which is subject to control. At the end of the season, teliospores are formed which give rise to the infection of the alternate host. The different rusts of wheat differ in the pattern and colour of the uredosori formed on wheat leaves. These are yellow to orange in P. striiformis, characteristically in rows on older leaves (in very susceptible wheat cultivars the leaves turn yellow and die). The darker uredosori of P. recondita are irregularly spread over the entire leaf surface. The uredosori of P. graminis form dark brown stripes on leaves and leaf sheaths. In general, yellow rust and brown rust are the diseases of practical importance in Europe. The importance of black rust was much reduced by a campaign to eradicate its alternate host (Berberis vulgaris) early in the 20th century, and black rust is only now occasionally serious in areas with warm summers in central and eastern Europe and on hard wheat in southern Europe.

Basic strategy

There is a range of cultural practices that may reduce rust infection of wheat. First, resistant cultivars should be grown or, at least, very susceptible cultivars should be avoided. Volunteer wheat should be destroyed and winter wheat should not be sown too early. Excessive nitrogen application should be avoided, to prevent too heavy and too dense a stand. It may still be useful in some areas to destroy alternate hosts such as Berberis vulgaris. If the risk of infection by rusts becomes serious in spring, application of a fungicide spray may be necessary. Normally, one or two applications are sufficient, but more may be needed on very susceptible cultivars. In practice, thresholds may be used (e.g. first appearance of P. striiformis, appearance of P. recondita on leaf 3). Alternatively, the advice of warning services (based on various forecasting models) must be followed. If rusts are present with other diseases at growth stage 39-65, it is common practice to apply fungicides against the whole disease complex.

Erysiphe graminis (powdery mildew)

General

Erysiphe graminis forms patches of superficial white, then greyish mycelium (powdery mildew) on leaves, leaf sheaths and ears of wheat. Leaves remain green and active for some time after infection, then the infected areas gradually die. The conidia, formed in great quantities as a white powder on the mycelium, are wind-dispersed over considerable distances to infect healthy leaves. This air-borne inoculum is practically ubiquitous and uncontrollable. Infection by conidia requires high humidity (but not free water on the leaf surface), while sporulation and spore dispersal are favoured by rather dry conditions. Powdery mildew is thus favoured by an alternation of wet and dry conditions, as often occurs in north-west Europe. Infected areas on leaves become chlorotic and cease to photosynthesize. Early mildew attack reduces tillering and later infection reduces "green leaf area", and thus grain yield. Moderate levels of mildew can be tolerated. Cleistothecia may appear on old colonies (as black points) at growth stage 39-65, but these contribute relatively little to inoculum in the spring, which mainly comes from lesions on winter cereal crops.

Basic strategy

Wheat is infected only by forma specialis tritici of E. graminis, so powdery mildew from barley or rye cannot infect wheat and vice versa. Winter wheat should, however, not be grown next to spring wheat. In general, wheat is not as heavily affected as barley (see EPPO Standard PP 2/11(1) Guideline on GPP for barley), but losses can be severe if the disease is not controlled. A range of cultural practices exist that may somewhat reduce infection by E. graminis. The growing of resistant cultivars is recommended. An open stand of wheat reduces the incidence of powdery mildew as compared to a dense stand, heavily fertilized with nitrogen. If powdery mildew infection becomes too serious, one or more chemical applications may be necessary; this should not be after full ear emergence (growth stage 59). Treatment may commence at first appearance of symptoms after growth stage 31. If powdery mildew is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Problems with resistance

E. graminis has been reported to show reduced sensitivity to fungicides of the sterol-biosynthesis inhibitor group, which has been characterized by gradual loss of performance, particularly in the triazole group of fungicides. Though fungicides of the benzimidazole group are effective against E. graminis, it is not GPP to use them on wheat because of resistance problems with Pseudocercosporella herpotrichoides (see below).

Leptosphaeria nodorum (glume blotch)

General

The disease caused by Leptosphaeria nodorum (synonym Phaeosphaeria nodorum; anamorph Septoria nodorum) can be seed-borne, but soil-borne debris is the main source of infection. Seed-borne infection can cause seedling losses. Wind-borne ascospores may bring the disease into a first-year wheat crop. Small brown blotches, sometimes increasing considerably, appear on leaves and leaf sheaths. Plant-to-plant spread is by rain splash of pycnidiospores. A few weeks before ripening, the glumes are also infected, their tips turning brownish with minute reddish/light brown points (pycnidia). Grain in infected ears does not fill properly. The disease is associated with heavy rain during summer. Glume blotch is the major disease of wheat in north-western Europe, but is less important further south.

