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Estimation method for the volatilization of pesticides from plants

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ABSTRACT

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Often considerable fractions of the pesticide dosage applied on crops volatilize. They contaminate the environment and are no longer effective against plant diseases. Based on data collected from various publications, an empirical relation could be established between the cumulative volatilization of a pesticide from plants and its vapour pressure. No clear correlation was found for the Henry and octanol-water partition coefficients. Within limits, the derived equation can be used to estimate the volatilization of other pesticides used for crop protection.

Keywords: air, emission, environment, crops

Inhoud

Preface

The function of Environmental Planning Bureau (Milieuplanbureau, MPB) lies, according to the Law for Environmental Management (Wet Milieubeheer), with the National Institute of Public Health and Environment (RIVM). An important activity of the MPB is the release of the Environmental Balances (Milieubalans, MB), every year, and the Environmental Outlooks (Milieuverkenningen, MV), once in four years. DLO contributions are made available to the MPB as:
– analyses for parts of the environmental policy in rural areas;
– development of new and improvement of existing models and databases for rural areas;
– management and quality control of DLO-expertises.

The cooperation between RIVM and DLO has been given shape by signing an Agreement in 1996 and the formation of the DLO research program `Development of expertise for the Environmental Planning Bureau'. In this program expertise is developed and operationalised for policy analyses on a national and regional scale for the MPB-function and the Ministry of Agriculture, Nature Management and Fisheries. The research in the program is therefore partially financed by RIVM.

In the MB information is given on the rate and extent of the emission of pesticides into the environment and their fate. Part of the DLO contribution to the Environmental Planning Bureau is realized within the project `Emission of pesticides into environmental compartments'. The results from the project reported here are used to improve the quantification of pesticide emission into the air after its application onto crops. The research presented in this report was carried out in the period between spring 1997 and winter 1997. Its progress and findings have regularly been discussed within the project team, which consisted of:
– Ir A.M.A. van der Linden (RIVM);
– Dr ir. F. van den Berg (SC-DLO);
– Dr ir M. Leistra (SC-DLO);
– Ir A.A.M.F.R. Smit (SC-DLO);
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Summary

Concern about the exposure of man and environment to pesticides has incited many governments to ban the use of the most persistent and mobile compounds and to support research on the fate and effects on man and environment of others. Many pesticides are used against crop diseases and pests, often as a preventive measure, in the form of spray liquids. Once settled on the plant leaves, the spray liquid starts to evaporate and the emulsified, suspended or dissolved pesticide may volatilize. The resulting pesticide vapour disperses into the atmosphere and may contaminate soil surfaces or water bodies outside the target area. A low plant coverage or rainy weather conditions (wash-off) typically leads to deposition on the soil surface within the target area from where the pesticide may leach to surface or ground water.

The present study is aimed at deriving a method to estimate the volatilization from crops for all pesticides commonly used in The Netherlands for crop protection. The study is also part of a national research programme tracking the fate of all approved pesticides in the environment. Results of the programme are stored in a national database providing better estimates for the net pesticide deposition on the soil. Subsequently, these data are used as input for leaching models to evaluate potential hazards to surface and ground water. The output of these models are presented in the national Environmental Balance publications (Milieubalans).

The volatilization of a pesticide from the plant surface is related to its physico-chemical properties, the leaf properties, and a number of environmental conditions, such as temperature, wind speed, relative humidity, etc. Literature indicates that most compounds penetrate poorly into the epicuticular wax of the plant leaf, although a number of pesticides are known to work systemically in plants. Sometimes adjuvants are added to the spray liquid in order to support wax and cuticle penetration.

Cumulative volatilization data from the literature were correlated to respectively the vapour pressure, octanol-water partition coefficient (K_{ow}), Henry coefficient (K_{Henry}), and vapour pressure and Henry coefficient divided by the K_{ow} of the various pesticides. This led to the conclusion that for a reasonably large number of compounds only the vapour pressure can describe the cumulative volatilization with sufficient accuracy. Volatilization therefore appears to be affected to a minor extent by sorption processes in and on plant leaves, commonly represented by the K_{ow}. The partition coefficient between the vapour phase and the liquid phase of a pesticide, K_{Henry}, does not seem to be a relevant factor, probably because the water component of the spray liquid quickly evaporates after application. Sorption and water solubility, however, could play important roles when studying the volatilization behaviour of individual pesticides over a short period of time.

The empirical relation between cumulative volatilization (CV) and vapour pressure (VP) can be written as log CV = a + b log VP, with a = 1.528 and b = 0.466 (n = 24 and r^2 = 0.77). This relation applies to a period of 7 days after application and to all crops lumped together. All volatilization data obtained with the indirect method of residue measurements were disregarded. Data for the CV against VP over K_{ow} showed a much lower correlation (r^2 = 0.56).

Due to the limited amount of available data, no good estimates could be made for individual crops. Only the combination of data for vegetables, potatoes, and sugar beets produced a similar relation with a = 1.538 and b = 0.530 (n = 9 and r^2 = 0.85). Crop characteristics are known to have (some) effect on the rate of volatilization through height, shape (deposition and wash-off) and wax layer (adsorption).

Since all relations were derived in a spreadsheet, which also contained some 200 other pesticides approved for crop protection in The Netherlands, cumulative volatilization estimates could be made for those others as well. The time period for volatilization and ambient temperature can be freely selected. However, extrapolation to a period exceeding 1 week is not validated considering the shorter duration of most experiments.

Estimates for pesticide volatilization from plants have been entered in the ISBEST information system on the regional use of pesticides in The Netherlands. The coupling of regional use and field-scale volatilization allows an assessment of the regional magnitude of pesticide volatilization into the air. This provides a useful tool for the evaluation of environmental risks and for policy making.

The method presented here is expected to overestimate the cumulative volatilization for compounds subject to fast transformation, e.g. due to hydrolysis or phototransformation, or for compounds which act systemically in the plant leaves. Data available on these pesticide properties are limited and often show wide ranges, which impedes their inclusion in the presented approach.

No investigations were made into the influence of weather conditions on the volatilization from plants. Temperature, relative humidity, and wind speed can be considered as important factors in this process. Climate chambers connected to a windtunnel are available, facilitating studies where the effects on the volatilization of each individual variable can be analyzed. An one-on-one translation from chamber results to field conditions is not (yet) warranted due to a lack of sufficient comparative studies.

1 Introduction

The increasing environmental awareness concerning pesticide applications has induced governments to control their use in most western countries during the past decades. Measures are especially directed against the more mobile and persistent compounds. Pesticides are usually sprayed directly onto the plants for crop protection. During application a substantial part may reach the atmosphere by drift of very fine spray droplets. Afterwards, a considerable fraction of the pesticide deposited on the plant surface may volatilize into the atmosphere. Both, droplets and vapour may settle on soil or water surfaces outside the target area. A low plant coverage or rainy weather conditions (wash-off) may lead to deposition on the soil surface within the target area from where it may contaminate surface and ground water.

In this document an attempt is made to estimate the volatilization of pesticides from plant surfaces. The study is part of a more comprehensive national programme tracing the fate of a pesticide after leaving the spray boom, its deposition on plant and soil surfaces, its long term volatilization behaviour, and its leaching potential to surface and ground water. Soil deposition and interception by the crop during application are covered in complementary studies by Porskamp et al. (1996) and Van de Zande (1998), respectively. Pesticide volatilization from the bare soil surface is described in Smit et al. (1997). A quantification of vapour and drift losses during spraying will be made in the near future. The combination of pesticide use and local emission should finally provide assessments of net loads on the soil surface on a regional and even national scale. All results are therefore collected in the national ISBEST information system (Informatie-Systeem BESTrijdingsmiddelen, Lentjes and Denneboom, 1996). Subsequent use of leaching models allows an evaluation of potential risks to surface and/or ground water.

Literature generally indicates the vapour pressure as having the largest influence on the volatilization of a pesticide. The wide range in vapour pressure, from virtually zero to several thousands of millipascals for the most common pesticides in crop protection, may therefore lead to substantial differences in the magnitude of volatilization. In this study it is attempted to establish a relation between the cumulative volatilization from the plant surface and the vapour pressure. Also possible relations with other physico-chemical properties, or combinations of them, are investigated.

Both, the large number of pesticides involved and data handling and correction procedures advocated the implementation of a spreadsheet approach. Moreover, the development of a spreadsheet adds a certain flexibility where the user can change environmental conditions and can add or delete particular compounds.

This report is divided into five chapters. After this introduction, Chapter 2 presents a general discussion of the pesticide properties and the various mechanisms involved in the volatilization from the plant surface. Chapter 3 describes the developed estimation method and the results obtained with this method. Chapter 4 presents a general discussion of the results. Finally, Chapter 5 provides the major conclusions and recommendations.

2 Mechanisms influencing volatilization

2.1 Introduction

In crop protection the plant material is the sole target for pesticide applications. Spraying large surfaces in the field requires ground-driven machinery or special spraying planes. This process usually leads to losses outside the fields due to inaccurate treatment and due to drift of very fine spray droplets. The weather conditions during application are a major factor determining these losses. Generally, farmers will wait for appropriate weather before spraying.

Other losses may occur as well. It can be expected that for fields with a plant coverage of less than 100%, part of the pesticide dosage reaches the soil surface. This fraction does not contribute to the crop protection. Also rainfall occurring within a few hours after application, i.e. before the spray droplets on the leaves are dried-up, often results in a complete or partial wash-off of the pesticide to the soil surface. Prolonged, intensive rainfall after this period may have the same effect.

The volatilization of a pesticide from the leaf surface is likely to depend on its physico-chemical properties with the vapour pressure as prime parameter. The amount effectively available for volatilization, however, also depends on the fraction of the pesticide immobilized by sorption in the wax layer of the leaf and by relevant transformation processes, such as hydrolysis and photo-transformation. The pesticide formulation, including the various adjuvants, may influence the distribution of the spray liquid over the leaves, which on its turn determines the effective contact area with the surrounding air. Adjuvants are sometimes also added to enhance the penetration of the pesticide into the plant material. Finally, sunlight intensity, ambient temperature, wind speed, and precipitation can be expected to play an important role during and after spray application.

2.2 Application

Spray applications of pesticides do not reach the target crop completely. Part of the dosage remains in the atmosphere for some time as very fine spray droplets. Eventually these droplets may vaporize or be deposited on non-target areas by drift. The weather conditions during application largely determine which process predominates. To date, these loss routes cannot be quantified. Further research can be conducted by monitoring the pesticide concentration in air, measuring pesticide deposits on surrounding areas and pesticide concentrations in water bodies, and by using modelling techniques (Holterman et al., 1994).

For cases where the crop incompletely covers the soil, another part of the pesticide dosage is likely to settle on the soil surface instead of on the target crop. An estimation for the deposition on the crop is provided by Van de Zande (1998). In this study, pesticide fractions deposited at different levels in the crop are related to application technique, crop type and growth stage, and leaf area index (LAI). The difference between spray dosage and deposition on the leaves has reached the soil, is lost to the

atmosphere, or is the result of the combination of both.

Pesticides are often applied in water-based spray liquids. These sprays settle on the plant leaves in a pattern of small droplets (Holloway, 1994). The fate of the pesticide is likely to be influenced by this pattern. Sometimes surfactants are added to the formulation in order to obtain a better leaf cover, thereby promoting a better protection against plant diseases. An enlarged contact area may be especially useful for pesticides acting systemically in the plant. Similar effects can be obtained by adding adjuvants which help pesticides in passing the epicuticular wax layer and epidermis of the plant leaves.

Rainfall has a distinct influence on the effectiveness of a pesticide on plant leaves. McDowell et al. (1987) mentions that the amount of rainfall may have a larger effect than rainfall intensity on the wash-off of an emulsifiable concentrate formulation of fenvalerate from cotton plants. However, rainfall occurring within a few hours after spraying usually has serious consequences, often resulting in a partial or complete wash-off of the pesticide. The Netherlands Ministry of Agriculture, Nature Management, and Fisheries advises farmers to spray contact fungicides only when a dry period between approximately 1.5 and 7 hours can be expected, depending on the actual weather conditions (IKC). The longer the weather stays dry the tighter the fungicides will be attached to the leaf surface, although the danger of wash-off remains for prolonged rainfall and, especially, intensive rain showers.

2.3 Properties and processes

Watanabe (1993) related the volatilization rate of 14 pesticides to their physico-chemical properties. It was concluded that for rice leaves the vapour pressure divided by the solubility in water and the sorption coefficient for organic carbon gave the best explanation ($r^2 = 0.83$). For glass surfaces a similar relation, but without the sorption coefficient, was found ($r^2 = 0.90$). Because volatilization rates were measured almost directly after spraying, i.e. in the presence of a wet deposit, the water solubility could be expected to be involved.

The majority of the spray liquids applied in the field are water-based. Depending on the weather conditions, the water component of the liquid may evaporate relatively fast from the leaf surface. This implies that the water solubility will hardly affect the cumulative volatilization, a process which may continue for several days or even longer for the less volatile compounds.

Taylor and Spencer (1990) describe the volatilization of pesticides into the atmosphere as two separate processes. The first one concerns a phase change from the liquid or solid state into vapour. The second process is the dispersion of the resulting vapour into the atmosphere through molecular diffusion and turbulent mixing. According to Hartley and Graham-Bryce (1980), the air layer with laminar flow characteristics, where diffusion controls the vapour transport, can only be defined in terms of an effective thickness. Its depth above the leaf surface is not expected to exceed a few millimetres and will vary with wind speed and surface roughness. Above this layer a transition zone exists where the flow becomes increasingly turbulent.

The effective vapour pressure is likely to be reduced by sorption and permeation into cuticular waxes and epidermal layer of the plant leaves (Taylor and Glotfelty, 1988). The degree of reduction is difficult to quantify, but Briggs and Bromilow (1994) state that most compounds penetrate poorly without adjuvants. Both, leaf type and pesticide characteristics in combination with the formulation can be expected to determine the extent of penetration. In a comparative study, Boencke et al. (1990) found very small differences for the cumulative volatilization of mevinphos from lettuce, kohlrabi, green beans, and summer wheat. The cumulative volatilization of lindane from lettuce leaves was found to be 97% of the original pesticide deposit versus 88% for summer wheat. Both values were measured after a period of one day. For deltamethrin a volatilization of 34% was established from kohlrabi against about 70% for the other crops after a similar period, which could be attributed to the waxy nature of kohlrabi leaves in relation to the sorptive properties of this compound.

Briggs and Bromilow (1994) give a qualitative description of the penetration of pesticides into the leaf. The solution is presented as the indispensable transport medium for percutaneous absorption, even to the extent that it is concluded that adjuvants, added for increasing the absorption of pesticides, mainly function as solubilising agents. Penetration into the wax layer, which is essentially hydrocarbon, is related to both the octanol-water and alkane-water (generally hexane or cyclohexane) partition coefficients and the type of leaf wax. A further permeation into the cuticle is associated with the octanol-water partition coefficient. It is expected that penetration into epicuticular waxes depends on the lipophility of the compound, for which no experimental data are available at present. Some presented general empirical rules are: (1) non-polar compounds are better absorbed than polar, (2) lipoidal compounds better than non-lipoidal, (3) solids with a low melting point better than those with a high melting point, and (4) liquids better than solids.

The cumulative volatilization depends on the pesticide residue on the leaves. Residues may also be depleted through photochemical transformation. A fraction of the residues residing on the surface of the (outer) plant leaves may effectively be transformed into metabolites by solar radiation, especially at the UV wavelengths (Leistra, 1998).

3 Estimation method

3.1 Introduction

In this chapter a method is presented to estimate the cumulative volatilization from plant surfaces of all pesticides approved for crop protection in The Netherlands. An inventory of the available literature data on volatilization together with the experimental conditions and the major pesticide properties, such as vapour pressure, solubility in water, and octanol-water partition coefficient, are presented in Paragraphs 3.2 and 3.3. In Paragraph 3.4 the effect of temperature on these properties is discussed. Adjustments for the various dosages referred to in the publications to the (gross) spray dosage are dealt with in Paragraph 3.5. This section also includes a correction procedure for the volatilization from the soil surface in cases where the spray liquid was not completely intercepted by the crop canopy. Finally, the best relation between the cumulative volatilization and one (or a combination) of the properties is selected in Paragraph 3.6. Estimates for the cumulative volatilization of other pesticides can then be made using the derived empirical equation.

Handling a large amount of data can be considerably facilitated by the development of a spreadsheet. Such an approach also adds a certain flexibility where the user can easily change input parameters and can add or remove particular compounds. Hence, all data and computations were entered in spreadsheet.

3.2 Literature data and experimental conditions

In general it can be stated that data on the volatilization of pesticides from plant surfaces are rather scarce. The literature search resulted in approximately 60 publications of which only 16 provided useful information, i.e. in terms of time series of volatilization measurements for one day or longer and a reasonably accurate description of the experimental conditions.

Data collected from the 16 publications are compiled in Annex 1. The used format includes:

title   - name of author and year of publication;
compound   - name of compound with most relevant physico-chemical properties;
formulation   - in GIFAP codes or trademark description;
date/place   - date and place of experiment;
duration   - duration of experiment (in days);
application   - mode of application (e.g. hand or machine sprayed, tools used, spray rate and time, etc.);
dosage   - pesticide dosage (in kg ha^{-1});
method   - experimental conditions (field, climate chamber, laboratory, and method used for air sampling);
plant/crop   - crop type, variety, height (in m), canopy cover (in %), and spray interception (in % of dosage);
soil   - relevant soil parameters, such as soil texture, organic matter or

organic carbon content (in %), moisture content at saturation (in %), dry bulk density (in kg m^{-3}), treated area (in m^2), depth of soil (in m for laboratory experiments only), temperature (in ^{o}C), and spray interception (in % of dosage);

water regime - rainfall and/or irrigation events (in mm on specified day during experiment); actual soil moisture content (in % on specified day, average value between brackets unless mentioned otherwise);

micro-climate - air temperatures (in ^{o}C at given height on specified day and where possible as night-day averages); wind speed (in m s^{-1} at given height on specified day and where possible as night-day averages; sometimes given as a range with average value between parentheses); relative humidity of the air (in % at given height on specified day and where possible as night-day averages; sometimes given as a range with average value between parentheses);

residue - pesticide residue on plant leaves at a number of time intervals after application (in % of dosage or in % of initial deposit); pesticide residue on the soil at a number of time intervals after application (in % of dosage or in % of initial deposit);

volatilization - volatilization rate at a number of time intervals after application (in g ha^{-1} h^{-1}); cumulative volatilization at a number of time intervals after application (in % of dosage).

Experimental conditions can vary from field trials to climate chambers and laboratory experiments. Especially in Germany a tendency can be observed to simulate outdoor conditions in specially designed climate chambers. These chambers are able to reproduce a variable wind speed in and over the crop, together with a variable temperature and humidity of the air, all in analogy to field conditions (Kubiak et al., 1993). Later versions even include artificial light sources for simulating the solar cycle. Atmospheric pesticide concentrations are measured by sampling small air volumes at the outlet. The setup of a closed chamber also permits the use of ^{14}C-labelled compounds, enabling a quantification of the mass balance. Often experiments are conducted in combination with a separate application chamber, where plants are sprayed with a dosage according to field practice. A comparative study between a field and climate chamber experiment carried out by Kubiak et al. (1995) showed good agreement. A cumulative volatilization of 74.7% (of the dosage) was found for methyl-parathion in a 24 hour field trial against 77.2% for the corresponding climate chamber experiment. A reasonable agreement was also reported by Van den Berg et al. (1995) in a similar comparison, albeit for a rather short period of time due to a breakdown of the climate control equipment connected to the chamber.

The above indicates that data from field trials and climate chambers may be combined for establishing a relation between volatilization data from the literature and the physico-chemical properties of the pesticides. Results from laboratory experiments, however, may deviate substantially from those obtained in field experiments due to large differences in environmental conditions.