Basic strategy

Commercial cultivars are available with a moderate degree of resistance. The use of disease-free seed is recommended, but seed treatments will give acceptable control of seed-borne infection if seed with a low incidence of the pathogen is used. If infection is heavy, fungicide sprays may be needed. One spray should be applied after flag-leaf emergence and a further application may be needed at ear emergence if conditions are very conducive. The aim of control is to prevent infection of the ear and flag leaf. The advice of warning services should be followed, if available. If glume blotch is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Mycosphaerella graminicola (leaf spot)

General

Mycosphaerella graminicola (anamorph Septoria tritici) causes speckled leaf blotch or leaf spot of wheat. The disease is not seed-borne, the primary inoculum usually being wind-blown ascospores from pseudothecia formed on last year's stubble. Spring-sown crops tend to escape this inoculum. However, if crops are sown into infected stubble or trash, the primary inoculum may also be pycnidiospores from this source. Yellow, later brown-yellow, spots appear on the leaves, with dark-brown specks (pycnidia) and apical yellowing of the leaf (tip-burn). Plant-to-plant spread is by rain-splashed pycnidiospores. Infected leaves die entirely or partly. The glumes are rarely infected (see Leptosphaeria nodorum). The disease is favoured by rainfall, especially in thin crops, and occurs on wheat crops throughout Europe, though especially in the west.

Basic strategy

Commercial cultivars with moderate levels of resistance are available. Early drilled crops are more severely affected. It is important to prevent infection of the upper leaves. One or two fungicide sprays may be needed, applied when infection is seen after growth stage 39, and earlier in the case of rainfall favouring infection of the upper leaves. The advice of warning services should be followed, if available. If leaf spot is present with other diseases, it is common practice to apply fungicides against the whole disease complex.

Tilletia tritici, Ustilago tritici (bunt and smut)

General

Tilletia tritici (syn. T. caries) causes covered smut or bunt of wheat. Seedlings are systemically infected by spores carried on the outside of the seeds. The disease can also be soil-borne. Shortly after flowering, infected tillers give rise to ears which become blue-green and during ripening the glumes open slightly. Diseased plants can be stunted, and the grains are filled with a mass of black spores, retained within the seed coat (covered smut).

Ustilago tritici (syn. U. nuda) causes loose smut of wheat. Infection is seed-borne within the seed, the fungus penetrating the endosperm while the grain is being formed. Infected seeds give rise to systemically infected plants. Diseased ears are visible directly after heading. The black spores are released between glumes and broken-down grains, giving a loose black powder (loose smut). They are wind-borne to healthy ears, which they infect.

In both cases, losses arise from direct loss of infected ears. In U. nuda, ears may also be secondarily infected at harvest.

Basic strategy

Seeds of wheat are externally contaminated by T. tritici during harvesting, when bunted grains are broken open and release their content of spores. Infection then occurs at the time of seed germination and can be prevented by a contact fungicide. In the case of U. tritici, the seeds are already internally infected at the time of harvest. Use of a systemic fungicide is needed to prevent further development of the fungus in the plant after seed germination. In any case, it is important to use disease-free and fungicide-treated seed. Treatment is very effective in controlling these diseases, and certification is of use against U. tritici. Therefore, these diseases are now practically unknown in intensive cereal cultivation in Europe. However, bunt is commonly found on seed samples and, if untreated farmer-saved seed is sown, these diseases reappear. This practice is therefore not GPP. It is also possible to have seed lots tested to decide whether they require treatment.

Tilletia controversa (dwarf bunt)

General

Tilletia controversa causes dwarf bunt, a disease which can only develop in regions where snow cover persists for several weeks. Therefore, this disease is mainly observed in regions above 600 m. Although T. controversa can be seed-borne, the main source of inoculum is soil infested with teliospores. The spores can persist for at least 10 years. For germination of the spores, light is essential and the temperature optimum lays between 1 and 8°C. Only spores on the soil surface germinate and infect the seedlings shortly after emergence. A persistent snow cover favours this rather long process of infection. Heavy infection at the stage of tillering results in severe damage. The symptoms are similar to those caused by T. tritici, but the plants are usually drastically shortened. The disease causes losses of grain that can be as high as 50%. The bunt balls are crushed during threshing, the teliospores are transported with the wind and contaminate the soil of neighbouring fields.