3.3 Physico-chemical properties of pesticides

Annex 2 contains the most relevant physico-chemical properties for all pesticides referred to in Annex 1, presenting the compiled data from the publications. Included are molecular mass (M), saturated vapour pressure (VP), solubility in water (S_{water}), air-water partition coefficient (K_{Henry}), and octanol-water partition coefficient (K_{ow}). The (cyclo)hexane-water partition coefficient is only available for a limited number of compounds and has therefore not been included in the analysis. In some cases no direct value could be obtained for the K_{ow}. However, a conversion can be made using the sorption coefficient for organic carbon in the equation presented by Rao and Davidson (1980):

$$\log(K_{oc}) = 1.029 \log(K_{ow}) - 0.18 \tag{1}$$

The major sources for the physico-chemical properties of pesticides are Tomlin (1994) and Hornsby et al. (1996). The Henry coefficient for all pesticides is calculated from their vapour pressure and solubility in water. The pertaining temperature for vapour pressure and water solubility is usually room temperature, unless mentioned otherwise.

3.4 Temperature effects

Ambient temperature during experiments may have a considerable effect on the vapour pressure and solubility in water of pesticides. Smit et al. (1997) proposes to make adjustments from room temperature (as usually cited by the various manuals) to ambient temperature using the Clausius-Clapeyron equation (Klotz and Rosenberg, 1974). This equation is commonly written as:

$$\frac{d(\ln VP)}{dT} = -\frac{\Delta H_v}{RT^2} \tag{2}$$

where: VP = vapour pressure at temperature T (Pa)
ΔH_v = heat of vaporization (J mole^{-1})
R = universal gas constant (8.314 J mole^{-1} K^{-1})
T = temperature (K)

Since information on the heat of vaporization for a specific pesticide is often missing, an average value of 95 kJ mole^{-1} is proposed (Smit et al., 1997). For a number of compounds included in this study values could be retrieved from the literature (Table 1).

Tabel 1 Heat of vaporization for five pesticides

Compound	Heat of vaporization (kJ mole^{-1})	Reference
lindane	115	Gückel et al., 1982
parathion	96	Gückel et al., 1982
parathion-methyl	94	Gückel et al., 1982
pp-DDT	117.9	Gückel et al., 1982
dieldrin	98.8	Spencer et al., 1969

In a similar way as for the vapour pressure, adjustments can also be made for the solubility in water by substituting the vapour pressure VP in Equation (2) with the solubility S and $\triangle H_v$ with the differential heat of solution $\triangle H_{sol}$ (Bowman and Sans, 1985). Table 2 presents some values for $\triangle H_{sol}$ taken from the literature. An average value of 27 kJ mole^{-1} was derived by Smit et al. (1997). This value can be used for pesticides without experimental data.

Tabel 2 Differential heat of solution for three insecticides (source: Bowman and Sans, 1985)

Compound	Differential heat of solution (kJ mole^{-1})
parathion	13.90
parathion-methyl	35.25
dieldrin	32.74

3.5 Adjustments for dosage and volatilization from soil

Volatilization of pesticides from field crops can be measured in two ways, directly and indirectly. Direct measurements are carried out by air sampling above the crop for which several techniques are available, with the aerodynamic and Bowen ratio methods as the most common among them (Majewski et al., 1990). These methods give a fairly accurate estimate of the actual rate of volatilization. The cumulative volatilization (CV) is calculated by integrating the volatilization rate over time and is (usually) expressed as a percentage of the applied dosage. Sometimes, however, the net dosage on the plants (and soil) is used as reference, thereby excluding the application losses. The net dosage can be calculated from deposits on the soil or from deposits on leaves fixed in a horizontal position in the field before spraying. In this study, CV values expressed in percentage of net dosage are converted to gross dosage using:

$$CV_{gross}\, D_{gross} = CV_{net}\, D_{net} \tag{3}$$

with: CV_{gross} = cumulative volatilization in percent of gross dosage
           D_{gross} = gross pesticide dosage (kg ha^{-1})
           CV_{net} = cumulative volatilization in percent of net dosage
           D_{net} = net pesticide dosage on plants (kg ha^{-1})

The volatilization measurements in most laboratory and climate chamber experiments are usually conducted with direct air sampling. Cumulative volatilization is related to the net dosage on plants (and soil), determined after subtraction of all application losses and wall contamination from the gross dosage. Thus obtained CV_{net} values are directly comparable to CV_{gross} values obtained in the field and do not require correction.

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The indirect method, on the other hand, estimates the cumulative volatilization based on residue measurements on plants. This approach entails the risk of neglecting other dissipation processes, such as pesticide absorption by the plant leaf, hydrolysis, photochemical transformation, etc. Pesticide behaviour should therefore be verified a priori. Interaction with the leaf and DT_{50} values for hydrolysis and photolysis can usually be retrieved from (product) manuals. Since systemic absorption by plant material is difficult to quantify and few DT_{50} values for photochemical transformation on leaves under outdoor conditions are available (and often show wide ranges depending on experimental conditions), it is advised to interpret the results obtained with this method with caution. Cumulative volatilization calculated for pesticides showing systemic action or having DT_{50} values in the order of a few days should be disregarded.

The cumulative volatilization obtained with the indirect method is expressed in percentage of the initial pesticide deposit on the plant leaves. For field experiments, additional information may be available regarding the spray dosage. This would permit a conversion from CV values based on leaf deposit into values based on gross dosage in analogy to Eq. 3.

Part of the pesticide dosage may reach the soil, especially if its surface is not completely covered by the crop canopy. This part may contribute to the volatilization rate measured with the direct method. Total volatilization can be written as follows when assuming the volatilization from plant and soil to be independent:

$$CV'_{gross} \, D'_{gross} = CV_{plant} \, D_{plant} + CV_{soil} \, D_{soil} \qquad\qquad (4)$$

with:
CV'_{gross}	=	cumulative volatilization in percent of gross dosage
D'_{gross}	=	gross pesticide dosage (kg ha^{-1})
CV_{plants}	=	cumulative volatilization in percent of plant deposit
D_{plants}	=	pesticide dosage on plants (kg ha^{-1})
CV_{soil}	=	cumulative volatilization in percent of soil deposit
D_{soil}	=	pesticide dosage on soil (kg ha^{-1})

D_{soil} can be estimated from the fraction of the gross (or net) pesticide dosage reaching the soil surface, based on for instance soil cover. Other methods include direct measurements of the soil deposit or backwards extrapolation using soil residue samples.

At present, CV_{soil} can only be estimated with a procedure developed for the volatilization from fallow soil (Smit et al., 1997). A well developed crop canopy will certainly interfere with the volatilization from the soil surface during daytime, mainly in terms of a higher pesticide concentration in the air, a lower net radiation, a lower soil temperature, and a lower wind speed. Hence, it can be expected that the actual cumulative volatilization from the soil will be lower than what is predicted by the estimation method. Since adsorption of pesticides to soil organic matter is usually much higher than absorption by plant leaves, and generally small pesticide fractions reach the soil surface when the crop is well developed, the contribution of volatilization from the soil to the total volatilization is expected to be small.

3.6 Results

The cumulative volatilization data retrieved from the literature are summarized in Table 3 for the field and climate chamber experiments. In total 14 useful publications were found with 13 different pesticides and 14 different crops. A direct comparison is complicated by the different duration of the various experiments, varying between 1 and 33 days, with some 5 days as average value. Annex 1 contains sufficient volatilization data, as retrieved from the various publications, to enable a regression analysis against time. Plotting these data on double logarithmic scales gave the best linear relation for pesticides with low volatilization rates, i.e. with a cumulative volatilization of less than some 10% of the dosage. For all other pesticides, plotting time on a logarithmic scale against the cumulative volatilization on a linear scale generally produced the best relation (Table 3). Subsequently, all volatilization data were inter- or extrapolated to a standard period of 1 week in the spreadsheet.

Another complication for intercomparison of the volatilization data is formed by differences in the dosage to which these data refer. As discussed in the previous paragraphs, volatilization data obtained with the direct measurement methods are usually related to application dosage or net dosage (application dosage minus spray losses). Recalculation of the cumulative volatilization on the basis of application dosage is usually possible. Generally, this is not the case when the volatilization was calculated using the indirect method. Initial pesticide deposits on plants cannot be related to spray dosage, because the latter information is lacking in most cases.

The spreadsheet was also used for adjustments in vapour pressure and solubility for other ambient temperatures than referred to in the handbooks. Moreover, (minor) corrections were included for the volatilization from the soil in cases where information was available about the fraction of the dosage that had reached the soil surface. The resulting cumulative volatilization for each pesticide is plotted on double logarithmic scales in Figs. 1 to 5 against its vapour pressure, octanol-water partition coefficient (K_{ow}), Henry coefficient (K_{Henry}), vapour pressure divided by K_{ow}, and Henry coefficient divided by the K_{ow}, respectively. A classification into field and climate chamber studies is made in all figures, with a further division into the direct and indirect methods used for determining the volatilization. Results obtained with the direct method are related to application or net dosage and those obtained with the indirect method to the initial plant deposit. For completeness laboratory results are also included.

Results for the insecticide toxaphene were marked beforehand as inconclusive based on findings in an earlier study (Smit et al., 1997). Its composition as a mixture of different compounds makes it impossible to establish single physico-chemical properties. With regards to deltamethrin, also denoted as inconclusive, it is remarked by the author of the study that this compound is not suitable for experiments using the indirect method for estimating the cumulative volatilization due to its vulnerability for phototransformation (Boencke et al., 1990).

Generally, field and climate chamber experiments with direct measurement of the pesticide volatilization can be considered as most reliable. Visual inspection of the 5 figures show that for the limited data set the cumulative volatilization can only be correlated to the vapour pressure and vapour pressure divided by K_{ow}. This is more clearly shown in Figures 6 and 7, where all redundant information obtained with the

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indirect method, laboratory experiments, and compounds showing anomalies in their behaviour are filtered out. The resulting empirical equation for the cumulative volatilization against vapour pressure at 7 days after application reads (n = 24 and r^2 = 0.77):

$$\log CV = 1.528 + 0.466 \log VP \quad ; \quad VP \leq 10.3 \tag{5}$$

where: CV = cumulative volatilization (% of applied dosage)

VP = vapour pressure (mPa)

An equation similar to Eq. (5) can be derived for the cumulative volatilization against vapour pressure divided by K_{ow} (n = 24 and r^2 = 0.56):

$$\log CV = 2.365 + 0.224 \log \frac{VP}{K_{ow}} \quad ; \quad \frac{VP}{K_{ow}} \leq 0.023 \tag{6}$$

with: K_{ow} = octanol-water partition coefficient (-)

Cumulative volatilization from crops for all other pesticides than those covered by the available literature can be best estimated using Eq. 5. For compounds with a vapour pressure above some 10.3 mPa the cumulative volatilization is set at 100% of the dosage. In the same spreadsheet as discussed above, about 200 pesticides approved for crop protection in The Netherlands were entered. These pesticides were classified according to the name of their active ingredient and were retrieved from the ISBEST information system, a national database for the use of pesticides (Lentjes and Denneboom, 1996). Spreadsheet output with estimates for the cumulative volatilization of pesticides from crops is included as Annex 4.

A further refinement can be obtained by splitting up the available data for more or less identical crops. This was done for the following combinations:
– low crops: vegetables, potatoes, sugar beet;
– cereals: wheat, summer wheat, barley;
–   beans.

Tabel 3 Cumulative volatilization (CV) values for 13 pesticides in 14 field and climate chamber studies at the end of the measurement period and estimated values at 7 days after application

Reference	Compound	Crop	Duration experiment (days)	CV at end of study (in % of dosage)	CV estimated at t=7 days (in % of dosage)	Correlation coefficient (r^2) Single log plot	Double log plot	Number of observations
Boencke et al., 1990	mevinphos	lettuce	3.1	98	100	0.710[1]	0.634	5
	mevinphos	kohlrabi	3.1	98	100	0.940[1]	0.860	5
	mevinphos	green beans	3.1	100	100	0.846[1]	0.815	5
	mevinphos	summer wheat	3.1	100	100	0.821[1]	0.753	5
	lindane	lettuce	3.1	97	100	0.858[1]	0.804	5
	lindane	kohlrabi	3.1	94	100	0.797[1]	0.700	5
	lindane	green beans	3.1	90	100	0.733[1]	0.672	5
	lindane	summer wheat	3.1	88	100	0.764[1]	0.655	5
	deltamethrin	lettuce	3.1	70	80	0.854[1]	0.848	4
	deltamethrin	kohlrabi	3.1	34	33	0.798[1]	0.969	3
	deltamethrin	green beans	3.1	72	93	0.926[1]	0.884	5
	deltamethrin	summer wheat	3.1	69	81	0.980[1]	0.971	3
Van den Berg et al., 1995	chlorothalonil	potato	7.1	4.7	4.3	0.689	0.988[1]	5
	parathion-ethyl	potato	7.1	31	31	0.926[1]	0.971	5
	parathion-ethyl	potato	1.1	25.8	42	0.997[1]	0.963	4
Grover et al., 1985	2,4-D	wheat	4.6	21	24	0.975[1]	0.968	6
Haenel and Siebers, 1995	lindane	sugar beet	3	100	100	0.884[1]	0.789	5
	lindane	sugar beet	3	100	100	0.930[1]	0.916	5
	lindane	sugar beet	1.7	98	100	0.997[1]	1.000	3
	lindane	sugar beet	3	100	100	0.944[1]	0.892	5
	lindane	sugar beet	3	100	100	0.986[1]	0.963	5
	lindane	sugar beet	1.7	95	100	0.993[1]	0.990	3
Smelt et al., 1997	fenpropimorph	sugar beet	6	16.5	18.4	0.913[1]	0.888	5
Willis et al., 1992	parathion-methyl	cotton	2	91	100	0.999[1]	0.991	5
	parathion-methyl	cotton	2	90	100	0.996[1]	0.961	5
	parathion-methyl	cotton	2	96	100	1.000[1]	0.997	5
	parathion-methyl	cotton	2	100	100	0.998[1]	0.991	5
	parathion-methyl	cotton	2	90	100	0.999[1]	0.992	5
	parathion-methyl	cotton	2	93	100	1.000[1]	0.996	5
Kubiak et al., 1995	parathion-methyl	french beans	1	77.2	100	0.995[1]	0.907	4
	parathion-methyl	french beans	1	74.7	100	0.832[1]	0.737	4
	isoproturon	french beans	1	0.6	0	na	na	na
	isoproturon	french beans	1	0.0	0	na	na	na

Table 3 Cont'd

Reference	Compound	Crop	Duration experiment (days)	CV at end of study (in % of dosage)	CV estimated at t=7 days (in % of dosage)	Correlation coefficient (r^2)		Number of observations
						Single log plot	Double log plot	
Rüdel and Waymann, 1992	lindane	garden beans	1.2	37.3	55.2	0.956[1]	0.983	5
	lindane	garden beans	1.2	57.5	82.8	0.946[1]	0.990	5
	lindane	garden beans	1.2	57.9	83.7	0.952[1]	0.991	5
Waymann and Rüdel., 1995	lindane	french beans	1.2	57.8	75.8	0.932[1]	0.956	5
	lindane	french beans	1.2	60.1	87.0	0.940[1]	0.995	5
	lindane	french beans	1.2	67.7	99.9	0.948[1]	0.992	5
Siebers et al., 1993	lindane	sugar beet	2	98	100	0.898[1]	0.918	4
	lindane	sugar beet	2	68	93	0.918[1]	0.936	4
Staimer et al., 1996	fenpropimorph	summer barley	4	48	57	0.961[1]	0.946	7
	fenpropimorph	summer barley	4	46	55	0.967[1]	0.968	7
	fenpropimorph	summer barley	4	60	71	0.926[1]	0.946	7
Stork et al., 1994	parathion-methyl	dwarf beans	6	73	77	0.970[1]	0.953	6
Taylor et al., 1977	dieldrin	grass	22.5	40	33	0.961[1]	0.955	8
	heptachlor	grass	22.5	85	81	0.858[1]	0.781	8
Willis et al., 1983	toxaphene	cotton	10.7	4.7	3.8	0.802	0.995[1]	6
	toxaphene	cotton	32.7	17	6.0	0.767	0.989[1]	6
	DDT	cotton	32.7	11	4.7	0.828	0.978[1]	6

[1]selected in spreadsheet
na=not applicable

The first combination produced an equation closely resembling Eq. 5 (with $n = 9$ and $r^2 = 0.85$):

$$\log CV = 1.538 + 0.530 \log VP \quad ; \quad VP \leq 7.4 \tag{7}$$

where: CV = cumulative volatilization (% of applied dosage)

Available data for the cereals turned out to be too limited for drawing any reliable conclusion. For the third group (beans), only the combination of volatilization results obtained with both the direct and the indirect methods, together with dosage conversion and including lab experiments, could produce a valid empirical relation (with $n = 16$ and $r^2 = 0.81$):

$$\log CV = 1.857 + 0.123 \log VP \quad ; \quad VP \leq 14.5 \tag{8}$$

where: CV = cumulative volatilization (% of deposit on plant leaf)

Fig. 1 Cumulative volatilization at 7 days after application against vapour pressure (Field = field measurement, Chamb = climate chamber measurement, Lab = laboratory measurement, Dir = direct measurement of pesticide concentration in air, Ind = indirect method by measuring pesticide residue on plant leaf, Gr = based on gross dosage, Nt = based on net dosage, Pl = based on plant deposit)

Fig. 2 Cumulative volatilization at 7 days after application against octanol-water partition coefficient
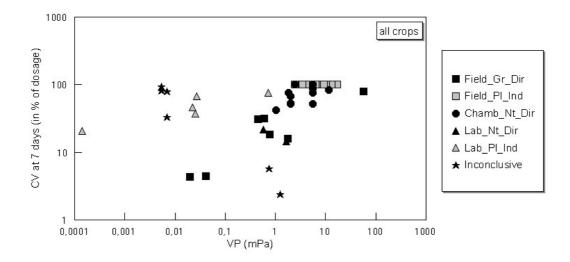
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Fig. 3 Cumulative volatilization at 7 days after application against Henry coefficient (Field = field measurement, Chamb = climate chamber measurement, Lab = laboratory measurement, Dir = direct measurement of pesticide concentration in air, Ind = indirect method by measuring pesticide residue on plant leaf, Gr = based on gross dosage, Nt = based on net dosage, Pl = based on plant deposit)

Fig. 4 Cumulative volatilization at 7 days after application against vapour pressure over octanol-water partition coefficient

Fig. 5 Cumulative volatilization at 7 days after application against Henry coefficient over octanol-water partition coefficient (Field = field measurement, Chamb = climate chamber measurement, Lab = laboratory measurement, Dir = direct measurement of pesticide concentration in air, Ind = indirect method by measuring pesticide residue on plant leaf, Gr = based on gross dosage, Nt = based on net dosage, Pl = based on plant deposit)
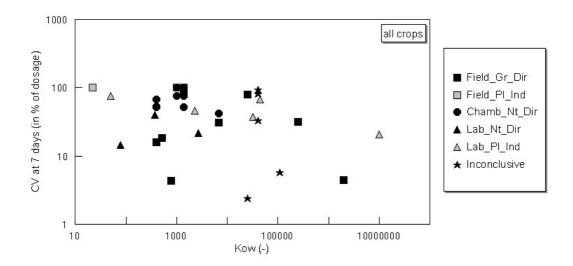

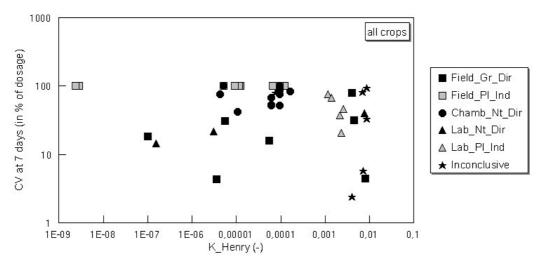*Fig. 6 Cumulative volatilization at 7 days after application against vapour pressure (without redundant data)*

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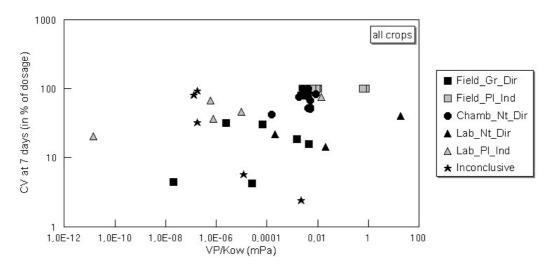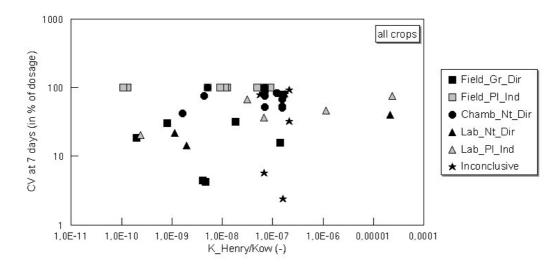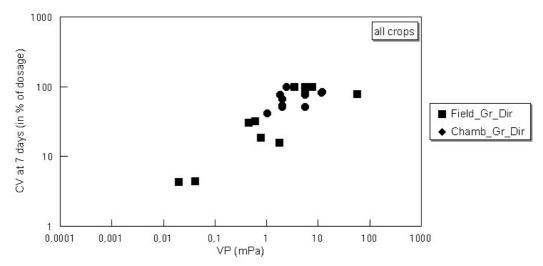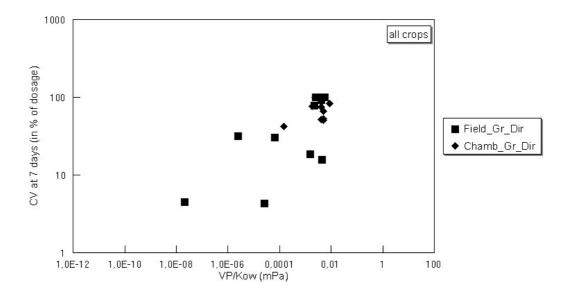*Fig. 7 Cumulative volatilization at 7 days after application against vapour pressure over octanol-water partition coefficient (without redundant data)*

4 General discussion

Literature on the volatilization of pesticides from plant leaves after spraying shows that high rates occur for many compounds. Lindane and parathion-methyl, for example, may be lost to the atmosphere within a few days. Some banned persistent insecticides, as for instance DDT and dieldrin, showed lower rates. Their volatilization, however, continued over a period of 3 to 4 weeks. Only isoproturon was found to volatilize to a very low extent.

Absorption by plant material could immobilize pesticides so that they are not available for emission to the atmosphere. Literature, however, indicates that most pesticides penetrate poorly into foliage without adjuvants. Indirectly, this view is supported by the high volatilization rates found, especially when compared to rates measured after soil applications. Apparently, the organic matter in the soil binds pesticides much more effectively than a wax layer on plant leaves.

Actual weather conditions after application, such as sunlight and wind speed, are expected to have more effect on the volatilization of pesticides from plants than from soils, mainly as a result of differences in sorption between plant and soil surfaces. The literature indicates that rainfall may cause a substantial reduction in pesticide residue on the plant leaves via wash-off. This may lead to a decline in volatilization rate, an increase in pesticide load on the soil (with a higher risk of leaching), and a less effective crop protection. The pesticide accumulated at the soil surface, due to wash-off or an incomplete soil cover during spraying, also contributes to the volatilization from a cropped field. However, the higher adsorption by the soil and the shielding effect of the crop canopy against weather influences renders this contribution relatively small.

The wide diversity in experimental data had to be elaborated in order to obtain a uniform measure of the extent of pesticide volatilization. The duration of the reported experiments varied between 1 and 33 days. This required inter- or extrapolation of the presented cumulative volatilization data, using regression analysis with single or double logarithmic conversion of the scales along the axes. One week was selected as the standard period for calculating the cumulative volatilization, because volatilization rates for most pesticides show a sharp decline a few days after application. Literature data on the cumulative volatilization are often presented on different bases. Where possible, translations from measured net dosage or plant deposit to application rate (gross dosage) were made.

A correlation between cumulative volatilization (in % of applied dosage) and vapour pressure could be established for a combination of field and climate chamber experiments with all crops lumped together and selecting only those experiments in which the direct method was used for measuring the volatilization rate. A less good correlation was found between volatilization and vapour pressure divided by the octanol-water partition coefficient (K_{ow}). No good correlation could be established between cumulative volatilization and K_{ow}, Henry coefficient, and K_{Henry} divided by K_{ow}. Since the literature indicates a relation between absorption in the plant leaves and the K_{ow}, the latter conclusion provides additional evidence that absorption is of minor importance for the volatilization of pesticides from crops. It is unlikely that K_{Henry} is a factor of prime importance in the volatilization process when the water component of the spray liquid quickly evaporates after application. Sorption and water solubility, however, could play important roles when studying the volatilization behaviour of a pesticide over a short period of time.

Data on the volatilization of pesticides from plant surfaces are rather scarce. Publications usually cover a small range of compounds and crops, lindane applications on beans being foremost among them. Due to this lack of data, no good estimates could be made for individual crops. Only the combination of vegetables, potatoes, and sugar beet produced a good relation. Crop characteristics are known to have (some) effect on the volatilization through shape (deposition and wash-off) and wax layer (adsorption).

The presented method is likely to overestimate the cumulative volatilization for certain compounds. Many processes may occur simultaneously after pesticide application on crops. In laboratory or chamber experiments some processes can be (artificially) minimized. In field studies, however, processes like penetration into the plant, wash-off, hydrolysis, (bio)chemical transformation and phototransformation make up variable contributions to the decline of the pesticide load on the leaves. Volatilization of pesticides subject to a rapid disappearance or transformation caused by any of these processes cannot be well estimated with the presented method. Moreover, data on these processes are also limited and often show wide ranges, which currently impedes their inclusion in the presented approach.

The relation between cumulative volatilization and vapour pressure is incorporated in a spreadsheet, which also contains some 200 other pesticides approved for crop protection in The Netherlands. Based on known vapour pressures and ambient temperature, the empirical relation provides the opportunity to estimate the cumulative volatilization from plant surfaces for those other compounds applied to crops. The time period for volatilization and the ambient temperature can be arbitrarily chosen. However, extrapolation to a period exceeding 1 week is uncertain considering the shorter duration of most experiments.

5 Conclusions and recommendations

1 The volatilization of pesticides from treated plants is an important process: a substantial fraction of the dosage may be emitted to the atmosphere. For particular compounds (e.g. lindane) this fraction may even approach 100% after a few days. This implies that the dispersion of pesticides via the air and the deposition on aquatic and terrestrial ecosystems requires further attention.

2 An empirical relation between the cumulative volatilization (CV) from plants and the vapour pressure (VP) of a pesticide could be established in the form of log CV = a + b log VP, with a = 1.528 and b = 0.466 (n = 24 and r^2 = 0.77). This relation applies to a period of 7 days after application and to all crops lumped together. Data for the CV against VP over K_{ow} gave a much lower correlation (r^2 = 0.56). No good correlation was found between VP and K_{ow}, Henry coefficient, and K_{Henry} divided by K_{ow}, respectively.

3 Volatilization from plants is affected to a minor extent by sorption processes in and on the leaves, commonly represented by the K_{ow}, for most pesticides. K_{Henry} does not seem to be a relevant factor, probably because the water in the spray liquid quickly evaporates after application under weather conditions appropriate for pesticide spraying.

4 Based on the presented equation, estimates are now available for the cumulative volatilization of all other pesticides applied on crops. These estimates can be computed with a spreadsheet using vapour pressure and ambient temperature as input. The presented approach may, however, overestimate the cumulative volatilization for certain compounds showing strong sorption or short half-lives for hydrolysis, (bio)chemical- or phototransformation.

5 Since the various transformation and sorption processes occurring on the plant leaf may have a substantial influence on the volatilization rate for some compounds, these processes should be studied in their mutual dependency in order to make a reasonable estimate of the material balance. It is also important to investigate the effect of the composition of the formulation in the trade product on the processes at the plant surface.

6 Estimates for pesticide volatilization from plants have been entered in the ISBEST information system on the regional use of pesticides in The Netherlands. The coupling of regional use and field-scale volatilization allows an assessment of the regional magnitude of pesticide volatilization into the air. This provides a useful tool for the evaluation of environmental risks and for policy making.

7 No investigations were made into the influence of weather conditions on the volatilization from plants. Temperature, relative humidity, and wind speed can be considered as important factors in this process. Climate chambers connected to a windtunnel are available so that all these variables can be studied individually. An one-on-one translation to field conditions is not (yet) possible due to a lack of sufficient comparative studies.

8 Some studies showed that rainfall may result in a substantial reduction of the pesticide load on the plant leaves through wash-off. The result is an increased load on the soil and hence an increased risk of leaching. Knowledge on the factors influencing wash-off and on the extent of this process is inadequate, requiring further research.

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Annex 1 Summaries of data retrieved from the literature

<u>**Boencke, 1990**</u>

compound:	**mevinphos (E- and Z-isomer)**

(insecticide, acaracide, organophosphorus group, $VP_{Tomlin,1994}$ = 17 mPa (20 ^{o}C), $VP_{Boencke,1990}$ = 80 mPa (20 ^{o}C), $S_{water,Hornsby,1996}$ = 600 000 mg l^{-1} (22.5 ^{o}C), $K_{ow,Tomlin,1994}$ = 1.34, $K_{ow,Boencke,1990}$ = 0.6, $DT_{50,hydrolysis,Tomlin,1994}$ = 35 d, Systemic action = unknown, but fast hydrolysed in plants (Tomlin,1994))

formulation:	PD5 (Plant protection agent with 47.4% a.i., aqueous emulsion, no GIFAP formulation code given)
date/place:	July 6-11, 1987, Braunschweig, FRG
duration:	3 d
application:	parcel sprayer with Tee Jet 11006 nozzles (600 l ha^{-1}), sprayed in morning
dosage:	initial deposit on leaves not given (spray dosage 0.285 kg ha^{-1} active ingredient)
method:	field measurements using residue method on plant leaves (indirect method)
plant/crop:	type: lettuce (surface: very smooth, variety: unknown, stage: end of head-formation)
	height: unknown
	area cover canopy: unknown
	spray interception : unknown
soil:	soil type and properties: NA
	area: 3 x 30 m^2
	depth: NA
	soil temperature: NA
	spray interception : unknown
water regime:	rainfall/irrigation: 25 mm (total over 5 days), rain on days 3-5
micro-climate:	air temperature: 11-24 ^{o}C (min-max)
	sunshine hours: 9 (average per day), (day 1-2: sunny and dry, day 3-5: cloudy with rainfall)
	wind speed: 1-4 m s^{-1} (min-max)
	RH: 47% (average)
residues:	plant:

62% of dosage (= initial deposit) after 1 hour	(value is average of 3 plots)
17% of dosage (=initial deposit) after 3 hours	(see above)
15% of dosage (=initial deposit) after 6 hours	(see above)
8% of dosage (=initial deposit) after 1 day	(see above; range: 5-13%)
2% of dosage (=initial deposit) after 3.125 day	(average of 3 plots)
soil: NA	

volatilization:	$rate_{t=0}$=unknown
	$rate_{t=1h}$=unknown
	$rate_{t=3h}$=unknown
	$rate_{t=6h}$=unknown
	$rate_{t=1d}$=unknown
	$rate_{t=3.125d}$=unknown

38% of dosage after 1 hour	(100%-residue on plants)
83% of dosage after 3 hours	(see above)
85% of dosage after 6 hours	(see above)
92% of dosage after 1 day	(see above; range: 87-95%)
98% of dosage after 3.125 day	(100%-residue on plants)

compound:	**mevinphos (E- and Z-isomer)**
formulation:	same
date/place:	same
duration:	same
application:	same
dosage:	same
method:	same
plant/crop:	type: kohlrabi (surface: very waxy, variety: unknown, stage: plant weight about 200 g)
	height: unknown

	area cover canopy: unknown
	spray interception: unknown
soil:	same
water regime:	same
micro-climate:	same
residue:	plant:

	61% of dosage after 1 hour	(value is average of 3 plots)
	35% of dosage after 3 hours	(see above)
	25% of dosage after 6 hours	(see above)
	14% of dosage after 1 day	(see above; range: 13-16%)
	2% of dosage after 3.125 day	(average of 3 plots)
	soil: NA	
volatilization:	$rate_{t=0}$=unknown	
	$rate_{t=1h}$=unknown	
	$rate_{t=3h}$=unknown	
	$rate_{t=6h}$=unknown	
	$rate_{t=1d}$=unknown	
	$rate_{t=3.125d}$=unknown	
	39% of dosage after 1 hour	(100%-residue on plants)
	65% of dosage after 3 hours	(see above)
	75% of dosage after 6 hours	(see above)
	86% of dosage after 1 day	(see above; range: 84-87%)
	98% of dosage after 3.125 day	(100%-residue on plants)

compound:	**mevinphos (E- and Z-isomer)**
formulation:	same
date/place:	July 20-27, 1987, Braunschweig, FRG
duration:	3 d
application:	same
dosage:	same
method:	same
plant/crop:	type: green beans (surface: hairy, variety: unknown, stage: flowering)
	height: unknown
	area cover canopy: unknown
	spray interception: unknown
soil:	same
water regime:	rainfall/irrigation: 13.4 mm (total over 7 days), 1 mm after 9 h, heavy rain after 3 days
micro-climate:	air temperature: 12-21.5 ^{o}C (min-max)
	sunshine hours: 5 (average per day), (day 1-7: cloudy)
	wind speed: 0-3 m s^{-1} (min-max)
	RH: 80% (average)
residue:	plant:

	31% of dosage after 1 hour	(value is average of 3 plots)
	15% of dosage after 3 hours	(see above)
	7% of dosage after 6 hours	(see above)
	1% of dosage after 1 day	(see above; range: 1-1%)
	0% of dosage after 3.125 day	(average of 3 plots)
	soil: NA	
volatilization:	$rate_{t=0}$=unknown	
	$rate_{t=1h}$=unknown	
	$rate_{t=3h}$=unknown	
	$rate_{t=6h}$=unknown	
	$rate_{t=1d}$=unknown	
	$rate_{t=3.125d}$=unknown	
	69% of dosage after 1 hour	(100%-residue on plants)
	85% of dosage after 3 hours	(see above)
	93% of dosage after 6 hours	(see above)
	99% of dosage after 1 day	(see above; range: 99-99%)
	100% of dosage after 3.125 day	(100%-residue on plants)

compound:	**mevinphos (E- and Z-isomer)**

compound: **mevinphos (E- and Z-isomer)**
formulation: same
date/place: same
duration: same
application: same
dosage: same
method: same
plant/crop: type: summer wheat (surface: rough, variety: unknown, stage: beginning of inflorescene emergence)
     height: unknown
     area cover canopy: unknown
     spray interception: unknown
soil: same
water regime: same
micro-climate: same
residue: plant:

50% of dosage after 1 hour	(value is average of 3 plots)
17% of dosage after 3 hours	(see above)
18% of dosage after 6 hours	(see above)
4% of dosage after 1 day	(see above; range: 4-6%)
0% of dosage after 3.125 day	(average of 3 plots)

     soil: NA

volatilization: $rate_{t=0}$=unknown
     $rate_{t=1h}$=unknown
     $rate_{t=3h}$=unknown
     $rate_{t=6h}$=unknown
     $rate_{t=1d}$=unknown
     $rate_{t=3.125d}$=unknown

50% of dosage after 1 hour	(100%-residue on plants)
83% of dosage after 3 hours	(see above)
82% of dosage after 6 hours	(see above)
96% of dosage after 1 day	(see above; range: 94-96%)
100% of dosage after 3.125 day	(100%-residue on plants)

compound: **lindane (gamma-HCH)**
     (insecticide, organochlorines group, γ-isomer, $VP_{Tomlin,1994}$=5.6 mPa (20 ^{o}C), $VP_{Hornsby,1996}$=17.3 mPa (30 ^{o}C), $VP_{Boencke,1990}$ = 5 mPa (20 ^{o}C), $S_{water,Tomlin,1994}$ = 7.3 mg l^{-1} (25 ^{o}C), $S_{water,Tomlin,1994}$ = 12 mg l^{-1} (35 ^{o}C), $S_{water,Boencke,1990}$ = 10 mg l^{-1}, $S_{cyclohexanone,Tomlin,1994}$ = 36 700 mg l^{-1} (20 ^{o}C), $K_{ow,Boencke,1990}$ = 5000, $DT_{50,solution,pH7,Tomlin,1994}$ = 191 d, Systemic action = unknown)
formulation: Nexit flüssig (with 25% a.i., aqueous emulsion, no GIFAP formulation code given)
date/place: July 6-11, 1987, Braunschweig, FRG
duration: 3 d
application: parcel sprayer with Tee Jet 11006 nozzles (600 l ha^{-1}), sprayed in morning
dosage: initial deposit on leaves not given (spray dosage 0.150 kg ha^{-1} active ingredient)
method: field measurements using (indirect) residue method
plant/crop: type: lettuce (surface: very smooth, variety: unknown, stage: end of head-formation)
     height: unknown
     area cover canopy: unknown
     spray interception: unknown
soil: soil type and properties: NA
     area: 3 x 30 m^2
     depth: NA
     soil temperature: NA
     spray interception : unknown
water regime: rainfall/irrigation: 25 mm (total over 5 days), rain on days 3-5
micro-climate: air temperature: 11-24 ^{o}C (min-max)
     sunshine hours: 9 (average per day), (day 1-2: sunny and dry, day 3-5: cloudy with rainfall)
     wind speed: 1-4 m s^{-1} (min-max)
     RH: 47% (average)
residue: plant:

49% of dosage (=initial deposit) after 1 hour (value is average of 3 plots)
26% of dosage (=initial deposit) after 3 hours   (see above)
14% of dosage (=initial deposit) after 6 hours   (see above)
5% of dosage (=initial deposit) after 1 day   (see above; range: 5-6%)
3% of dosage (=initial deposit) after 3.125 day   (average of 3 plots)
soil: NA

volatilization: $rate_{t=0}$=unknown
$rate_{t=1h}$=unknown
$rate_{t=3h}$=unknown
$rate_{t=6h}$=unknown
$rate_{t=1d}$=unknown
$rate_{t=3.125d}$=unknown
51% of dosage after 1 hour   (100%-residue on plants)
74% of dosage after 3 hours   (see above)
86% of dosage after 6 hours   (see above)
95% of dosage after 1 day   (see above; range: 94-95%)
97% of dosage after 3.125 day   (100%-residue on plants)

compound:	**lindane (gamma-HCH)**
formulation:	same
date/place:	same
duration:	same
application:	same
dosage:	same
method:	same
plant/crop:	type: kohlrabi (surface: very waxy, variety: unknown, stage: plant weight about 200 g)
	height: unknown
	area cover canopy: unknown
	spray interception: unknown
soil:	same
water regime:	same
micro-climate:	same
residue:	plant:

70% of dosage after 1 hour   (value is average of 3 plots)
32% of dosage after 3 hours   (see above)
18% of dosage after 6 hours   (see above)
9% of dosage after 1 day   (see above; range: 8-11%)
6% of dosage after 3.125 day   (average of 3 plots)
soil: NA

volatilization: $rate_{t=0}$=unknown
$rate_{t=1h}$=unknown
$rate_{t=3h}$=unknown
$rate_{t=6h}$=unknown
$rate_{t=1d}$=unknown
$rate_{t=3.125d}$=unknown
30% of dosage after 1 hour   (100%-residue on plants)
68% of dosage after 3 hours   (see above)
82% of dosage after 6 hours   (see above)
91% of dosage after 1 day   (see above; range: 89-92%)
94% of dosage after 3.125 day   (100%-residue on plants)

compound:	**lindane (gamma-HCH)**
formulation:	same
date/place:	July 20-27, 1987, Braunschweig, FRG
duration:	3 d
application:	same
dosage:	same
method:	same
plant/crop:	type: green beans (surface: hairy, variety: unknown, stage: flowering)
	height: unknown
	area cover canopy: unknown

	spray interception: unknown
soil:	same
water regime:	rainfall/irrigation: 13.4 mm (total over 7 days), 1 mm after 9 h, heavy rain after 3 days
micro-climate:	air temperature: 12-21.5 °C (min-max)
	sunshine hours: 5 (average per day), (day 1-7: cloudy)
	wind speed: 0-3 m s^{-1} (min-max)
	RH: 80% (average)
residue:	plant:
	55% of dosage after 1 hour (value is average of 3 plots)
	24% of dosage after 3 hours (see above)
	18% of dosage after 6 hours (see above)
	15% of dosage after 1 day (see above; range: 13-17%)
	10% of dosage after 3.125 day (average of 3 plots)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=3.125d}$=unknown
	45% of dosage after 1 hour (100%-residue on plants)
	76% of dosage after 3 hours (see above)
	82% of dosage after 6 hours (see above)
	85% of dosage after 1 day (see above; range: 83-87%)
	90% of dosage after 3.125 day (100%-residue on plants)

compound:	**lindane (gamma-HCH)**
formulation:	same
date/place:	same
duration:	3 d
application:	same
dosage:	same
method:	same
plant/crop:	type: summer wheat (surface: rough, variety: unknown, stage: beginning of inflorescene emergence)
	height: unknown
	area cover canopy: unknown
	spray interception: unknown
soil:	same
water regime:	same
micro-climate:	same
residue:	plant:
	75% of dosage after 1 hour (value is average of 3 plots)
	31% of dosage after 3 hours (see above)
	31% of dosage after 6 hours (see above)
	23% of dosage after 1 day (see above; range: 17-27%)
	23% of dosage after 3.125 day (average of 3 plots)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=3.125d}$=unknown
	25% of dosage after 1 hour (100%-residue on plants)
	69% of dosage after 3 hours (see above)
	69% of dosage after 6 hours (see above)
	77% of dosage after 1 day (see above; range: 73-83%)
	88% of dosage after 3.125 day (100%-residue on plants)

compound: **deltamethrin**
(insecticide, pyrethroids group, $VP_{Tomlin,1994}<0.0133$ mPa (25 ^{o}C),
$VP_{Boencke,1990}=0.002$ mPa (20 ^{o}C), $S_{water,Tomlin,1994}<0.0002$ mg l^{-1} (25 ^{o}C), $S_{water,Boencke,1990}<0.1$ mg l^{-1},
$S_{cyclohexanone,Tomlin,1994}=750\,000$ mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}=40\,000$ (20 ^{o}C), $K_{ow,Boencke,1990}=269\,000$,
$DT_{50,solution,pH9,Tomlin,1994}=2.5$ d, Decomposes under sunlight: $DT_{50,photolysis,soil,Tomlin,1994}=9$ d,
Systemic action = non-systemic, but metabolites found in oily crops (Tomlin,1994))

formulation: Decis flüssig (with 2.8% a.i., aqueous emulsion, no GIFAP formulation code
given)
date/place: July 6-11, 1987, Braunschweig, FRG
duration: 3 d
application: parcel sprayer with Tee Jet 11006 nozzles (600 l ha^{-1}), sprayed in morning
dosage: initial deposit on leaves not given (spray dosage 0.062 kg ha^{-1} active ingredient)
method: field measurements using (indirect) residue method
plant/crop: type: lettuce (surface: very smooth, variety: unknown, stage: end of head-formation)
height: unknown
area cover canopy: unknown
spray interception: unknown
soil: soil type and properties: NA
area: 3 x 30 m^2
depth: NA
soil temperature: NA
spray interception : unknown
water regime: rainfall/irrigation: 25 mm (total over 5 days), rain on days 3-5
micro-climate: air temperature: 11-24 ^{o}C (min-max)
sunshine hours: 9 (average per day), (day 1-2: sunny and dry, day 3-5: cloudy with
rainfall)
wind speed: 1-4 m s^{-1} (min-max)
RH: 47% (average)
residue: plant:
100% of dosage (=initial deposit) after 1 hour   (value is average of 3 plots)
64% of dosage (=initial deposit) after 3 hours   (see above)
58% of dosage (=initial deposit) after 6 hours   (see above)
56% of dosage (=initial deposit) after 1 day   (see above; range: 44-67%)
30% of dosage (=initial deposit) after 3.125 day   (average of 3 plots)
soil: NA
volatilization: rate$_{t=0}$=unknown
rate$_{t=1h}$=unknown
rate$_{t=3h}$=unknown
rate$_{t=6h}$=unknown
rate$_{t=1d}$=unknown
rate$_{t=3.125d}$=unknown
0% of dosage after 1 hour   (100%-residue on plants)
36% of dosage after 3 hours   (see above)
42% of dosage after 6 hours   (see above)
44% of dosage after 1 day   (see above; range: 33-56%)
70% of dosage after 3.125 day   (100%-residue on plants)

compound: **deltamethrin**
formulation: same
date/place: same
duration: same
application: same
dosage: same
method: same
plant/crop: type: kohlrabi (surface: very waxy, variety: unknown, stage: plant weight about 200 g)
height: unknown
area cover canopy: unknown
spray interception: unknown
soil: same
water regime: same
micro-climate: same

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residue: plant:
                 100% of dosage after 1 hour   (value is average of 3 plots)
                 100% of dosage after 3 hours   (see above)
                 100% of dosage after 6 hours   (see above)
                 88% of dosage after 1 day   (see above; range: 81-90%)
                 66% of dosage after 3.125 day   (average of 3 plots)
                 soil: NA
volatilization: rate$_{t=0}$=unknown
                 rate$_{t=1h}$=unknown
                 rate$_{t=3h}$=unknown
                 rate$_{t=6h}$=unknown
                 rate$_{t=1d}$=unknown
                 rate$_{t=3.125d}$=unknown
                 0% of dosage after 1 hour   (100%-residue on plants)
                 0% of dosage after 3 hours   (see above)
                 0% of dosage after 6 hours   (see above)
                 12% of dosage after 1 day   (see above; range: 10-19%)
                 34% of dosage after 3.125 day   (100%-residue on plants)

compound: **deltamethrin**
formulation: same
date/place: July 20-27, 1987, Braunschweig, FRG
duration: 3 d
application: same
dosage: same
method: same
plant/crop: type: green beans (surface: hairy, variety: unknown, stage: flowering)
                 height: unknown
                 area cover canopy: unknown
                 spray interception: unknown
soil: same
water regime: rainfall/irrigation: 13.4 mm (total over 7 days), 1 mm after 9 h, heavy rain after 3 days
micro-climate: air temperature: 12-21.5 ^{o}C (min-max)
                 sunshine hours: 5 (average per day), (day 1-7: cloudy)
                 wind speed: 0-3 m s^{-1} (min-max)
                 RH: 80% (average)
residue: plant:
                 93% of dosage after 1 hour   (value is average of 3 plots)
                 85% of dosage after 3 hours   (see above)
                 61% of dosage after 6 hours   (see above)
                 29% of dosage after 1 day   (see above; range: 11-43%)
                 28% of dosage after 3.125 day   (average of 3 plots)
                 soil: NA
volatilization: rate$_{t=0}$=unknown
                 rate$_{t=1h}$=unknown
                 rate$_{t=3h}$=unknown
                 rate$_{t=6h}$=unknown
                 rate$_{t=1d}$=unknown
                 rate$_{t=3.125d}$=unknown
                 7% of dosage after 1 hour   (100%-residue on plants)
                 15% of dosage after 3 hours   (see above)
                 39% of dosage after 6 hours   (see above)
                 71% of dosage after 1 day   (see above; range: 57-89%)
                 72% of dosage after 3.125 day   (100%-residue on plants)

compound: **deltamethrin**
formulation: same
date/place: same
duration: 3 d
application: same

dosage: same
method: same
plant/crop: type: summer wheat (surface: rough, variety: unknown, stage: beginning of inflorescene
                 emergence)
                 height: unknown
                 area cover canopy: unknown
                 spray interception: unknown
soil: same
water regime: same
micro-climate: same
residue: plant:
                 100% of dosage after 1 hour   (value is average of 3 plots)
                 78% of dosage after 3 hours   (see above)
                 77% of dosage after 6 hours   (see above)
                 31% of dosage after 1 day   (see above; range: 28-83%)
                 soil: NA
volatilization: $rate_{t=0}$=unknown
                 $rate_{t=1h}$=unknown
                 $rate_{t=3h}$=unknown
                 $rate_{t=6h}$=unknown
                 $rate_{t=1d}$=unknown
                 $rate_{t=3.125d}$=unknown
                 0% of dosage after 1 hour   (100%-residue on plants)
                 22% of dosage after 3 hours   (see above)
                 23% of dosage after 6 hours   (see above)
                 69% of dosage after 1 day   (see above; range: 17-72%)

Note: (1) - Reference experiments for volatilization from glass beads and soil under lab and field conditions are
also available; (2) - Measurement method used in `residue disappearance', and all losses are directly attributed to volatilization. This may
lead to an overestimation, although photochemical and hydrolytic stability was tested;
(3) - Vapour pressures appear to determine the volatilization during the first 6 hours. Later on, leaf texture and
distribution over the leaf seems to gain importance; (4) - Washing-off from leaf surface for all pesticides is
considered negligible; (5) - Initial residues high on green beans (up to 30 mg kg^{-1}), attributed to rather low net
weight and large surface area. On other crops in order of 3-5 mg kg^{-1}; (6) - Some systemic action seems to occur
for deltamethrin, in particular in combination with the waxy leaves of kohlrabi and less pronounced with lettuce.

Berg, 1995
compound: **chlorothalonil**
                 (fungicide, group unknown, $VP_{Tomlin,1994}$=0.076 mPa (25 ^{o}C), $VP_{Hornsby,1996}$=100 mPa (25 ^{o}C),
                 $VP_{Genderen,1993}$ = 26 mPa (25 ^{o}C), $S_{water,Tomlin,1994}$ = 0.9 mg l^{-1} (25 ^{o}C), $S_{water,Hornsby,1996}$ = 0.6 mg l^{-1} (25 ^{o}C),
                 $S_{cyclohexanone,Tomlin,1994}$ = 30 g kg^{-1} (25 ^{o}C), $K_{ow,Tomlin,1994}$ = 776 (20 ^{o}C),
                 Stable under all (acidic and neutral) conditions, Systemic action = non-systemic, but parent
                 compound and metabolites are found in crops (Tomlin,1994))
formulation: DC or SC (Daconil 500 flowable)
date/place: August 18, 1993, Biddinghuizen, Netherlands
duration: 7.1 d
application: Douven spraying machine with 48 Teejet nozzles (XR 110 03) and rate calculated at 245 l ha^{-1},
                 sprayed between 12.36 PM and 12.55 PM
dosage: 1.94 kg ha^{-1} active ingredient (spray dosage)
method: field measurements using Aerodynamic (AD) Method with sampling heights at 0.8, 1.0, 1.3, and
                 1.5 m above ridges of 0.2 m and Bowen Ratio (BR) Method with similar sampling heights
plant/crop: type: potato (variety: Agria cultivar)
                 height: 0.5 m (on ridge of 0.2 m)
                 area cover canopy: 100% (crop fully grown; visual estimation)
                 spray interception: 85% (ratio areic mass on leaves at t = 0 over spray dosage)
                 soil load: 0% (estimated)
soil: soil type and properties: NA
                 area (LxW): 260 x 96 m
                 depth: NA
                 soil temperature: NA
                 spray interception : 0% (estimated)

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water regime:	rainfall/irrigation: 23 mm (total over 8 days), distributed over days 2 (0.5mm), 4 (19mm), 5 (1mm), 6 (2mm), 7 (0.5mm)

micro-climate: air temperature (at 0.8m): 15-20 °C (day 0), 12-15 °C (day 1), 14-16.5 °C (day 2),
14.5-18 °C (day 3), 11.5-11.5 °C (day 4), 10-13 °C (day 5), 9.5-14 °C (day 6), 8-13.5 °C (day 7),
12-15 °C (whole period), (all averages night-day); 6-21 °C (min. and max. whole period);
sunshine hours: 9 (average per day), (day 0-1: sunny and dry, day 2-4: cloudy with rainfall);
wind speed (at 2.0m): 1.1-2.1 m s^{-1} (day 0), 1.0-1.5 m s^{-1} (day 1), 1.5-3 m s^{-1} (day 2),
1.3-2.7 m s^{-1} (day 3), 1.9-3.4 m s^{-1} (day 4), 1.8-2.5 m s^{-1} (day 5), 1.8-3.2 m s^{-1} (day 6),
1.3-2.6 m s^{-1} (day 7), 1.5-2.6 m s^{-1} (whole period), (all averages night-day);
0.4-4.7 (min. and max. whole period)
RH: 70-90% (day 0), (average night-day)

residue: plant:
85% of dosage (or 100% of original areic mass) after 0 hours
82% of dosage (or 96% of original areic mass) after 2 hours   (linear interpolation)
79% of dosage (or 93% of original areic mass) after 3.84 hours
77% of dosage (or 93% of original areic mass) after 1 day   (linear interpolation)
77% of dosage (or 91% of original areic mass) after 1.1 day
78% of dosage (or 92% of original areic mass) after 2 days   (linear interpolation)
78% of dosage (or 92% of original areic mass) after 2.2 days
84% of dosage (or 98% of original areic mass) after 3 days   (linear interpolation)
85% of dosage (or 100% of original areic mass) after 3.2 days
81% of dosage (or 96% of original areic mass) after 7.1 days
soil: NA

volatilization: rate$_{t=0}$=unknown
rate$_{t=2h}$=0.85 g ha^{-1} h^{-1}
rate$_{t=1d}$=1.1 g ha^{-1} h^{-1}
rate$_{t=2d}$=0.95 g ha^{-1} h^{-1}
rate$_{t=3d}$=1.2 g ha^{-1} h^{-1}
rate$_{t=7.1d}$=0.46 g ha^{-1} h^{-1}
0.1% of dosage after 2 hours   (average of AD and BR method)
0.6% of dosage after 1 day   (average of AD and BR method)
1.4% of dosage after 2 days   (average of AD and BR method)
2.3% of dosage after 3 days   (average of AD and BR method)
4.7% of dosage after 7.1 days   (average of AD and BR method)

compound: **parathion (-ethyl)**
(insecticide, acaracide, organophosphorus group, VP$_{Tomlin,1994}$=0.89 mPa (20 °C),
VP$_{Hornsby,1996}$=0.7 mPa (20 °C), S$_{Tomlin,1994}$ = 11 mg l^{-1} (25 °C), S$_{water,Hornsby,1996}$ = 0.9 mg l^{-1} (25 °C),
S$_{hexane,Tomlin,1994}$ = 50 000-100 000 g/l (20 °C), K$_{ow,Tomlin,1994}$ = 6760,
DT$_{50,hydrolysis,pH7,Tomlin,1994}$ = 260 d, Systemic action = unknown, but metabolites found in crops
(Tomlin,1994))

formulation: EC (Luxan parathion 25%)

date/place: August 18, 1993, Biddinghuizen, Netherlands

duration: 7.1 d

application: Douven spraying machine with 48 Teejet nozzles (XR 110 03) and rate calculated at 245 l ha^{-1},
sprayed between 12.36 PM and 12.55 PM

dosage: 1.06 kg ha^{-1} active ingredient (spray dosage)

method: field measurements using Aerodynamic (AD) Method with sampling heights at 0.8, 1.0, 1.3, and
1.5 m above ridges of 0.2 m and Bowen Ratio (BR) Method with similar sampling heights

plant/crop: type: potato (variety: Agria cultivar)
height: 0.5 m (on ridge of 0.2 m)
area cover canopy: 100% (crop fully grown; visual estimation)
spray interception: 70% (ratio areic mass on leaves at t = 0 over spray dosage)
soil load: 0% (estimated)

soil: soil type and properties: NA
area (LxW): 260 x 96 m
depth: NA
soil temperature: NA
spray interception : 0% (estimated)

water regime: rainfall/irrigation: 23 mm (total over 8 days), distributed over days 2 (0.5mm), 4 (19mm),
5 (1mm), 6 (2mm), 7 (0.5mm)

micro-climate: air temperature (at 0.8m): 15-20 °C (day 0), 12-15 °C (day 1), 14-16.5 °C (day 2),
14.5-18 °C (day 3), 11.5-11.5 °C (day 4), 10-13 °C (day 5), 9.5-14 °C (day 6), 8-13.5 °C (day 7),

12-15 ^{o}C (whole period), (all averages night-day); 6-21 ^{o}C (min. and max. whole period);
sunshine hours: 9 (average per day), (day 0-1: sunny and dry, day 2-4: cloudy with rainfall);
wind speed (at 2.0m): 1.1-1.8 m s^{-1} (day 0), 1.0-1.5 m s^{-1} (day 1), 1.5-3 m s^{-1} (day 2),
1.3-2.7 m s^{-1} (day 3), 1.9-3.4 m s^{-1} (day 4), 1.8-2.5 m s^{-1} (day 5), 1.8-3.2 m s^{-1} (day 6),
1.3-2.6 m s^{-1} (day 7), 1.5-2.6 m s^{-1} (whole period), (all averages night-day);
0.4-4.7 m s^{-1} (min. and max. whole period)
RH: 70-90% (day 0), (average night-day)

residue:	plant:
	70% of dosage (or 100% of original areic mass) after 0 hours
	49% of dosage (or 70% of original areic mass) after 2 hours (linear interpolation)
	34% of dosage (or 49% of original areic mass) after 3.48 hours
	18% of dosage (or 26% of original areic mass) after 1 day (linear interpolation)
	16% of dosage (or 23% of original areic mass) after 1.1 day
	7% of dosage (or 10% of original areic mass) after 2 days (linear interpolation)
	4.8% of of dosage (or 6.9% of original areic mass) after 2.2 days
	2.3% of dosage (or 3.3% of original areic mass) after 3 days (linear interpolation)
	1.7% of dosage (or 2.4% of original areic mass) after 3.2 days
	0.4% of dosage (or 0.5% of original areic mass) after 7.1 days
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=2h}$=20.1 g ha^{-1} h^{-1}
	rate$_{t=1d}$=9.6 g ha^{-1} h^{-1}
	rate$_{t=2d}$=5.3 g ha^{-1} h^{-1}
	rate$_{t=3d}$=1.3 g ha^{-1} h^{-1}
	rate$_{t=7.1d}$=0.2 g ha^{-1} h^{-1}
	3.8% of dosage after 2 hours (average of AD and BR method)
	13% of dosage after 1 day (average of AD and BR method)
	23% of dosage after 2 days (average of AD and BR method)
	28% of dosage after 3 days (average of AD and BR method)
	31% of dosage after 7.1 days (average of AD and BR method)

compound:	**parathion (-ethyl)**
formulation:	EC (E 605 with 0.25 kg parathion per liter and radiolabelled ^{14}C)
date/place:	1993, Neustadt, FRG
duration:	1.05 d
application:	mechanically sprayed with Tee Jet nozzle (XR 110 03 VS) and rate calculated at 234 l ha^{-1}
dosage:	0.365 kg ha^{-1} active ingredient (net application on plants only; spray dosage 1.0 kg ha^{-1} a.i.)
method:	greenhouse measurements using volitilization chambers (1.5 x 1.0 x 0.8 m) with radiolabelled ^{14}C
plant/crop:	type: potato (variety: Cultivar surprise)
	height: 0.5 m
	area cover canopy: NA
	spray interception: 100% (soils and walls covered and pesticide contamination substracted from spray dosage)
soil:	soil type and properties: NA
	area: 0.5 m^2
	depth: NA
	soil temperature: NA
	spray interception : 0%
water regime:	rainfall/irrigation: nil
micro-climate:	air temperature: 19-21 ^{o}C (day 0, with faulty equipment at night),
	24-20 ^{o}C (day 1, with faulty equipment), (all averages night-day);
	wind speed (at ≈0.6m): 0.7-0.85 m s^{-1} (day 0, with faulty equipment at night),
	0.05-0.45 m s^{-1} (day 1, with faulty equipment), (all averages night-day);
	RH: 60-90% (day 0, with faulty equipment at night),
	70-75% (day 1, with faulty equipment), (all averages night-day)
residue:	plant:
	100% of dosage after 0 hours
	unknown % of dosage after 2 hours
	68.6% of dosage after 1.05 day
	soil: NA
volatilization:	rate$_{t=2h}$= 6.8 g ha^{-1} h^{-1} (reference area is 0.5 m^2)

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rate$_{t=6h}$= 8.1 g ha^{-1} h^{-1} (reference area is 0.5 m^2)
rate$_{t=1d}$= 3.2 g ha^{-1} h^{-1} (reference area is 0.5 m^2)
rate$_{t=1.05d}$= 4.4 g ha^{-1} h^{-1} (reference area is 0.5 m^2)
3.5% of dosage (=applied on plants) after 2 hours
12.0% of dosage (=applied on plants) after 6 hours
24.5% of dosage (=applied on plants) after 1 day
25.8% of dosage (=applied on plants) after 1.05 days

Note: (1) - None-extractable amount of parathion from potato plants is 12% of dosage for lab experiment. At the end of the trial (25.10 h), a total of 68.6% of the dosage was found as plant residue. Other loss routes appeared negligible; (2) - Parathion residues on potato plants appeared higher under laboratory conditions than in the field, which may be ascribed to photochemical degradation; (3) - In case 15% of the dosage reaches the soil, the following estimation can be made for the volatilization of chlorothalonil and parathion-ethyl from bare soil (field conditions): CV$_{chlorothalonil}$=0.15·4=0.6% and CV$_{parathion}$=0.15·10=1.5% of dosage for a 7.1 day period with an estimated θ=20%, ρ = 1200 kg m^{-3}, and OM = 1.1% (Smit et al.,1997).