Basic strategy

It is recommended to avoid growing winter wheat in areas where T. controversa occurs. Spring wheat should be cultivated instead, as it can escape from the disease. Certified and fungicide-treated seed should be used to prevent infection. Every effort should be made to avoid contaminating healthy soils.

Pseudocercosporella herpotrichoides (eyespot)

General

Tapesia yallundae (anamorph Pseudocercosporella herpotrichoides) overwinters on stubble residues. Conidia formed in the spring (and, as recently discovered, also ascospores) constitute the primary inoculum. Plants are infected through the leaf sheath, and the lesion gradually penetrates through to the stem, forming a lens-shaped spot with a darker border. Another fungus, Ceratobasidium cereale (anamorph Rhizoctonia cerealis), forms lesions with a darker, more sharply defined border (sharp eyespot). If eyespot lesions reach the stem before growth stage 31/32, there is a high risk of later foot rot and crop lodging. Secondary infection of other plants does not normally occur, so the aim of control is to prevent primary infection. Fast- and slow-growing strains of P. herpotrichoides occur in different areas; this situation is monitored by warning services, which should be consulted if necessary.

Basic strategy

A number of factors predispose wheat crops to eyespot: high soil pH, cereal as preceding crop, early sowing date, cultivar, dense sowing, dense tillering. Good cultural conditions reduce the incidence. Winter wheat should be sown late and rather shallow (the disease is of no importance on spring wheat). The proportion of cereals in the crop rotation should not be too high; in a 50% rotation of cereals with non-cereals, a 2-year change may be advisable rather than a crop change every year. Cultivars with a certain degree of resistance are available. Since fast- and slow-growing strains of the fungus may show different susceptibility to fungicides, the advice of warning services should be sought as to the strains locally present. If at the start of stem elongation (growth stage 31) more than a threshold percentage of tillers shows eyespots, a fungicide spray should be applied. This threshold varies according to the strain and the climatic conditions from 15 to 35%. The advice of warning services should be followed, if available. Use of plant growth regulators to shorten the length of the stem and reduce lodging may reduce the effects of eyespot infection.

Problems with resistance

P. herpotrichoides was slow to develop resistance to the benzimidazole group of fungicides, but this resistance is now common. Resistance to triazoles (which, in any cases, are less effective against the slow-growing strains) and prochloraz has also been found in certain areas.

Gaeumannomyces graminis (take-all)

General

Gaeumannomyces graminis is a soil fungus which infects the roots of wheat, on which it forms a characteristic black superficial mycelium. The infection may spread to the collar and lower leaf sheaths. The root system is partly or entirely destroyed, and infected plants produce bleached inflorescence (whiteheads) with no grain (take-all), especially under hot dry conditions. The fungus persists as saprophytic mycelium in crop debris, which infects new roots directly. There is no air-borne phase (see eyespot). Infection tends to occur as patches in the crop. Take-all is one of the most serious causes of yield loss in intensive cereal crops, and is the principal reason why it is not GPP to grow wheat continuously.

Basic strategy

As a root-infecting soil fungus, G. graminis is practically inaccessible to treatment with fungicides. Because the fungus does not persist very long in debris, control is readily achieved by crop rotation.

Fusarium culmorum, Monographella nivalis (foot rot, snow mould)

General

Fusarium culmorum and Monographella nivalis are soil fungi which infect the foot of wheat plants. Both can infect seedlings and M. nivalis, in particular, can cause serious seedling losses. Both may also be seed-borne but the two fungi can also infect the roots of young plants directly from the soil. Under suitable conditions, root infection can spread to the stem base, which can be seriously damaged. In the case of F. culmorum, this spread is favoured by rather dry warm weather and the disease is mostly known from central and southern Europe. The base of the tillers turns brown or develops large brown spots; the tillers bend, and the crop lodges. In the case of M. nivalis, this spread occurs at low temperatures, characteristically under melting snow cover during the winter. The spots are lighter in colour. F. culmorum is an unspecialized parasite, able to infect the roots of many plants and to persist saprophytically. M. nivalis similarly attacks many other Gramineae and persists in the soil. Seedlings and young plants can be protected from primary root infection by treating the seeds with fungicide. Another member of the foot-rot complex, Ceratobasidium cereale (anamorph Rhizoctonia cerealis), has symptoms resembling eyespot, but is less important. Other fungi with Fusarium anamorphs (e.g. Gibberella avenacea) also belong to this complex.