Breeze 1992
Time course of volatilization is lacking. Herbicide uptake by different plants presented:

Herbicide	pecies	Dose (mg/plant)	Period (h)	Uptake (ng/cm^2/h)
Fluazifop	reen foxtail	0.1	12	4000
2,4-D acid	Hemp dogbane	0.03	12	1600
Glyphosate	Hemp dogbane	0.02	12	250
Haloxyfop-methyl	Quackgrass	0.007	96	69
Chlorsulfuron	Wild garlic	0.017	12	39
Metsulfuron	Wild garlic	0.012	12	36
Diclofop-methyl	Cltivated oat	0.0064	24	33

Grover 1985
compound:	**2,4-D (iso-octyl ester)**

(herbicide, aryloxyalkanoic group, iso-octyl ester rapidly converts to parent acid, VP$_{2,4-D\ acid,Tomlin,1994}$ = 11 mPa (20 ^{o}C), VP$_{2,4-D\ acid,\ Hornsby,1996}$=1 mPa (20 ^{o}C), S$_{water,2,4-D\ acid,Tomlin,1994}$=311 mg l^{-1} (25 ^{o}C,pH1), S$_{water,Hornsby,1996,estimated}$=100 mg l^{-1} (25 ^{o}C), S$_{water,2,4-D\ acid,Hornsby,1996}$=890 mg l^{-1} (25 ^{o}C), S$_{heptane,Tomlin,1994}$=1.1 g kg^{-1} (20 ^{o}C), K$_{ow,Tomlin,1994}$=507 (pH1), Systemic action=selective systemic herbicide, especially esters are absorbed by foliage (Tomlin,1994))

formulation: aqueous emulsion (no GIFAP formulation code given)
date/place: June 25, 1980, Regina, Canada
duration: 4.6 d
application: tractor-mounted sprayer (100 l ha^{-1}), sprayed between 9 and 10 AM local time
dosage: 0.45 kg ha^{-1} a.i. acid eq. (net dosage based on bare soil sample analysis; spray dosage 0.5 kg ha^{-1} a.i. acid eq.)
method: field measurements using Aerodynamic (AD) Method with sampling heights at 0.3, 0.5, 0.75, 1.0, 1.5, and 2.0 m above crop canopy
plant/crop: type: wheat (variety: Triticum aestivum L.)
height: 0.20 m
area cover canopy: 56±7% (in rows)
spray interception: 52% of net spray dosage
soil: soil type and properties: heavy clay: sand=1%, silt=27%, clay=69%, OM=3%, pH=7.7 (all derived from incorrect data), $\theta_{sat,estimated}$=51%, $\rho_{dry\ soil,estimated}$=1250 kg m^{-3}
area: 3 x 30 m^2
depth: NA
soil temperature: 30.8 ^{o}C (day 0), 20.3 ^{o}C (day 1), 23.6 ^{o}C (day 2), 18.6 ^{o}C (day 3), 18.5 ^{o}C (day 4), 20.1 ^{o}C (day 5), (all estimated average values per day)
spray interception: 48% of net spray dosage (estimated)
water regime: rainfall/irrigation: 3.8 mm (day 2);
MC$_{(0-0.001m)}$=12 dry_mass% or $\theta_{(0-0.001m)}$=16% (day 0),
MC$_{(0-0.001m)}$=9 dry_mass% or $\theta_{(0-0.001m)}$=13% (day 1),
MC$_{(0-0.001m)}$=28 dry_mass% or $\theta_{(0-0.001m)}$=38% (day 2),
MC$_{(0-0.001m)}$=12 dry_mass% or $\theta_{(0-0.001m)}$=17% (day 3),

MC$_{(0-0.001m)}$=10 dry_mass% or $\Theta_{(0-0.001m)}$=13% (day 4),

MC$_{(0-0.001m)}$=9 dry_mass% or $\Theta_{(0-0.001m)}$=12% (day 5), (all estimated average values per day)

micro-climate: air temperature (at 1m): -23.4 ^{o}C (day 0), 8.5-28.3 ^{o}C (day 1), 15.5-22.6 ^{o}C (day 2),
9.3-20.3 ^{o}C (day 3), 4.2-24.0 ^{o}C (day 4), 11.8-29.3 ^{o}C (day 5), (values at 05:00 and 15:00h),
13-18 ^{o}C (estimated averages night-day whole period),
(day 0-2: clear, day 3: cloudy (30%), day 4-5: clear);
wind speed (at 1m): 2.6 m s^{-1} (day 0), 4.9 m s^{-1} (day 1), 3.9 m s^{-1} (day 2), 2.7 m s^{-1} (day 3),
3.6 m s^{-1} (day 4), 4.0 m s^{-1} (day 5), (mean daily values), 3.6 m s^{-1} (estimated average whole period);
RH (at 1m): 65% (day 0), 79% (day 1), 77% (day 2), 80% (day 3), 78% (day 4), 75% (day 5),
(all estimated average values per day), 76% (estimated average whole period)

residue: plant (canopy receiving 0.52 times net dosage of 450 g ha^{-1} a.i.):

total 2,4-D	2,4-D acid	
52±7% (100%)	0±0%	of net dosage (or initial deposit) after 0 hours
33±3% (63%)	10±3%	of net dosage (or initial deposit) after 1 day
19±1% (37%)	16±1%	of net dosage (or initial deposit) after 3 days
16±1% (31%)	15±1%	of net dosage (or initial deposit) after 5 days
14±1% (27%)	14±1%	of net dosage (or initial deposit) after 9 days
11±0% (21%)	11±0%	of net dosage (or initial deposit) after 19 days
10±0% (19%)	10±0%	of net dosage (or initial deposit) after 35 days

soil (bare in between rows and receiving 1-0.52 times net dosage of 450 g ha^{-1} a.i.):

total 2,4-D	2,4-D acid	
48±13% (100%)	0±0%	of net dosage (or initial deposit) after 0 hours
49±8% (102%)	17±3%	of net dosage (or initial deposit) after 1 day
34±3% (71%)	21±4%	of net dosage (or initial deposit) after 3 days
31±3% (65%)	22±4%	of net dosage (or initial deposit) after 5 days
29±2% (60%)	20±3%	of net dosage (or initial deposit) after 9 days
25±8% (52%)	22±7%	of net dosage (or initial deposit) after 19 days
1±0% (2%)	1±0%	of net dosage (or initial deposit) after 35 days

volatilization: rate$_{t=0}$=unknown
rate$_{t=2h}$=5.0 g ha^{-1} h^{-1} (ester flux in acid eq.)
rate$_{t=1d}$=1.6 g ha^{-1} h^{-1} (ester flux in acid eq.)
rate$_{t=2d}$=1.8 g ha^{-1} h^{-1} (ester flux in acid eq.)
rate$_{t=3d}$=0.1 g ha^{-1} h^{-1} (ester flux in acid eq.)
rate$_{t=4d}$=0.2 g ha^{-1} h^{-1} (ester flux in acid eq.)
rate$_{t=4.6d}$=0.0 g ha^{-1} h^{-1} (ester flux in acid eq.)
2% of dosage after 2 hours
12% of dosage after 1 day
19% of dosage after 2 days
20% of dosage after 3 days
21% of dosage after 4 days
21% of dosage after 4.6 days

Note: (1) - Pesticide losses during spraying estimated at 0.2% of dosage (includes: droplet drift, vaporization from droplets, and volatilization from soil and plants during application); (2) - Daily daylight flux of ester from crop canopy can be expressed for first 5 days by: flux (g ha^{-1} day^{-1})) = 0.179±0.013 (day^{-1}) times ester residue on canopy (g ha^{-1}); (3) - Volatilization from soil can be assumed minimal due to very dry conditions; (4) - Hydrolysis to acid of 2,4-D on wheat starts one day after application and is for a major part completed after appr. 2 days; (5) - Hydrolysis to acid and other metabolites of 2,4-D on soil depends foremost on the moisture content, and is for a major part completed after appr. 18 days; (6) - Estimation for volatilization of 2,4-D acid from bare soil under given (field) conditions comes to 0.48·6=2.9% of dosage for a 4.6 day period (Smit et al.,1997); (7) - Transformation behaviour for 2,4-D on soil under crop is expected to be the same as for bare soil; (8) - Photolysis of 2,4-D on the leaves (and possibly soil) may be a transformation mechanism; (9) - Rapid 2,4-D volatilization flux during first two days and proportional to residues on plant leaves.

Haenel, 1995
compound: **lindane**
(insecticide, organochlorines group, γ-isomer, VP$_{Tomlin,1994}$=5.6 mPa (20 ^{o}C),
VP$_{Hornsby,1996}$=17.3 mPa (30 ^{o}C), VP$_{Boencke,1990}$=5 mPa (20 ^{o}C), S$_{water,Tomlin,1994}$=7.3 mg l^{-1} (25 ^{o}C),
S$_{water,Tomlin,1994}$=12 mg l^{-1} (35 ^{o}C), S$_{water,Boencke,1990}$=10 mg l^{-1}, S$_{cyclohexanone,Tomlin,1994}$=36 700 mg l^{-1} (20 ^{o}C),
K$_{ow,Boencke,1990}$=5000, DT$_{50,solution,pH7,Tomlin,1994}$=191 d, Systemic action=unknown)
formulation: Nexit stark (80% lindane, no GIFAP formulation code given)

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date/place: July 30, 1991, Braunschweig-Völkenrode, FRG

duration: 3 d

application: hand-moved motor sprayer with 2m boom and 4 nozzles Teejet 11006, sprayed at 09.48 local time

dosage: 1.08 kg ha^{-1} active ingredient (spray dosage; initial deposits on plants unknown)

method: field measurements at 0.9 and 1.8 m height using Aerodynamic-Profile Approach
(including newly developed correction method for small experimental surfaces)

plant/crop: type: sugar beet (variety: K.W. Tina, stage: unknown)
height: 0.45 m
area cover canopy: 100%
spray interception: 100%

soil: soil type and properties: sandy clay loam: sand=49%, silt=43%, clay=8%, C_{org}=1.3%, pH=6.2, MC_{sat}=27.7 dry_mass%, $\theta_{sat,estimated}$=42.0%, $\rho_{dry\ soil,estimated}$=1500 kg m^{-3}
area (LxW): 31.4 x 20.5 m (with 4 replicates)
depth: NA
temperature: unknown
spray interception : 0%

water regime: rainfall/irrigation: none

micro-climate: air temperature (at 0.9m): 20-26 ^{o}C (day 0), 17-23 ^{o}C (day 1), 18-19 ^{o}C (day 2),
18-18 ^{o}C (day 3), 18-22 ^{o}C (whole period), (all night-day averages); 15-28 ^{o}C (range)
wind speed (at 1.8m): 1.7-4.3 m s^{-1} (day 0), 1.8-2.8 m s^{-1} (day 1), 2.7-3 m s^{-1} (day 2),
3-3.2 m s^{-1} (day 3), 2.3-3.3 m s^{-1} (whole period), (all night-day averages); 1.8-5.2 m s^{-1} (range)
RH (at 1.8m): 30-83% (54), (range, after Siebers, 1993)

residue: plant:
100% of initial deposit after 0 hours
54% of initial deposit after 2 hours (linear interpolation)
25% of initial deposit after 6 hours (see above)
11% of initial deposit after 1 day (see above)
5% of initial deposit after 2 days (see above)
0% of initial deposit after 3 days (linear extrapolation)
soil: NA

volatilization: rate$_{t=0,estimated}$=190 g ha^{-1} h^{-1}
rate$_{t=2h,estimated}$=190 g ha^{-1} h^{-1}
rate$_{t=6h,estimated}$=95 g ha^{-1} h^{-1}
rate$_{t=1d,estimated}$=11 g ha^{-1} h^{-1}
rate$_{t=2d,estimated}$=1 g ha^{-1} h^{-1}
rate$_{t=3d,estimated}$=1 g ha^{-1} h^{-1}
30% of dosage after 2 hours
85% of dosage after 6 hours
101% of dosage after 1 day
110% of dosage after 2 days
115% of dosage after 3 days

compound: **lindane**

formulation: same

date/place: August 13, 1991, Braunschweig, FRG

duration: 3 d

application: hand-moved motor sprayer with 2m boom and 4 nozzles Teejet 11006, sprayed at 09.48 local time

dosage: 0.70 kg ha^{-1} active ingredient (spray dosage; initial deposits on plants unknown)

method: same

plant/crop: same

soil: same

water regime: same

micro-climate: air temperature (at 1.0m): 12-15 ^{o}C (day 0), 11-20 ^{o}C (day 1), 13-21 ^{o}C (day 2),
16-21 ^{o}C (day 3), 13-20 ^{o}C (whole period), (all night-day averages); 10-25 ^{o}C (range)
wind speed (at 1.8m): 0-1.7 m s^{-1} (day 0), 0.4-1.8 m s^{-1} (day 1), 0-1.8 m s^{-1} (day 2),
1.6-3.2 m s^{-1} (day 3), 0.6-1.9 m s^{-1} (whole period), (all night-day averages); 0-5 m s^{-1} (range)
RH (at 1.8m): 38-98% (73), (range, after Siebers, 1993)

residue: plant:

100% of initial deposit after 0 hours
91% of initial deposit after appr. 2 hours   (linear interpolation)
72% of initial deposit after appr. 6 hours   (see above)
33% of initial deposit after appr. 1 day   (see above)
19% of initial deposit after appr. 2 days   (see above)
0% of initial deposit after appr. 3 days   (linear extrapolation)
soil: NA

volatilization: $rate_{t=0,estimated}$=60 g ha^{-1} h^{-1}
$rate_{t=2h,estimated}$=0.5 g ha^{-1} h^{-1}
$rate_{t=6h,estimated}$=0.5 g ha^{-1} h^{-1}
$rate_{t=1d,estimated}$=10 g ha^{-1} h^{-1}
$rate_{t=2d,estimated}$=9 g ha^{-1} h^{-1}
$rate_{t=3d,estimated}$=3 g ha^{-1} h^{-1}
11% of dosage after 2 hours
11% of dosage after 6 hours
64% of dosage after 1 day
91% of dosage after 2 days
100% of dosage after 3 days

compound:	**lindane**
formulation:	same
date/place:	September 22, 1992, Salzdahlum, FRG
duration:	1.7 d
application:	tractor-mounted spray boom (12 m) with Teejet 11006 nozzles, sprayed at appr. 17.15 local time
dosage:	0.088 kg ha^{-1} active ingredient (spray dosage; initial deposits on plants unknown)
method:	field measurements at 1.0 and 1.9 m height using Aerodynamic-Profile Approach (including newly developed correction method (for small experimental surfaces)
plant/crop:	type: sugar beet (variety: Edda, stage: unknown)
	height: 0.40 m
	area cover canopy: 100%
	spray interception: 100%
soil:	soil type and properties: NA
	area (LxW): 108 x 108 m^2
	depth: NA
	soil temperature: NA
	spray interception : 0%
water regime:	rainfall/irrigation: none
micro-climate:	air temperature (at 1.0m): 16-19 ^{o}C (day 0), 13-16 ^{o}C (day 1), 7-17°C (day 2), 11-17°C (whole period), (all night-day averages); 6-22 ^{o}C (range)
	wind speed (at 1.9m): 3.6-4.0 m s^{-1} (day 0), 3.0-2.4 m s^{-1} (day 1), 1.0-1.4 m s^{-1} (day 2), 2.3-1.5 m s^{-1} (whole period), (all night-day averages); 0-4.4 m s^{-1} (range)
residue:	plant:
	100% of initial deposit after 0 hours
	38% of initial deposit after appr. 2 hours
	8% of initial deposit after appr. 1 day
	5% of initial deposit after appr. 1.7 days
	soil: NA
volatilization:	$rate_{t=0,estimated}$= 26 g ha^{-1} h^{-1}
	$rate_{t=2h,estimated}$= 18 g ha^{-1} h^{-1}
	$rate_{t=1d,estimated}$= 0.3 g ha^{-1} h^{-1}
	$rate_{t=1.7d,estimated}$= 0.1 g ha^{-1} h^{-1}
	49% of dosage after 2 hours
	87% of dosage after 1 day
	98% of dosage after 1.7 days

Note: (1) - Two similar experiments available in report (not present); (2) - In first experiment non-modified data was used for obtaining CV values; (3) - First two experiments also described in Siebers et al. (1993) and some basic data taken from this source; (4) - Residue analysis based on pesticide concentrations found in crop harvested at fixed intervals and concentration found directly after application; (5) - Direct and indirect (residue) method are used together for intercomparison. However, reference dosages may be different, i.e. spray dosage

for the direct method and initial residues on plants for the indirect method.

Smelt, 1996

compound: **fenpropimorph**

(fungicide, morpholines group, $VP_{Tomlin,1994}$=2.3 mPa (20 ^{o}C), $S_{water,Tomlin,1994}$=4.3 mg l^{-1} (20 ^{o}C, pH7),
$S_{cyclohexane,Tomlin,1994}$>1000 g kg^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}$=13 000 (pH7),
Stable under all (acidic, neutral, alkalic and light) conditions,
Systemic action=systemic, absorbed through leaves (Tomlin,1994))

formulation: EC (Corbel 750, Ciba-Geigy)

date/place: June 25, 1996, Jülich-Merzenhausen, FRG

duration: 6 d

application: Douven field sprayer with 22 m boom and 44 nozzles Teejet XR11003,
sprayed at appr. 15.00 local time

dosage: 0.691 kg ha^{-1} active ingredient (spray dosage)

method: field measurements using Aerodynamic (AD) Method with sampling heights at 0.7, 0.9, and
1.2 m and Bowen Ratio (BR) Method with similar sampling heights

plant/crop: type: sugar beet (variety: unknown, stage: unknown)
height: 0.41 m (25/6) and 0.42 m (28/6)
area cover canopy: 75-95% (visual estimation)
spray interception: 82% (from intial plant residue)

soil: soil type and properties: silty clay loam: sand=6.4%, silt=78.2%, clay=15.4%, C_{org}=1.1%, pH≈8,
$\theta_{sat.,estimated}$=48%, $\rho_{dry\ soil}$=1150 kg m^{-3}
area (LxW): 182 x 198 m
depth: NA
temperature (at 0.04m): 14-15.5 ^{o}C (day 0), 12.5-17 ^{o}C (day 1), 14-16 ^{o}C (day 2),
15-17.5 ^{o}C (day 3), 15.5-14.5 ^{o}C (day 4), 13-14 ^{o}C (day 5), 13.5-14 ^{o}C (day 6),
14-15.5 ^{o}C (whole period, estimated average), (all night-day averages);
10-19.5 ^{o}C (range)
spray interception : 100-(75+95)/2=15% (estimated)

water regime: total rainfall: 12.45 mm, 0.2 mm (day 2), 0.75 mm (day 3), 6.25 mm (day 4), 1.25 mm (day 5),
4.00 mm (day 6)
MC_{sat}=8.7 dry_mass% or $\theta_{(0-0.08m)}$= 10.1% (day 0-5)
MC_{sat}=12.4 dry_mass% or $\theta_{(0-0.08m)}$= 14.3% (day 6)

micro-climate: air temperature (at 0.7m): 10-15 ^{o}C (day 0), 7-19 ^{o}C (day 1), 11-16 ^{o}C (day 2), 14-20 ^{o}C (day 3),
12-18 ^{o}C (day 4, estimated average), 12-18 ^{o}C (day 5, estimated average),
12-18 ^{o}C (day 6, estimated average), 12-18 ^{o}C (whole period, estimated average),
(all night-day averages); 4-22 ^{o}C (range)
wind speed (at 1.2m): 0.6-2.2 m s^{-1} (day 0), 0.4-1.6 m s^{-1} (day 1), 0.5-1.8 m s^{-1} (day 2),
1-3.2 m s^{-1} (day 3), 2.5-3.8 m s^{-1} (day 4), 3.8-4.4 m s^{-1} (day 5), 2.8-3.6 m s^{-1} (day 6),
1.8-2.9 (whole period), (all night-day averages); 0.3-6.2 m s^{-1} (range)

residue: plant:
82±15% of dosage (or 100% of initial deposit) after 0 hours
68.4±14.9% of dosage (or 83% of initial deposit) after appr. 1 hour
63% of dosage (or 77% of initial deposit) after appr. 2 hours (estimated)
57.8±12.4% of dosage (or 70% of initial deposit) after appr. 3 hours
34.6±4.0% of dosage (or 42% of initial deposit) after appr. 1 day
26.8±4.7% of dosage (or 33% of initial deposit) after appr. 2 days
23.7±5.1% of dosage (or 29% of initial deposit) after appr. 3 days
12.8±2.1% of dosage (or 16% of initial deposit) after appr. 6 days
soil: NA

volatilization: $rate_{t=0}$= 18.4 g ha^{-1} h^{-1}
$rate_{t=2h}$= 18.0 g ha^{-1} h^{-1}
$rate_{t=1d}$= 0.4 g ha^{-1} h^{-1}
$rate_{t=2d}$= 0.1 g ha^{-1} h^{-1}
$rate_{t=3d}$= 0.1 g ha^{-1} h^{-1}
$rate_{t=6d}$= 0.05 g ha^{-1} h^{-1}
5.3% of dosage after 2 hours   (average of AD and BR method)
15.1% of dosage after 1 day   (average of AD and BR method)
15.6% of dosage after 2 days   (average of AD and BR method)

| 15.8% of dosage after 3 days | (average of AD and BR method) |
| 16.5% of dosage after 6 days | (average of AD and BR method) |

Note: (1) - Experiment consisted of two compounds fenpropimorph and clopyralid. Clopyralid concentrations were often below detection limit and course with time of volatilization rate appeared unusual. Therefore this compound was excluded; (2) - Rinsing tests with water, methanol, and chloroform indicate a high penetration of fenpropimorph in the sugar beet leaf; (3) - Air temperature measurements not available for days 4, 5, and 6 after application; (4) - Due to various reasons initial residue on leaves is lower than 100%; (5) - Estimation for volatilization of fenpropimorph from bare soil under given (field) conditions comes to 18% of dosage for a 6 day period (Smit et al.,1997).

Willis, 1992

compound:	**parathion-methyl**
	(insecticide, organophosphorus group, $VP_{Hornsby,1996}$=2 mPa (20 ^{o}C), $S_{water,Hornsby,1996}$=60 mg l^{-1} (25 ^{o}C), $S_{hexane,Tomlin,1994}$=15 000 mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}$=1000, $DT_{50,hydrolysis,Tomlin,1994}$=40 d, Systemic action=unknown, but metabolised by plants (Tomlin,1994))
formulation:	EC (in water (79.5 l ha^{-1}))
date/place:	August/September, 1983, Oxford, Miss., USA
duration:	2 d
application:	spraying machine with TX8 nozzles, sprayed at 10.00 AM local time
dosage:	initial deposit on leaves not given (spray dosage 0.280 kg ha^{-1} active ingredient)
method:	field measurements using (indirect) residue method for foliage
plant/crop:	type: cotton (Gossypium hirsutum L, variety: unknown, stage: unknown)
	height: 1.22 m
	area cover canopy: 100% (in rows of 1 m wide)
	spray interception: 100% (estimated)
soil:	soil type and properties: NA
	area: 10 000 m^2 (3 replicate areas)
	depth: NA
	soil temperature: NA
	spray interception: 0% (estimated)
water regime:	rainfall/irrigation: none
micro-climate:	air temperature (at 1.22m): 33.0±4.6 ^{o}C (day average)
	wind speed (at 2.22m): 1.07±0.51 m s^{-1} (day average)
	RH (at 1.22m): 63±18% (day average)
residues:	plant:
	84% of dosage (=initial deposit) after 0 hours (curve fit with elapsed time (r^2=0.87, n=14))
	61% of dosage (=initial deposit) after 1 hour (see above)
	53% of dosage (=initial deposit) after 2 hours (see above)
	27% of dosage (=initial deposit) after 12 hours (see above)
	17% of dosage (=initial deposit) after 1 day (see above)
	9% of dosage (=initial deposit) after 2 days (see above)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=2h}$=unknown
	rate$_{t=12h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=2d}$=unknown
	39% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)
	47% of dosage(=initial deposit) after 2 hours (see above)
	73% of dosage(=initial deposit) after 12 hours (see above)
	83% of dosage (=initial deposit) after 1 day (see above)
	91% of dosage (=initial deposit) after 2 days (see above)

compound:	**parathion-methyl**
formulation:	EC (in oil (4.7 l ha^{-1}) + water (74.8 l ha^{-1}))
date/place:	same
duration:	same

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application:	spraying machine with TX8 nozzles, sprayed at 10.00 AM local time
dosage:	same
method:	same
plant/crop:	same
soil:	same
water regime:	same
micro-climate:	air temperature (at 1.22m): 29.4±4.1 ^{o}C (day average)
	wind speed (at 2.22m): 1.39±0.69 m s^{-1} (day average)
	RH (at 1.22m): 70±16% (day average)
residues:	plant:
	88% of dosage (=initial deposit) after 0 hours (curve fit with elapsed time (r^2=0.89, n=10))
	72% of dosage (=initial deposit) after 1 hour (see above)
	57% of dosage (=initial deposit) after 2 hours (see above)
	30% of dosage (=initial deposit) after 12 hours (see above)
	19% of dosage (=initial deposit) after 1 day (see above)
	10% of dosage (=initial deposit) after 2 days (see above)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=2h}$=unknown
	rate$_{t=12h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=2d}$=unknown
	28% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)
	43% of dosage (=initial deposit) after 2 hours (see above)
	70% of dosage (=initial deposit) after 12 hours (see above)
	81% of dosage (=initial deposit) after 1 day (see above)
	90% of dosage (=initial deposit) after 2 days (see above)

compound:	**parathion-methyl**
formulation:	EC (in oil (4.7 l ha^{-1}) + water (16.7 l ha^{-1}))
90date/place:	same
duration:	same
application:	spraying machine with TX2 nozzles, sprayed at 10.00 AM local time
dosage:	same
method:	same
plant/crop:	type: same
soil:	same
water regime:	same
micro-climate:	air temperature (at 1.22m): 32.1±4.0 ^{o}C (day average)
	wind speed (at 2.22m): 1.43±0.71 m s^{-1} (day average)
	RH (at 1.22m): 64±16% (day average)
residues:	plant:
	88% of dosage (=initial deposit) after 0 hours (average curve fit value of other experim.)
	47% of dosage (=initial deposit) after 1 hour (curve fit with elapsed time (r^2=0.94, n=15))
	40% of dosage (=initial deposit) after 2 hours (see above)
	20% of dosage (=initial deposit) after 12 hours (see above)
	12% of dosage (=initial deposit) after 1 day (see above)
	4% of dosage (=initial deposit) after 2 days (see above)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=2h}$=unknown
	rate$_{t=12h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=2d}$=unknown
	53% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)
	60% of dosage (=initial deposit) after 2 hours (see above)
	80% of dosage (=initial deposit) after 12 hours (see above)
	88% of dosage (=initial deposit) after 1 day (see above)

96% of dosage (=initial deposit) after 2 days (see above)

compound: **parathion-methyl**
formulation: EC (in oil (4.7 l ha^{-1}) + water (16.7 l ha^{-1}))
date/place: same
duration: same
application: spraying machine with CDA-30 (Controlled Droplet Applicator), sprayed at 10.00 AM
                local time
dosage: same
method: same
plant/crop: same
soil: same
water regime: same
micro-climate: air temperature (at 1.22m): 32.1±4.4 ^{o}C (day average)
                wind speed (at 2.22m): 1.29±0.75 m s^{-1} (day average)
                RH (at 1.22m): 65±17% (day average)
residues: plant:
                88% of dosage (=initial deposit) after 0 hours   (average curve fit value of other experim.)
                43% of dosage (=initial deposit) after 1 hour (curve fit with elapsed time (r^2=0.96, n=15))
                35% of dosage (=initial deposit) after 2 hours   (see above)
                14% of dosage (=initial deposit) after 12 hours   (see above)
                6% of dosage (=initial deposit) after 1 day   (see above)
                0% of dosage (=initial deposit) after 2 days   (see above)
                soil: NA
volatilization: rate$_{t=0}$=unknown
                rate$_{t=1h}$=unknown
                rate$_{t=2h}$=unknown
                rate$_{t=12h}$=unknown
                rate$_{t=1d}$=unknown
                rate$_{t=2d}$=unknown
                57% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)
                65% of dosage (=initial deposit) after 2 hours   (see above)
                86% of dosage (=initial deposit) after 12 hours   (see above)
                94% of dosage (=initial deposit) after 1 day   (see above)
                100% of dosage (=initial deposit) after 2 days   (see above)

compound: **parathion-methyl**
formulation: EC (in oil (4.7 l ha^{-1}))
date/place: same
duration: same
application: spraying machine with CDA-14 (Controlled Droplet Applicator), sprayed at 10.00 AM
                local time
dosage: same
method: same
plant/crop: same
soil: same
water regime: same
micro-climate: air temperature (at 1.22m): 32.1±3.7 ^{o}C (day average)
                wind speed (at 2.22m): 1.21±0.54 m s^{-1} (day average)
                RH (at 1.22m): 62±15% (day average)
residues: plant:
                92% of dosage (=initial deposit) after 0 hours   (curve fit with elapsed time (r^2=0.88, n=16))
                67% of dosage(=initial deposit) after 1 hour (see above)
                59% of dosage (=initial deposit) after 2 hours   (see above)
                31% of dosage (=initial deposit) after 12 hours   (see above)
                20% of dosage (=initial deposit) after 1 day   (see above)
                10% of dosage (=initial deposit) after 2 days (see above)
                soil: NA

volatilization: rate$_{t=0}$=unknown

rate$_{t=1h}$=unknown

rate$_{t=2h}$=unknown

rate$_{t=12h}$=unknown

rate$_{t=1d}$=unknown

rate$_{t=2d}$=unknown

33% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)

41% of dosage (=initial deposit) after 2 hours   (see above)

69% of dosage (=initial deposit) after 12 hours   (see above)

80% of dosage (=initial deposit) after 1 day   (see above)

90% of dosage (=initial deposit) after 2 days (see above)

compound: **parathion-methyl**

formulation: EC (in oil (9.4 l ha^{-1}))

date/place: same

duration: same

application: spraying machine with CDA-20 (Controlled Droplet Applicator), sprayed at 10.00 AM
local time

dosage: same

method: same

plant/crop: same

soil: same

water regime: same

micro-climate: air temperature (at 1.22m): 29.0±4.3 ^{o}C (day average)

wind speed (at 2.22m): 1.33±0.72 m s^{-1} (day average)

RH (at 1.22m): 70±16% (day average)

residues: plant:

88% of dosage (=initial deposit) after 0 hours   (average curve fit value of other experim.)

49% of dosage (=initial deposit) after 1 hour (curve fit with elapsed time (r^2=0.98, n=15))

42% of dosage (=initial deposit) after 2 hours   (see above)

22% of dosage (=initial deposit) after 12 hours   (see above)

15% of dosage (=initial deposit) after 1 day   (see above)

7% of dosage (=initial deposit) after 2 days   (see above)

soil: NA

volatilization: rate$_{t=0}$=unknown

rate$_{t=1h}$=unknown

rate$_{t=2h}$=unknown

rate$_{t=12h}$=unknown

rate$_{t=1d}$=unknown

rate$_{t=2d}$=unknown

51% of dosage (=initial deposit) after 1 hour (calculated as (100-plant residue)%)

58% of dosage (=initial deposit) after 2 hours   (see above)

78% of dosage (=initial deposit) after 12 hours   (see above)

85% of dosage (=initial deposit) after 1 day   (see above)

93% of dosage (=initial deposit) after 2 days (see above)

Note: (1) - Presented CV values are based on fraction of initial pesticide load remaining on foliage, i.e. relation
with dosage may not be straightforward and various transformation and/or sorbing processes are disregarded;
(2) - Statistical analysis showed that initial deposit on plants for fifth experiment was significantly lower than for other
experiments, presumably due to drift (not shown by curve fit relation). Initial deposits for other experiments
showed little variation. Where initial data could not be obtained, an average value derived from other experiments
has been used.

Kubiak, 1995

compound: **parathion-methyl**

(insecticide, organophosphorus group, VP$_{Hornsby,1996}$=2 mPa (20 ^{o}C), VP$_{Kubiak,1995}$=1.3 mPa (20 ^{o}C),
S$_{water,Hornsby,1996}$=60 mg l^{-1} (25 ^{o}C), S$_{water,Kubiak,1995}$=55 mg l^{-1} (20 ^{o}C), S$_{hexane,Tomlin,1994}$=15 000 mg l^{-1} (20 ^{o}C),
K$_{ow,Tomlin,1994}$=1000, DT$_{50,hydrolysis,Tomlin,1994}$=40 d, Systemic action=unknown, although metabolised
by plants (Tomlin,1994) but not within 24 h (Kubiak,1995))

formulation:	WP (400 l/ha with radiolabelled ^{14}C)
date/place:	August, 1993, Neustadt, FRG
duration:	1 d
application:	sprayed with moving nozzle Tee Jet E-8001 in application chamber
dosage:	0.2 kg ha^{-1} active ingredient (net value on plants after substraction of losses; spray dosage applied 1.8 times higher)
method:	lab measurements (volatilization chamber) with ^{14}C-labelled compound
plant/crop:	type: French beans (variety: Canadian wonder, stage: blossoming)
	height: unknown
	area cover canopy: NA
	spray interception: 100% (soils and walls covered and pesticide contamination substracted from gross dosage)
soil:	soil type and properties: NA
	area: 0.5 m^2
	depth: NA
	soil temperature: NA
	spray interception: 0%
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 15-21.5 $^{\circ}$C (day 0), (night-day averages); 11-26 $^{\circ}$C (range)
	wind speed: 0.40-0.55 m s^{-1} (day 0), (night-day average); 0.40-1.05 m s^{-1} (range)
	RH: 80-60% (day 0), (night-day average); 45-90% (range)
residues:	plant:
	100% of dosage after 0 hours (sd=17%)
	unknown % of dosage after 3 hours
	unknown % of dosage after 6 hours
	20.3 % of dosage after 1 day (17.3% extractable and 3.0% non-extractable)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	15.9% of dosage after 1 hour
	40.5% of dosage after 3 hours
	53.4% of dosage after 6 hours
	77.2% of dosage after 1 day

compound:	**parathion-methyl**
formulation:	WP (400 l ha^{-1} with radiolabelled ^{14}C)
date/place:	unknown, Neustadt, FRG
duration:	1 d
application:	sprayed with Tee Jet E-8001 nozzles
dosage:	initial deposit on leaves not given (spray dosage 0.2 kg ha^{-1} active ingredient)
method:	field measurements using (indirect) residue method for foliage with ^{14}C-labelled compound
plant/crop:	type: French beans (variety: Canadian Wonder, stage: blossoming)
	height: unknown
	area cover canopy: unknown
	spray interception: unknown
soil:	soil type and properties: NA
	area: 62 m^2
	depth: NA
	soil temperature: NA
	spray interception: unknown
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 15-21.5 $^{\circ}$C (day 0), (night-day averages); 11-26 $^{\circ}$C (range)
	wind speed: 0.10-0.45 (day 0), m s^{-1} (night-day average); 0.0-1.05 m s^{-1} (range)
	RH: 80-60% (day 0), (night-day average); 45-90% (range)
residues:	plant:
	100% of dosage (=initial deposit) after 0 hours (sd=17%)
	86.1% of dosage (=initial deposit) after 1 hour (sd=23%)

	48.6% of dosage (=initial deposit) after 3 hours	(sd=35%)
	29.8% of dosage (=initial deposit) after 6 hours	(sd=32%)
	25.3% of dosage (=initial deposit) after 1 day	(sd=16%)
	soil: NA	
volatilization:	rate$_{t=0}$=unknown	
	rate$_{t=1h}$=unknown	
	rate$_{t=3h}$=unknown	
	rate$_{t=6h}$=unknown	
	rate$_{t=1d}$=unknown	
	13.9% of dosage (=initial deposit) after 1 hour	(calculated as (100-plant residue)%)
	51.4% of dosage (=initial deposit) after 3 hours	(see above)
	70.2% of dosage (=initial deposit) after 6 hours	(see above)
	74.7% of dosage (=initial deposit) after 1 day	(see above)

compound:	**isoproturon**
	(herbicide, ureas group, $VP_{Tomlin,1994}$=0.0033 mPa (20 ^{o}C), $VP_{Kubiak,1995}$<1 mPa (20 ^{o}C), $S_{water,Tomlin,1994}$=65 mg l^{-1} (22 ^{o}C), $S_{n-hexane,Tomlin,1994}$≈200 mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}$=320 (22 ^{o}C, pH7), Systemic action=unknown, but not metabolised within 24 h (Kubiak, 1995))
formulation:	SC (400 l ha^{-1} with radiolabelled ^{14}C)
date/place:	unknown, Neustadt, FRG
duration:	1 d
application:	sprayed with moving nozzle Tee Jet E-8001 in application chamber
dosage:	1.5 kg ha^{-1} active ingredient (net value on plants after substraction of losses; spray dosage applied 1.8 times higher)
method:	lab measurements (volatilization chamber) with ^{14}C-labelled compound
plant/crop:	type: French beans (variety: Canadian Wonder, stage: blossoming)
	height: unknown
	area cover canopy: NA
	spray interception: 100% (soils and walls covered and pesticide contamination substracted from gross dosage)
soil:	soil type and properties: NA
	area: 0.5 m^2
	depth: NA
	soil temperature: NA
	spray interception: 0%
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 17-26 ^{o}C (day 0), (night-day averages); 14-28.5 ^{o}C (range)
	wind speed: 0.45-0.55 m s^{-1} (day 0), (night-day average); 0.40-0.80 m s^{-1} (range)
	RH: 95-60% (day 0), (night-day average); 45-90% (range)
residues:	plant:
	100% of dosage after 0 hours (sd=12%)
	100.4% of dosage after 1 day (97.0% extractable and 3.4% non-extractable)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1d}$=unknown
	0.6% of dosage after 1 day

compound:	**isoproturon**
formulation:	SC (400 l ha^{-1} with radiolabelled ^{14}C)
date/place:	unknown, Neustadt, FRG
duration:	1 d
application:	sprayed with Tee Jet E-8001 nozzles
dosage:	initial deposit on leaves not given (spray dosage 1.5 kg ha^{-1} active ingredient)
method:	field measurements using (indirect) residue method for foliage with ^{14}C-labelled compound
plant/crop:	type: French beans (variety: Canadian Wonder, stage: blossoming)
	height: unknown
	area cover canopy: unknown
	spray interception: unknown

soil:	soil type and properties: NA
	area: 25 m^2
	depth: NA
	soil temperature: NA
	spray interception: unknown
water regime:	rainfall/irrigation: none
micro-climate:	air temperature: temperature: 16-25 ^{o}C (day 0), (night-day average); 14-28.5 ^{o}C (range); cloudy
	wind speed: 0.15-0.50 m s^{-1} (day 0), (night-day average); 0.0-0.80 m s^{-1} (range)
	RH: 95-60% (day 0), (night-day average); 45-90% (range)
residues:	plant:
	100% of dosage (=initial deposit) after 0 hours (sd=12%)
	101.7% of dosage (=initial deposit) after 1 day (sd=16%)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1d}$=unknown
	0% of dosage (=initial deposit) after 1 day (calculated as (100-plant residue)%)

Note: (1) - More than 99% of the extractable residues from plants as well as of the volatilized ^{14}C was unchanged parathion-methyl, which is in line with presented DT$_{50}$ value.