Basic strategy

Because of the build-up of inoculum on a preceding cereal crop, rotation may reduce foot rot incidence to a certain extent. However, both pathogens remain as part of the natural soil microflora, and rotation is not as effective as against Gaeumannomyces graminis. Soil conditions should be optimal, and the seeds used should be certified and disease-free. Use of a fungicidal seed treatment against these fungi is effective routine GPP for wheat. Seed treatment with contact fungicides can be used for low levels of infection (<10%) but systemic fungicides are recommended for higher levels.

Gibberella zeae, Fusarium culmorum (ear rot)

General

Infection of ears by Gibberella zeae (anamorph Fusarium graminearum) or Fusarium culmorum is favoured by wet weather conditions (relative humidity over 75%) after ear emergence. Infection by F. culmorum is by rain-splashed conidia coming from infected debris in the soil, and the ear-rot phase can be considered as an extension of the foot-rot phase of this fungus (q.v.). Lightly infected ears give rise to infected seeds. G. zeae forms perithecia on infected debris and on wheat ears after infection, and the inoculum consists mainly of air-borne ascospores. Infection of the leaves can lead to large, oily blotches. The fungus is not important as a foot-rot pathogen of wheat (though it is important on maize). Ear rot reduces yield, decreases the thousand-grain weight and leads to bad quality indices. Under improper storage conditions, the fungi in infected wheat may produce toxins which are health-hazardous for human or animal consumption.

Basic strategy

Tolerant cultivars should be used. In areas at risk, heavy nitrogen fertilization and late sowing should be avoided. The foot-rot phase of F. culmorum should be controlled by treating the seeds with a fungicide (see Foot rot). If climatic conditions favourable to ear rot appear, preventive fungicide sprays should be applied especially in central Europe where this disease is most important. In other areas, fungicide sprays applied against other diseases generally control ear rot.

Pyrenophora tritici-repentis (leaf blotch)

General

Pyrenophora tritici-repentis is a fungus which gained importance in the 1980s. It infects a wide range of cultivated and wild monocotyledonous plants. The pathogen overwinters on stubble residues and initial infection in spring is caused by ascospores from this source. Symptoms are observed in late March-early April in the form of light-brown ascospore lesions with yellow margins on the lower leaves of winter-wheat plants. Following secondary conidial infection, small dark-brown spots, then oval or fusiform light-brown spots develop. Finally, leaves dry from the tip. P. tritici-repentis and Leptosphaeria nodorum may appear together. Conidial infection requires warmth (20-22°C) and precipitation.

Basic strategy

Stubble residues should preferably be ploughed in. Less susceptible cultivars should be used in areas at risk. Infection may occur from the two-node stage to flowering. A single fungicide spray may be applied at the time of appearance of symptoms.

Fungus Strategies specific to Denmark

Autumn control of leaf diseases or snow mould is never recommended.

From GS 29 it is recommended to carry out monitoring in the field to follow the development of eyespot, mildew and rust diseases. This information should create background for assessing the need for control as well as recommending and effective fungicide and dose. Various handbooks or the decision support system PC-Plant Protection can be used as support. Control of septoria (*Septoria tritici, Stagonospora nodorum*) diseases are based on information on precipitation or visible assessments.

The following thresholds are examples from some of the growth stages :

Eyespot : Control of more than 35% of the plants have attack at GS 30-32. On attacked plants symptoms should be visible on the white leaf sheath beneath the outer leaf.

Mildew : susceptible varieties – more than 10 % plants attacked at GS 29-31, resistant varieties – more than 25% of plants attacked at GS 29-31.

Yellow rust: susceptible varieties – more than 1 % plants attacked at GS 29-31, after 1st application treatments are repeated with 3 weeks interval. resistant varieties – more than 1 % of plants attacked at GS 29-31. Should not be followed by routine treatments.