Rüdel, 1992

compound:	**lindane**
	(insecticide, organochlorines group, γ-isomer, VP$_{Tomlin,1994}$=5.6 mPa (20 ^{o}C),
	VP$_{Hornsby,1996}$=17.3 mPa (30 ^{o}C), VP$_{Rüdel,1992}$=1.2 mPa, S$_{water,Tomlin,1994}$=7.3 mg l^{-1} (25 ^{o}C),
	S$_{water,Tomlin,1994}$=12 mg l^{-1} (35 ^{o}C), S$_{cyclohexanone,Tomlin,1994}$=36 700 mg l^{-1} (20 ^{o}C),
	K$_{ow,Boencke,1990}$=5000, DT$_{50,solution,pH7,Tomlin,1994}$=191 d, Systemic action=unknown)
formulation:	SC (Nexit flüssig with 80% a.i.)
date/place:	unknown, Schmallenberg, FRG
duration:	1.21 d
application:	sprayed with nozzle Lechler FC4-448
dosage:	0.875±0.085 kg ha^{-1} active ingredient (assumed as net dosage, i.e. difference between
	application dosage and losses (but could also be net deposit measured on plants); spray dosage
	approximately 1.5 kg ha^{-1})
method:	lab measurements in wind tunnel with volatilization chamber (LxWxH: 2 x 0.85 x 0.85 m) with
	1 m^2 of bowls
plant/crop:	type: garden beans (Phaseolus vulgaris, variety: Saxa green, stage: in flower and/or first fruit
	bearing, but low soil cover)
	height: unknown
	area cover canopy: unknown
	spray interception: 82% of given dosage (approximation, calculated as 79 mg lindane over 96
	mg lindane deposit on leaves, due to low soil cover)
soil:	soil type and properties: silty sand: sand=75-79%, C$_{org}$=1.1-1.5% (1.3), $\theta_{sat.,estimated}$=44%,
	$\rho_{dry soil,estimated}$=1450 kg m^{-3}
	area: 1 m^2
	depth: 0.03 m
	soil temperature: NA
	spray interception: 100-82=18%
water regime:	rainfall/irrigation: none
	θ=0.6·44=26.4%
micro-climate:	temperature: 20.0±0.3 ^{o}C (day 0)
	wind speed: 1.02±0.02 m s^{-1} (day 0)
	RH: 49.7±4.2% (day 0)
residues:	plant: NA
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=1.21d}$=unknown

2.4% of dosage after 1 hour
7.5% of dosage after 3 hours
14.4% of dosage after 6 hours
35.4% of dosage after 1 day
37.3% of dosage after 1.21 days   (linear interpolation)

compound:	**lindane**
formulation:	same
date/place:	same
duration:	same
application:	same
dosage:	same
method:	same
plant/crop:	type: same
	height: unknown
	area cover canopy: unknown
	spray interception: 100% (approximation of net deposit on leaves)
soil:	spray interception: 0%
water regime:	same
micro-climate:	temperature: 24.6±0.3 ^{o}C (day 0)
	wind speed: 1.11±0.01 m s^{-1} (day 0)
	RH: 41.6±0.6% (day 0)
residues:	plant: NA
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=1.21d}$=unknown

4.0% of dosage after 1 hour
12.2% of dosage after 3 hours
20.1% of dosage after 6 hours   (linear interpolation)
52.1% of dosage after 24 hours   (linear interpolation)
57.5% of dosage after 1.21 days

compound:	**lindane**
formulation:	same
date/place:	same
duration:	same
application:	same
dosage:	same
method:	same
plant/crop:	type:same
	height: unknown
	area cover canopy: unknown
	spray interception: 100% (approximation of net deposit on leaves)
soil:	spray interception: 0%
water regime:	same
micro-climate:	temperature: 24.7±0.3 ^{o}C (day 0)
	wind speed: 1.13±0.01 m s^{-1} (day 0)
	RH: 35.0±1.0% (day 0)
residues:	plant: NA
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=1.21d}$=unknown

4.5% of dosage after 1 hour
12.5% of dosage after 3 hours
21.7% of dosage after 6 hours
53.0% of dosage after 1 day
57.9% of dosage after 1.21 days

Note: (1) - Reference is made to volatilization related to the deposit on the plant leaves, whereas it is not made clear as to how the the deposit is calculated (directly or indirectly); (2) - No reference is made that soil was covered during application. Estimation for volatilization of lindane from bare soil for the first experiment under given conditions comes to $0.18 \cdot 13 = 2.3\%$ of dosage for a 1.21 day period (Field conditions, Smit et al.,1997). Author presents a value of 28.4% of dosage for a bare soil application under comparable ambient conditions, which would result in volatilization losses from the soil for the first experiment of $0.18 \cdot 28.4 = 5.1\%$. Corrected volatilization from leaves, CV_{plant}, can be calculated with:

$$0.373\ D_T = CV_{plant}\ D_{plant} + CV_{soil}\ D_{soil} \qquad \text{with } D_{lplant} / D_T = 0.82 \text{ and } D_T = D_{plant} + D_{soil}$$

which results in 39.3%.

Waymann, 1995

compound: **lindane**
                 (insecticide, organochlorines group, γ-isomer, $VP_{Tomlin,1994}$=5.6 mPa (20 °C),
                 $VP_{Hornsby,1996}$=17.3 mPa (30 °C), $S_{water,Tomlin,1994}$=7.3 mg l^{-1} (25 °C), $S_{water,Tomlin,1994}$=12 mg l^{-1} (35 °C),
                 $S_{cyclohexanone,Tomlin,1994}$=36 700 mg l^{-1} (20 °C), $K_{ow,Boencke,1990}$=5000, $DT_{50,solution,pH7,Tomlin,1994}$=191 d,
                 Systemic action=unknown)
formulation: SC (Nexit flüssig with 80% a.i.)
date/place: unknown, Schmallenberg, FRG
duration: 1.21 d
application: sprayed on surface with moving nozzle Teejet 8001EVS
dosage: 1.65 kg ha^{-1} active ingredient (net value on bowls after substraction of losses)
method: lab measurements in wind tunnel with volatilization chamber (LxWxH: 2 x 0.85 x 0.85 m) with
                 4 bowls (A=0.09 m^2 each)
plant/crop: type: French beans (Phaseolus vulgaris, variety: unknown, stage: blooming or first fruit bearing)
                 height: 0.3-0.4 m (0.35)
                 area cover canopy: unknown
                 spray interception: 100% (estimated)
soil: soil type and properties: silty sand: sand=75-79%, C_{org}=1.1-1.5% (1.3), $\theta_{sat,estimated}$=44%,
                 $\rho_{dry\ soil,estimated}$=1450 kg m^{-3}
                 area (LxW): 0.36 m^2
                 depth: 0.03 m
                 soil temperature: NA
                 spray interception: 0% (estimated)
water regime: rainfall/irrigation: none
micro-climate: temperature: 20 °C (day 0)
                 wind speed (at ≈0.53m): 0.4 m s^{-1} (day 0)
                 RH: 49% (day 0)
residues: plant: NA
                 soil: NA
volatilization: rate$_{t=0}$=unknown
                 rate$_{t=1h}$=61.1 g ha^{-1} h^{-1}
                 rate$_{t=3h}$=unknown
                 rate$_{t=8h}$=unknown
                 rate$_{t=23h}$=unknown
                 rate$_{t=1.21d}$=unknown
                 3.7% of dosage after 1 hour
                 13.2% of dosage after 3 hours
                 20.8% of dosage after 8 hours
                 38.1% of dosage after 23 hours
                 41.4% of dosage after 1 day   (linear interpolation)
                 57.8% of dosage after 1.21 days

compound: **lindane**
formulation: same
date/place: same
duration: same
application: same
dosage: 1.56 kg ha^{-1} active ingredient (net value on bowls after substraction of losses)
method: same
plant/crop: same
soil: same
water regime: same
micro-climate: temperature: same
wind speed (at ≈0.53m): 1.0 m s^{-1} (day 0)
RH: 47% (day 0)
residues: plant: NA
soil: NA
volatilization: rate$_{t=0}$=unknown
rate$_{t=1h}$=65.5 g ha^{-1} h^{-1}
rate$_{t=3h}$=unknown
rate$_{t=7h}$=unknown
rate$_{t=23h}$=unknown
rate$_{t=1.21d}$=unknown
4.2% of dosage after 1 hour
11.7% of dosage after 3 hours
20.4% of dosage after 6 hours   (linear interpolation)
23.3% of dosage after 7 hours
54.1% of dosage after 23 hours
55.0% of dosage after 1 day   (linear interpolation)
60.1% of dosage after 1.21 days

compound: **lindane**
formulation: same
date/place: same
duration: same
application: same
dosage: 1.41 kg ha^{-1} active ingredient (net value on bowls after substraction of losses)
method: same
plant/crop: same
soil: same
water regime: same
micro-climate: temperature: same
wind speed (at ≈0.53m): 2.0 m s^{-1} (day 0)
RH: 45% (day 0)
residues: plant: NA
soil: NA
volatilization: rate$_{t=0}$=unknown
rate$_{t=1h}$=79.0 g ha^{-1} h^{-1}
rate$_{t=3h}$=unknown
rate$_{t=7h}$=unknown
rate$_{t=23h}$=unknown
rate$_{t=1.21d}$=unknown
5.6% of dosage after 1 hour
15.6% of dosage after 3 hours
25.0% of dosage after 6 hours   (linear interpolation)
28.1% of dosage after 7 hours
61.4% of dosage after 23 hours
62.3% of dosage after 1 day   (linear interpolation)
67.7% of dosage after 1.21 days

Notes: (1) - Test area size, dosage and wind speed appear to be important parameters; (2) - No reference is made of whether the pesticide reached the soil or not.

compound: **lindane**

(insecticide, organochlorines group, γ-isomer, $VP_{Tomlin,1994}$=5.6 mPa (20 ^{o}C),
$VP_{Hornsby,1996}$=17.3 mPa (30 ^{o}C), $S_{water,Tomlin,1994}$=7.3 mg l^{-1} (25 ^{o}C), $S_{water,Tomlin,1994}$=12 mg l^{-1} (35 ^{o}C),
$S_{cyclohexanone,Tomlin,1994}$=36 700 mg l^{-1} (20 ^{o}C), $K_{ow,Boencke,1990}$=5000, $DT_{50,solution,pH7,Tomlin,1994}$=191 d,
Systemic action=unknown)

formulation: Nexit stark (80% lindane, no GIFAP formulation code given)

date/place: July 30, 1991, Braunschweig-Völkenrode, FRG

duration: 2 d

application: hand-moved motor sprayer with 2m boom and 4 nozzles Teejet 11006, sprayed at 09.48 local
time

dosage: 1.08 kg ha^{-1} active ingredient (spray dosage; initial deposits on plants unknown)

method: field measurements at 0.9 and 1.8 m height using Aerodynamic-Profile Approach
(including newly developed correction method for small experimental surfaces)

plant/crop: type: sugar beet (variety: K.W. Tina, stage: unknown)
height: 0.45 m
area cover canopy: 100%
spray interception: 100%

soil: soil type and properties: sandy clay loam: sand=49%, silt=43%, clay=8%, C_{org}=1.3%, pH=6.2,
MC_{sat}=27.7 dry_mass%, $\theta_{sat,estimated}$=42.0%, $\rho_{dry\ soil,estimated}$=1500 kg m^{-3}
area (LxW): 31.4 x 20.5 m (with 4 replicates)
depth: NA
temperature: unknown
spray interception: 0%

water regime: rainfall/irrigation: none

micro-climate: air temperature (at 0.9m): 20-26 ^{o}C (day 0), 17-23 ^{o}C (day 1), 18-19 ^{o}C (day 2),
18-18 ^{o}C (day 3), 18-22 ^{o}C (whole period), (all night-day averages); 15-28 ^{o}C (range)
wind speed (at 1.8m): 1.7-4.3 m s^{-1} (day 0), 1.8-2.8 m s^{-1} (day 1), 2.7-3 m s^{-1} (day 2),
3-3.2 m s^{-1} (day 3), 2.3-3.3 m s^{-1} (whole period), (all night-day averages); 1.8-5.2 m s^{-1} (range)
RH (at 1.8m): 30-83% (54), (range)

residue: plant:
100% of initial deposit after 0 hours
54% of initial deposit after 2 hours   (linear interpolation)
25% of initial deposit after 6 hours   (see above)
10% of initial deposit after 1 day   (at 1.026 day)
 5% of initial deposit after 2 days   (linear interpolation)
soil: NA

volatilization: rate$_{t=0}$=unknown
rate$_{t=2h}$=unknown
rate$_{t=1d}$=unknown
rate$_{t=2d}$=unknown
30% of dosage after 2 hours   (curve fit value)
74% of dosage after 6 hours   (curve fit value)
87% of dosage after 1 day
98% of dosage after 2 days

compound: **lindane**

formulation: same

date/place: August 13, 1991, Braunschweig, FRG

duration: 2 d

application: hand-moved motor sprayer with 2m boom and 4 nozzles Teejet 11006, sprayed at 09.48 local
time

dosage: 0.70 kg ha^{-1} active ingredient (spray dosage; initial deposits on plants unknown)

method: same

plant/crop: same

soil: same

water regime: same

micro-climate: air temperature (at 1.0m): 12-15 ^{o}C (day 0), 11-20 ^{o}C (day 1), 13-21 ^{o}C (day 2),
16-21 ^{o}C (day 3), 13-20 ^{o}C (whole period), (all night-day averages); 10-25 ^{o}C (range)

wind speed (at 1.8m): 0-1.7 m s^{-1} (day 0), 0.4-1.8 m s^{-1} (day 1), 0-1.8 m s^{-1} (day 2),
1.6-3.2 m s^{-1} (day 3), 0.6-1.9 m s^{-1} (whole period), (all night-day averages); 0-5 m s^{-1} (range)
RH (at 1.8m): 38-98% (73), (range)

residue:	plant:

100% of initial deposit after 0 hours
91% of initial deposit after appr. 2 hours   (linear interpolation)
72% of initial deposit after appr. 6 hours   (see above)
35% of initial deposit after appr. 1 day   (at 1.026 day)
19% of initial deposit after appr. 2 days   (linear interpolation)
soil: NA

volatilization: rate$_{t=0}$=unknown
rate$_{t=2h}$=unknown
rate$_{t=1d}$=unknown
rate$_{t=2d}$=unknown
10% of dosage after 2 hours   (curve fit value)
13% of dosage after 6 hours   (curve fit value)
58% of dosage after 1 day
68% of dosage after 2 days

Note: (1) - Both experiments also described in Haenel and Siebers (1995) with (slightly) different measured values attributed to different correction methods; (2) - Data for indirect method in first experiment probably incorrectly dated; (3) - Residue analysis based on pesticide concentrations found in crop harvested at fixed intervals and concentration found directly after application; (4) - Direct and indirect (residue) method are used together for intercomparison. However, reference dosages may be different, i.e. spray dosage for the direct method and initial residues on plants for the indirect method.