Septoria : susceptible varieties – Count days with precipitation from GS 33. Apply an effective fungicide after 4 days with precipitation (more than 1 mm per day) or if more than 10 % of plants are attacked at 3rd leaf at GS 45-59. less susceptible varieties – Count days with precipitation from GS 37. Apply an effective fungicide after 5 days with precipitation (more than 1 mm per day). Do not apply before GS 39.

Choice of fungicide: It is recommended to use mixtures with different mode of action to avoid fungicide resistance. A maximum of two applications with strobilurins per season is recommended.

Although reduced dosages are recommended this are only on low disease levels in order to avoid a big selection pressure.

A p h i d s a n d I n s e c t s

General

Aphids, especially Sitobion avenae, Metopolophium dirhodum and Rhopalosiphum padi, may become numerous on tillers and ears of wheat, and may inflict direct feeding damage or indirect damage because of the formation of sooty moulds or transmission of virus diseases (especially Barley yellow dwarf luteovirus).

Quality of grain is also affected by aphid infestations. Diuraphis noxia is important in the eastern part of the EPPO region.

Basic strategy

The wheat crop should be regularly inspected in spring, and an insecticide spray application should be made if numbers reach a certain level. Various threshold levels are recommended, for example: 30% of tillers carry aphids before flowering; 70% of tillers are infested during and shortly after flowering up to caryopsis watery ripe. A single spray is usually sufficient. Use of certain selective insecticides will favour natural enemies.

Virus diseases are not normally a problem in wheat and chemical control of aphids for that purpose is generally not necessary. In areas with mild winter climate, there may however be a problem with Barley yellow dwarf luteovirus; damage can be prevented by late sowing (winter wheat) or early sowing (spring wheat), or by spraying an insecticide in the autumn. Seed treatment of winter wheat is also possible.

I n s e c t s

Thrips

General

Many species of thrips (Limothrips cerealium, L. denticornis, Stenothrips graminum, Haplothrips aculeatus, Thrips angusticeps, Haplothrips tritici, Aptinothrips elegans, Anaphothrips obscurus) feed on wheat leaves, causing silvery spots; infested leaves may turn brown. Feeding on the ear during emergence causes whitish, empty grains. Thrips are only a problem in the northern part of the EPPO region.

Basic strategy

Thrips can be controlled by spray application of insecticides, but this is normally not necessary. A single treatment may be applied after emergence of the ears (growth stage 50), if numbers exceed two larvae per ear. Thorough inspection is necessary, for the insects are minute and difficult to see. Sprays should not be applied after the milky-ripe stage. Certain treatments applied against aphids will give incidental control of thrips.

Tipula spp. (leatherjackets)

General

Leatherjackets are the larvae of craneflies (Tipula spp.). They live in the soil and largest populations occur in grassland.

Basic strategy

Wheat crops may be damaged when following grassland or uncultivated land. In general, this rotation should be avoided if possible. The presence of larvae can be checked before ploughing the grassland by either taking soil cores and extracting larvae in the laboratory or by pouring a salt solution onto the ground, which forces the larvae to the surface. Spring wheat is likely to be at risk when 50 larvae per m2 or more are present in early spring. Winter wheat is less at risk from leatherjackets because the crop usually establishes before the main feeding period of the larvae; no specific threshold has been expressed. Attacks may be prevented by ploughing out grassland before mid-August. It is GPP to apply a soil insecticide treatment, by overall spray at high water volume, soon after ploughing grassland or uncultivated land if damaging populations of leatherjackets are present. An overall spray at high water volume can also be applied to a growing crop if damage is seen.

Wireworms and white grubs

General

The larvae of certain Elateridae (Agriotes spp., wireworms) and Melolonthidae (Melolontha spp., white grubs) damage the stem bases and the roots of wheat plants. These become yellow and the main shoot turns brown. Development of wireworms takes several years, and adults and larvae of different ages coexist each year. Development of white grubs takes 3-4 years and is generally synchronized. Damage normally only occurs from the 3rd larval stage onwards, starting in the year after adult flight.

Basic strategy

Grassland or uncultivated land as a preceding crop should be avoided. However, if a wheat crop is grown in such a high-risk rotation, an overall soil spray treatment as well as the seed treatment may be justified. The level of population of wireworms and white grubs in the soil is needed to make an informed decision on treatment and should be determined by soil sampling.

Delia coarctata (wheat bulb fly)

General

Eggs of Delia coarctata are laid during the summer months in bare soil or in soil under a root crop. The eggs hatch in the following spring and the larvae bore into the wheat plant. Both winter and early-sown spring wheat may be damaged. The central shoot of the attacked plant dies, turning yellow although the outer leaves remain green. The larvae move from tiller to tiller on the same plant and sometimes through the soil to another plant. Damage is common and can be serious. Opomyza florum is another cereal fly which mines wheat stems like D. coarctata.

Basic strategy

Damage can be reduced effectively by cultural methods. The crop rotation can be chosen so that wheat does not follow a fallow or crop which provides suitable egg-laying conditions (bare soil during July and August). If the crop follows grass, ploughing out can be delayed to reduce egg-laying. Land lying bare after harvest should not be tilled in early August as this will encourage egg-laying. In high-risk situations, early drilling with an increase in seed rate is recommended.

Control with insecticides is normal GPP against D. coarctata. The type of treatment is decided on the basis of previous cropping, crop-sowing date and the perceived level of risk based on sampling for eggs. Insecticides are preferably applied as seed treatments, but may also be applied as seedbed sprays at or soon after sowing, as sprays at the start of egg hatch or at peak egg hatch, and as sprays at the onset of plant damage. If a soil or seed treatment has been applied against wireworms, this may also have action against D. coarctata, according to the insecticide used.

Agromyza spp. (leaf miners)

General

Agromyza spp. are small flies (3-5 mm long) which emerge in spring. The females feed by puncturing leaves along the veins. The eggs are deposited between the two epidermes of the leaves, and the larvae mine the mesophyll. The mines often become confluent, giving a typical appearance (mesophyll tissues in the upper third of leaf are completely destroyed). Agromyza spp. are locally important in northern Europe.

Basic strategy

Moderate levels of attack do not cause losses. Insecticide sprays may be applied from growth stage 31 in the case of heavy attacks, or if a threshold of more than 20% mining on lower leaves accompanied with puncturing of upper leaves is reached at growth stage 55. Aphid control has an incidental effect on Agromyza spp.

Oscinella frit (frit fly)

General

The larvae of Oscinella frit are 3-4 mm long, white, legless and lack a distinct head (though having black mouthparts). There are normally three generations a year, but only the autumn generation attacks wheat when it is sown after infested grass. The larvae migrate from the ploughed-in grass to invade the wheat plant, the centre leaf of which turns yellow and dies.

Basic strategy

If winter wheat is sown after grass, the land should be ploughed early and at least 4 weeks before sowing. Similarly, grass-infested stubble should be ploughed soon after harvest. The risk of damage to wheat is only slight in most years and does not justify routine insecticide spray treatment unless regular damage has occurred previously. Crops at risk should be examined from emergence and sprayed if more than 10% of shoots are damaged. Seed treatments are also effective.

Zabrus tenebrioides (corn ground beetle)

General

The larvae of Zabrus tenebrioides live in the soil in a self-made tube. Leaves of young wheat plants are pulled down into the tube. The larvae eat only the leaf blade. Damage can be detected from the remains of the leaves in the tubes. The pest tends to occur and damage plants in patches. The larvae are active in spring, and on mild winter days, and their development ends at the beginning of heading. Z. tenebrioides is mainly important in central and eastern Europe. It has one generation every 2 years in the northern part of its range and one generation per year in the southern part. It can survive on volunteer cereals.

Basic strategy

Cultural control can be used to reduce the risk of attack: early harvesting of straw and destruction of volunteer cereals. In areas of heavy infestation, an overall insecticide treatment of soil is recommended before sowing. Seed treatments may be used but are less effective. If infestations are nevertheless observed, a corrective spray treatment may be applied. It is advisable to treat in the morning or in the evening, as the larvae do not feed during daytime. Z. tenebrioides can also occur sporadically in other areas of Europe. In this case, a spray treatment when damage is seen is sufficient.

Eurygaster and Aelia spp. (shield bugs)

General

Pentatomid bugs (e.g. Aelia acuminata, A. rostrata, Eurygaster austriaca, E. integriceps, E. maura, E. testudinaria) are mainly important in south-east Europe and Mediterranean countries. Adults overwinter in uplands and migrate to cereal crops in spring. Nymphs develop on the wheat crop and cause damage by feeding on the young grain (injection of saliva which affects bread-making quality).

Basic strategy

Most commonly, sprays are applied at full heading to protect the young grain, on the basis of a threshold density of nymphs. An alternative strategy is to spray at the end of winter, when the adults migrate, on the basis of forecasts of adult development.

Cnephasia pumicana

General

Adults are small moths with 1.5-cm wingspan. They lay eggs in summer under the bark of trees. In spring, the larvae are carried to wheat crops by wind. They can be found mainly on field edges. They perforate the leaf surface and mine the leaves, causing leaves to curl upwards. At heading, they move to the ears on which they can cause serious damage.

Basic strategy

Insecticide sprays should be applied if a threshold of one larva per 20 tillers is observed.

Psammotettix striatus

General

This leafhopper transmits a phytoplasma causing a yellow dwarfing disease of wheat. The symptoms can be confused with Barley yellow dwarf luteovirus.

Basic strategy

Generally controlled by treatments against aphids. Sprays against Psammotettix striatus may be needed if aphids are not treated.

Contarinia tritici, Sitodiplosis mosellana (wheat blossom midges)

General

The larvae of Contarinia tritici feed on the floral parts of wheat, preventing pollination and development of the grain. The larvae of Sitodiplosis mosellana feed on the developing grain, resulting in reduced grain size and milling/baking qualities. In most seasons and regions, damage is slight. However, S. mosellana in particular can cause serious losses in northern Europe.

Basic strategy

Regular rotation will reduce numbers of midges. Intensive wheat growing and successive cropping will increase the risk of damage. When control measures are required, sprays should be applied between ear emergence and start of flowering.

Mayetiola destructor (Hessian fly)

General

The larvae damage the stems of wheat causing them to lodge. Damage occurs sporadically, mainly in northern Europe.

Basic strategy

An insecticide spray should be applied at the time of egg-laying, according to warning systems if available. A suggested threshold is 15 eggs per stem.

Haplodiplosis marginata (saddle gall midge)

General

In May and June, female midges deposit their eggs on the surface of wheat leaves. The whitish, later orange-red larvae attack the stems under the leaf sheaths. Larval feeding results in the formation of saddle-shaped galls. Spring-sown crops are more susceptible to damage than those sown in the autumn. Infestations are common but at low levels.

Basic strategy

The pest is associated with frequent cereal growing on heavy land. It can be avoided by practising a wide crop rotation and controlling grass weeds wherever possible. In high-risk areas, insecticide sprays are necessary and should be directed against newly hatched larvae. If 10% or more of tillers have eggs present, an insecticide should be applied at egg hatch. Only one application is necessary.

Oulema melanopus, O. gallaeciana (cereal leaf beetles)

General

Oulema melanopus and O. gallaeciana (syn. O. lichenis) are shiny-blue beetles which feed on wheat leaves, causing elongated holes. The yellow larvae are covered by a blackish, sticky substance and may be mistaken for small slugs. The larvae skeletonize the leaves, causing long white stripes.

Basic strategy

Damage is commonly seen, especially on spring-sown crops, but is often not very important. Chemical treatment is justified after reaching a threshold such as 15 adults per m2 just before oviposition, or 0.5-1 larvae per stem. Treatments may be combined with those against aphids, in which case suitable active substances should be used.

Aphid control strategies specific to Denmark

It is not GPP to add an insecticide to a fungicide treatment if the threshold is not exceeded.

The fields should be monitored for Ahpids from earing and on to GS 75.

The following thresholds are used:

GS 41-50: More than 40% tillers attacked

GS 51-60: More than 50% tillers attacked

GS 61-75: More than 60% tillers attacked

0,5-1,0 larvae of Oulema melanopus per ear bearing tiller

Nematodes

General

Two nematodes feed on the roots of wheat: Meloidogyne naasi (cereal root-knot nematode) which induces the formation of many extra roots and elongated root knots, and Heterodera avenae (cereal cyst nematode) which causes strong root branching and deformation, with cysts visible later in the season. Attacks are visible in the field as spots where crop growth is retarded. Spring-sown wheat is especially susceptible to M. naasi.

Basic strategy

Crop rotation is useful, reducing the proportion of cereals and grass seed crops. Maize is not a host plant and can safely be grown. No treatment is recommended specifically against these nematodes.

Slugs

General

Slugs (e.g. Agriolimax arvensis, Deroceras reticulatum) damage wheat seedlings and hollow out wheat seeds, and the problem is increasing with direct drilling and when land is left uncultivated (e.g. "set aside" according to the Common Agricultural Policy of the European Union). Early slug damage can be very important. Later leaf feeding is not important. Slugs are largely a problem on medium to heavy textured soils in wet seasons.

Basic strategy

A firmly consolidated seedbed will restrict slug movement and encourage rapid seedling growth. The surface should be clod-free. To assess the risk of slug damage and the need for and time of molluscicide treatments, test baiting when the soil surface is moist is advised. The normal method of treatment is to scatter molluscicide formulated as a bait, and it is most effectively applied after seedbed preparation but a few days prior to drilling. Bait pellets can also be mixed with the seed. As slugs are often at the borders of the field, spot treatment is sometimes possible.

Weeds

Basic strategy

Although chemical weed control is the most widely used method of weed control in wheat, there are opportunities to use cultural methods before sowing the crop and during crop growth, e.g. competitive crops and mechanical weed control. It is GPP to destroy emerged grass and broad-leaved weeds by mechanical cultivation or use of herbicides in the stubble of the preceding crop. This is particularly useful where it is intended to prepare the seedbed without ploughing. Normally, it is GPP to cultivate, e.g. to plough and harrow, before sowing the wheat crop, with a light harrowing and/or rolling after drilling to consolidate the seedbed, if necessary. Seedbed preparation methods depend on soil type, soil conditions and time of the year. The objective is to remove remnants of the previous crop, destroy weed populations and prepare a seedbed in optimal conditions to encourage rapid germination of a full, competitive stand of wheat and to provide a level clod-free surface for maximum activity of a residual herbicide.

Herbicides can be applied pre-sowing, pre-emergence, post-emergence and pre-harvest. Weed-control decisions should be based on economic damage thresholds if available (including the risk of seed return of aggressive weed species), or on past knowledge of the field, if a treatment before weed emergence is planned. Annual grass and dicotyledonous weeds may be controlled in the autumn provided that it is likely that weed thresholds may be exceeded. A suitable combination of residual and foliar-acting herbicides should be used. Late-sown crops or crops with low weed populations may not need herbicide treatment before the spring. Spring applications of suitable foliar-acting herbicides should be made only where annual grass or dicotyledonous weed thresholds are likely to be exceeded, or where weeds have escaped the autumn treatment, or where spring-germinating weeds predominate. With spring wheat, seedbed cultivation should destroy a large proportion of the autumn or spring-germinated weeds. A post-emergence foliar herbicide may be necessary, with rates adjusted for weed size.

It is GPP to ensure that conditions favourable for active growth of crop and weeds exist in the spring before application of a foliar herbicide. Crop and weed growth stages should be followed carefully to avoid inefficient use of herbicides on large weeds and crop damage. The risk of a carry-over effect to a succeeding crop should also be considered.

In order to delay or minimize the development of herbicide resistance, guidelines are available and should be followed.

Perennial weeds such as Phragmites australis, Juncus spp., Elymus repens, Cirsium spp. and volunteer potatoes can be controlled shortly before harvest with non-selective foliar herbicides, e.g. glyphosate. The crop should be almost dead at this time and the grain nearly ripe, and the weeds should be alive and well exposed. Spot treatment with ropewick applicators is also possible at this time for some weeds.

Weed Control Strategies Specific to Denmark

Delaying sowing can reduce the population of weed in the field. Although the level can be reduced it is often not cost effective to do so, as weed control still may be needed and yields will be reduced significantly from late sowing. Weed harrowing has in some situations been used successfully, but generally the methods are too uncertain in autumn sown crops.

It is recommended to make a weed map of the fields in order to know which weed problems are likely to appear. Before application monitoring of the weed species and numbers/m2 in the field should create background for assessing the need for control as well as recommending and effective herbicide and dose. Various handbooks or decision support systems can be used as support. It is generally recommended to aim at weed control in the autumn as this give good possibilities of using reduced dosages of herbicides. Only if specific weed problems develop in spring is it recommended to repeat the herbicide application. It is obligatory to control wild oat if this appear either by herbicide or hand weeding.

If perennial grasses (*Elymus repens)* are found at significant levels treatments can be recommended as pre-harvest treatment. This is not an option in wheat grown for bread quality.

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