Staimer, 1996

compound:	**fenpropimorph**

(fungicide, morpholines group, VP$_{Tomlin,1994}$=2.3 mPa (20 ^{o}C), S$_{water,Tomlin,1994}$=4.3 mg l^{-1} (20 ^{o}C, pH7),
S$_{cyclohexane,Tomlin,1994}$>1000 g kg^{-1} (20 ^{o}C), K$_{ow,Tomlin,1994}$=13 000 (pH7),
Stable under all (acidic, neutral, alkalic and light) conditions,
Systemic action=systemic, absorbed through leaves (Tomlin,1994))

formulation:	EC (Corbel 750, Ciba-Geigy, and radiolabelled ^{14}C)
date/place:	unknown, Neustadt, FRG
duration:	4 d
application:	sprayed on surface with moving nozzle Tee-Jet E 8001
dosage:	0.75 kg ha^{-1} active ingredient (net value on plant stands after substraction of losses; actual dosage applied 1.1 times higher)
method:	lab measurements in volatilization chamber (LxWxH: 2 x 0.85 x 0.85 m) with 4 bowls (A=0.09 m^2 each) and radiolabelled ^{14}C
plant/crop:	type: summer barley (variety: Alexis, stage: ear emergence)
	height: 0.3-0.4 m (0.35)
	area cover canopy: unknown
	spray interception: 80% (see: spray interception soil)
soil:	soil type and properties: NA
	area (LxW): 0.5 m^2
	depth: 0.1 m
	temperature: NA
	spray interception: 20% (estimated: D$_{Soil,t0}$ = 0.183 D$_{Total}$ + (0.11+0.02)/2 D$_{Soil,t0}$; see also note 1)
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 13-18 ^{o}C (day 0), 12-20 ^{o}C (day 1), 13-19 ^{o}C (day 2), 14-19 ^{o}C (day 3),

15-20 ^{o}C (day 4), 14-19 ^{o}C (whole period), (all night-day averages); 8-23 ^{o}C (range)
wind speed: 0.4-1.1 m s^{-1} (day 0), 0.2-0.6 m s^{-1} (day 1), 0.2-0.9 m s^{-1} (day 2), 0.7-1.2 m s^{-1} (day 3),
0.4-0.6 m s^{-1} (day 4), 0.4-0.9 m s^{-1} (whole period), (all night-day averages); 0.1-1.4 m s^{-1} (range)
RH: 80-70% (day 0), 81-62% (day 1), 81-70% (day 2), 81-58% (day 3), 62-49% (day 4),
78-64% (whole period), (all night-day averages); 46-90% (range)

residues:	plant:

80% of dosage after 0 hours   (calculated)
22.3% of dosage after 4 days
soil:

	20% of dosage after 0 hours	(calculated)
	18.3% of dosage after 4 days	
volatilization:	rate$_{t=0}$=unknown	
	rate$_{t=1h}$=unknown	
	rate$_{t=3h}$=unknown	
	rate$_{t=6h}$=unknown	
	rate$_{t=1d}$=unknown	
	rate$_{t=2d}$=unknown	
	rate$_{t=3d}$=unknown	
	rate$_{t=4d}$=unknown	
	8% of dosage after 1 hour	(total=leaf+soil)
	24% of dosage after 3 hours	(see above)
	30% of dosage after 6 hours	(see above)
	43% of dosage after 1 day	(see above)
	47% of dosage after 2 days	(see above)
	48% of dosage after 3 days	(see above)
	48% of dosage after 4 days	(see above)

compound:	**fenpropimorph**	
formulation:	same	
date/place:	same	
duration:	same	
application:	same	
dosage:	same	
method:	same	
plant/crop:	spray interception: 79% (see: spray interception soil)	
soil:	spray interception: 21% (estimated: $D_{Soil,t0} = 0.193\ D_{Total} + (0.11+0.02)/2\ D_{Soil,t0}$; see also note 1)	
water regime:	same	
micro-climate:	same	
residues:	plant:	
	79% of dosage after 0 hours	(calculated)
	23.4% of dosage after 4 days	
	soil:	
	21% of dosage after 0 hours	(calculated)
	19.3% of dosage after 4 days	
volatilization:	rate$_{t=0}$=unknown	
	rate$_{t=1h}$=unknown	
	rate$_{t=3h}$=unknown	
	rate$_{t=6h}$=unknown	
	rate$_{t=1d}$=unknown	
	rate$_{t=2d}$=unknown	
	rate$_{t=3d}$=unknown	
	rate$_{t=4d}$=unknown	
	7% of dosage after 1 hour	(total=leaf+soil)
	20% of dosage after 3 hours	(see above)
	27% of dosage after 6 hours	(see above)
	42% of dosage after 1 day	(see above)
	45% of dosage after 2 days	(see above)
	46% of dosage after 3 days	(see above)
	46% of dosage after 4 days	(see above)

compound:	**fenpropimorph**	
formulation:	same	
date/place:	same	
duration:	same	
application:	same	
dosage:	same	
method:	same	
plant/crop:	spray interception: 72% (see: spray interception soil)	

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soil:	spray interception: 28% (estimated: $D_{Soil,t0}$ = 0.263 D_{Total} + (0.11+0.02)/2 $D_{Soil,t0}$; see also note 1)
water regime:	same
micro-climate:	same
residues:	plant:
	72% of dosage after 0 hours (calculated)
	18.4% of dosage after 4 days
	soil:
	28% of dosage after 0 hours (calculated)
	26.3% of dosage after 4 days
volatilization:	$rate_{t=0}$=unknown
	$rate_{t=1h}$=unknown
	$rate_{t=3h}$=unknown
	$rate_{t=6h}$=unknown
	$rate_{t=1d}$=unknown
	$rate_{t=2d}$=unknown
	$rate_{t=3d}$=unknown
	$rate_{t=4d}$=unknown
	10% of dosage after 1 hour (total=leaf+soil)
	18% of dosage after 3 hours (see above)
	42% of dosage after 6 hours (see above)
	54% of dosage after 1 day (see above)
	58% of dosage after 2 days (see above)
	59% of dosage after 3 days (see above)
	60% of dosage after 4 days (see above)

Note: (1) - Three separate experiments with applications on various bare soils indicated a volatilization between 2 and 11% of the dosage after four days. A correction on the above presented CV values for these amounts is required, although distribution of the pesticide over leaves and soil during application is not given. Estimation for volatilization of fenpropimorph from bare soil under given conditions (θ=24%, ρ=1250 kg m^{-3}, T=19 ^{o}C, C_{org}=1.3%, pH=6.8) results in 14% of dosage (Smit et al.,1997). It is assumed that the same soils were used in the three experiments for volatilization from plant leaves; (2) - Volatile $^{14}CO_2$ amounted to 1.8, 1.1, and 1.5% for the three leaf trials respectively; (3) - Extracted radioactivity from plants consisted of fenpropimorph acid and other polar metabolites. In the soil only fenpropimorph could be detected.

Stork, 1994

compound:	**parathion-methyl**
	(insecticide, organophosphorus group, $VP_{Hornsby,1996}$=2 mPa (20 ^{o}C), $VP_{Kubiak,1995}$=1.3 mPa (20 ^{o}C), $S_{water,Hornsby,1996}$=60 mg l^{-1} (25 ^{o}C), $S_{water,Kubiak,1995}$=55 mg l^{-1} (20 ^{o}C), $S_{hexane,Tomlin,1994}$=15 000 mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}$=1000, $DT_{50,hydrolysis,Tomlin,1994}$=40 d, Systemic action=unknown, although metabolised by plants (Tomlin,1994) but not within 24 h (Kubiak,1995))
formulation:	WP (40% a.i. with radiolabelled ^{14}C)
date/place:	July 13, 1993, Jülich, FRG
duration:	6 d
application:	sprayed with moving nozzle Teejet E-8004E in application chamber at equivalent of 450 l ha^{-1}
dosage:	0.068 kg ha^{-1} active ingredient (net value on plants and soil after substraction of losses)
method:	lab measurements with volatilization chamber connected to windtunnel using radiolabelled ^{14}C
plant/crop:	type: dwarf beans (variety: Canadian wonder, stage: first blossom)
	height: unknown
	area cover canopy: ≈100%
	spray interception: 97% (see: spray interception soil)
soil:	soil type and properties: gleyic cambisol: sand=73.3%, clay=3.6%, C_{org}=0.99%, $\theta_{sat,estimated}$=44%, $\rho_{dry\ soil,estimated}$=1450 kg m^{-3}
	area: 0.5 m^{2}
	depth: NA
	soil temperature: NA
	spray interception: 3% (estimated: $D_{Soil,t0}$ = 0.023 D_{Total} + 0.15 $D_{Soil,t0}$; see also note 4)
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 19.4 ^{o}C (average)
	wind speed: 0.9 m s^{-1} (average above beans); 0.5 m s^{-1} (inside beans)
	RH: 81% (average)

residues:	plant:	
	97% of dosage after 0 hours	(calculated)
	21.9% of dosage after 6 days	
	soil:	
	3% of dosage after 0 hours	(calculated)
	2.3% of dosage after 6 days	
volatilization:	rate$_{t=0}$=unknown	
	rate$_{t=1h}$=unknown	
	rate$_{t=3h}$=unknown	
	rate$_{t=6h}$=unknown	
	rate$_{t=1d}$=unknown	
	50% of dosage after 1 day	(total=leaf+soil)
	62% of dosage after 2 days	(see above)
	67% of dosage after 3 days	(see above)
	71% of dosage after 4 days	(see above)
	72% of dosage after 5 days	(see above)
	73% of dosage after 6 days	(see above)

Note: (1) - No parathion found in leachate; (2) - Biomineralization estimated at 0.5% of dosage; (3) - Measured wash-off from leaves equal to 3.8% after 6 days of which 0.6% was unchanged parathion; (4) - Residue in soil amounted to 2.3% of dosage after 6 days. Estimation for cumulative volatilization of parathion-methyl from bare soil after 6 days under following conditions, θ=22% (0.5 θ_{sat}), ρ=1450 kg m^{-3}, T=19.4 ^{o}C, and C$_{org}$=0.99%, results in 15% of dosage (Smit et al.,1997).

Sundaram, 1989

compound:	**aminocarb**	
	(insecticide, carbamates group, VP$_{Hornsby,1996}$=2.3 mPa, S$_{water,Hornsby,1996}$=915 mg l^{-1} (20 ^{o}C),	
	K$_{ow,Sangster,1993}$=79, DT$_{50,foliage,NCSU}$=4 d, Systemic action=unknown)	
formulation:	EC (Matacil 180F with 19.6% w/w a.i. and surfactant Atlox 3409F in water (26:1.5:72.5 vol%))	
date/place:	unknown, Sault Ste. Marie, Canada	
duration:	0.5 d	
application:	sprayed in application chamber (4.3x0.9x3.05 m) at equivalent of 4.5 l ha^{-1}	
dosage:	appr. 0.075 kg ha^{-1} active ingredient or 535 µg/plant (net value on plants after substraction of losses; spray dosage 0.210 kg ha^{-1} a.i.)	
method:	lab measurements in volatilization chamber (1.2x0.6x0.9 m)	
plant/crop:	type: balsam fir (variety: unknown, stage: seedlings)	
	height: 0.40±0.03 m (crown)	
	area cover canopy: NA	
	spray interception: NA	
soil:	soil type and properties: NA	
	area: 0.071±0.001 m^2/plant (3.0 m^2 total)	
	depth: NA	
	soil temperature: NA	
	spray interception: NA	
water regime:	rainfall/irrigation: none	
micro-climate:	temperature: 20±2 ^{o}C (fixed), 18-22 ^{o}C (range)	
	wind speed: 0 m s^{-1} (fixed)	
	RH: 65±3% (fixed)	
residues:	plant:	
	100% of dosage after 0.25 hours	(3 replicates average; SD<10%)
	71.4% of dosage after 12 hours	(3 replicates average; SD<10%)
	soil: NA	(covered with aluminium foil)
volatilization:	rate$_{t=0}$=unknown	
	rate$_{t=1h}$=unknown	
	rate$_{t=3h}$=unknown	
	rate$_{t=6h}$=unknown	
	rate$_{t=1d}$=unknown	
	4.8% of dosage after 1 hour	(average of three replicates; SD<12%)
	7.0% of dosage after 2 hours	(see above)
	8.2% of dosage after 4 hours	(see above)

	8.8% of dosage after 6 hours	(see above)
	9.0% of dosage after 8 hours	(see above)
	9.2% of dosage after 10 hours	(see above)
	9.4% of dosage after 12 hours	(see above)

compound: **fenithrothion**
(insecticide, phenylamides group, $VP_{Tomlin,1994}$=18 mPa (20 ^{o}C), $S_{water,Tomlin,1994}$=21 mg l^{-1} (20 ^{o}C), $S_{hexane,Tomlin,1994}$=24 000 mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}$=2690 (20 ^{o}C), $DT_{50,hydrolysis,estimated,Tomlin,1994}$=84.3 d (22 ^{o}C), $DT_{50,fir/spruce,Tomlin,1994}$=4 d, Systemic action=unknown)

formulation: technical (Sumithion 97% pure with surfactant Atlox 3409F and co-surfactant Dowanol TPM in water (11:1.5:1.5:84 vol%))

date/place: unknown, Sault Ste. Marie, Canada

duration: 0.5 d

application: sprayed in application chamber (4.3x0.9x3.05 m) at equivalent of 1.5 l ha^{-1}

dosage: appr. 0.080 kg ha^{-1} active ingredient or 567 µg/plant (net value on plants after substraction of losses; spray dosage 0.210 kg ha^{-1} a.i.)

method: lab measurements in volatilization chamber (1.2x0.6x0.9 m)

plant/crop: type: balsam fir (variety: unknown, stage: seedlings)
height: 0.40±0.03 m (crown)
area cover canopy: NA
spray interception: NA

soil: soil type and properties: NA
area: 0.071±0.001 m^2/plant (3.0 m^2 total)
depth: NA
soil temperature: NA
spray interception: NA

water regime: rainfall/irrigation: none

micro-climate: temperature: 20±2 ^{o}C (fixed), 18-22 ^{o}C (range)
wind speed: 0 m s^{-1} (fixed)
RH: 65±3% (fixed)

residues: plant:

100% of dosage after 0.25 hours	(3 replicates average; SD<10%)
73.0% of dosage after 12 hours	(3 replicates average; SD<10%)
soil: NA	(covered with aluminium foil)

volatilization: rate$_{t=0}$=unknown
rate$_{t=1h}$=unknown
rate$_{t=3h}$=unknown
rate$_{t=6h}$=unknown
rate$_{t=1d}$=unknown

8.9% of dosage after 1 hour	(average of three replicates; SD<12%)
11.8% of dosage after 2 hours	(see above)
13.7% of dosage after 4 hours	(see above)
14.5% of dosage after 6 hours	(see above)
14.9% of dosage after 8 hours	(see above)
14.9% of dosage after 10 hours	(see above)
14.9% of dosage after 12 hours	(see above)

compound: **mexacarbate**
(insecticide, carbamates group, $VP_{Hornsby,1996}$=13 000 mPa (138.9 ^{o}C !), $S_{water,Hornsby,1996}$=100 mg l^{-1} (25 ^{o}C), $S_{water,other sources}$=nil, $K_{ow,Sangster,1993}$=367.3, $DT_{50,hydrolysis,Spectrum Laboratories}$=25.7 d, Systemic action=unknown)

formulation: EC (Zectran UCZF19 with 21.7% w/w a.i. and surfactant Atlox 3409F in water (22:1.5:76.5 vol%))

date/place: unknown, Sault Ste. Marie, Canada

duration: 0.5 d

application: sprayed in application chamber (4.3x0.9x3.05 m) at equivalent of 4.5 l ha^{-1}

dosage: appr. 0.069 kg ha^{-1} active ingredient or 490 µg/plant (net value on plants after substraction of losses; spray dosage 0.210 kg ha^{-1} a.i.)

plant/crop: type: balsam fir (variety: unknown, stage: seedlings)
height: 0.40±0.03 m (crown)

	area cover canopy: NA
	spray interception: NA
soil:	soil type and properties: NA
	area: 0.071±0.001 m^2/plant (3.0 m^2 total)
	depth: NA
	soil temperature: NA
water regime:	rainfall/irrigation: none
micro-climate:	temperature: 20±2 ^{o}C (fixed), 18-22 ^{o}C (range)
	wind speed: 0 m s^{-1} (fixed)
	RH: 65±3% (fixed)
residues:	plant:
	100% of dosage after 0.25 h (3 replicates average; SD<10%)
	9.40% of dosage after 12 hours (3 replicates average; SD<10%)
	soil: NA (covered with aluminium foil)
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	21.5% of dosage after 1 hour (average of three replicates; SD<12%)
	26.7% of dosage after 2 hours (see above)
	29.0% of dosage after 4 hours (see above)
	30.0% of dosage after 6 hours (see above)
	30.3% of dosage after 8 hours (see above)
	30.3% of dosage after 10 hours (see above)
	30.3% of dosage after 12 hours (see above)

Note: (1) - Experiments mainly setup for intercomparison; (2) - Percentage unaccounted for after 12 hours amounts to 19.2% of dosage for aminocarb, 12.1% for fenithrotion, and 60.3% for mexacarbate; (3) - Rapid loss rate for all chemicals with an exponential decline up to 6 hours post-spray.

Taylor/Turner, 1977

compound:	**dieldrin**
	(insecticide, organochlorines group, VP$_{Worthing,1987}$=0.4 mPa (20 ^{o}C),
	S$_{water,Worthing,1987}$=0.186 mg l^{-1} (20 ^{o}C), K$_{ow,DeBruijn,1989}$=251 000, DT$_{50,hydrolysis,ARS,1995}$=3830 d,
	DT$_{50,photolysis,ARS,1995}$=6.4 d, Extremely persistant, Systemic action=unknown)
formulation:	commercial Shell Chemical (in mix with heptachlor)
date/place:	July 12, 1973, Beltsville, Md., USA
duration:	23 d
application:	tractor-mounted field sprayer with 6.4 m boom, sprayed at appr. 10.00 local time (mid-time)
dosage:	5.6 kg ha^{-1} active ingredient (spray dosage)
method:	field measurements using Aerodynamic (AD) Method with sampling heights at 0.1, 0.2, 0.3, 0.5, and 1.0 m
plant/crop:	type: grass (Dactylis glomerata L., variety: orchard, stage: NA)
	height: 0.10 m (until 2 days after application)
	area cover canopy: unknown
	spray interception: 36% (estimated, see residue and note)
soil:	soil type and properties: fine sandy loam: OM=1.2% (after Glotfelty, Smit et al., 1997, cb55),
	$\rho_{dry\ soil,estimated}$=1400 kg m^{-3}, $\theta_{sat.,estimated}$=47%
	area (LxW): 244 x 82 m (2.00 ha)
	temperature: NA
	water regime: total rainfall: 49.5 mm, 12 mm (day 9), 7.5 mm (day 10), 30 mm (days 18 and 19)
	$\theta_{estimated}$=10% (whole period and estimated close to wilting point)
	spray interception: 6.4% (estimated, see residue and note)
micro-climate:	air temperature (at 1.2m): 20 ^{o}C (day 0, application time); 14-32 ^{o}C (23), (range day temperatures whole period); weather hot, hazy, and generally dry, with thunderstorms on days 9, 10, 18, and 19 after day of application
	wind speed (at 1.2m): 4.2 m s^{-1} (day 0, application time)
	RH (at 1.2m): 40% (day 0, application time)
residue:	plant:

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dieldrin	*photodieldrin*		
36%	unknown %of dosage after 0 hours		$(27.5\%+CV_{0-3h})$
27.5±4.5%	0.26±0.05%	of dosage after 2.9 hours	(mean of 5 samples)
23.1%	0.55%	of dosage after 1.0 day	(linear interpolation)
18±6%	0.89±0.14%	of dosage after 2.0 days	(mean of 5 samples)
7.8%	1.5%	of dosage after 5.0 days	(linear interpolation)
7.5±1.6%	1.5±0.3%	of dosage after 5.1 days	(mean of 5 samples)
5.2±0.7%	1.5±0.3%	of dosage after 8.0 days	(see above)
5.5%	1.7%	of dosage after 13 days	(linear interpolation)
6.1±0.5%	2.00±0.21%	of dosage after 22 days	(mean of 5 samples)
6.0%	2.0%	of dosage after 22.5 days	(linear interpolation)
2.5±0.4%	1.4±0.0%	of dosage after 35 days	(mean of 5 samples)
2.1±0.4%	1.6±0.1%	of dosage after 55 days	(see above)
1.4±0.2%	1.1±0.1%	of dosage after 79 days	(see above)
1.1±0.2%	0.5±0.1%	of dosage after 107 days	(see above)

soil:

6.4%	unknown %of dosage after 0 hours		(estimated)
6.4±1.8%	0%	of dosage after 2.9 hours	(mean of 5 samples)
6.8%	0%	of dosage after 1.0 day	(linear interpolation)
7.3±1.6%	0%	of dosage after 2.0 days	(mean of 5 samples)
7.3%	0%	of dosage after 5.0 days	(linear interpolation)
7.0±1.3%	0%	of dosage after 5.1 days	(mean of 5 samples)
6.6±2.7%	0%	of dosage after 8.0 days	(see above)
7.2%	0.2%	of dosage after 13 days	(linear interpolation)
8.4±1.6%	0.55%	of dosage after 22 days	(mean of 5 samples)
8.4%	0.55%	of dosage after 22.5 days	(linear interpolation)
7.7±0.9%	0.45%	of dosage after 35 days	(mean of 5 samples)
4.5±1.1%	0.71%	of dosage after 55 days	(see above)
7.5±1.3%	0.96%	of dosage after 79 days	(see above)
6.8±1.1%	0.13%	of dosage after 107 days	(see above)

volatilization:	$rate_{t=0}=258$ g ha^{-1} h^{-1}	(estimated)
	$rate_{t=2h}=169$ g ha^{-1} h^{-1}	
	$rate_{t=6h}=60.6$ g ha^{-1} h^{-1}	
	$rate_{t=1d}=23.9$ g ha^{-1} h^{-1}	
	$rate_{t=2d}=20$ g ha^{-1} h^{-1}	
	$rate_{t=5d}=4.3$ g ha^{-1} h^{-1}	
	$rate_{t=8d}=3.18$ g ha^{-1} h^{-1}	
	$rate_{t=13d}=0.81$ g ha^{-1} h^{-1}	
	$rate_{t=22d}= 0.54$ g ha^{-1} h^{-1}	
	7.6% of dosage after 2 hours	(based on estimation first hour volatilization)
	15% of dosage after 6 hours	(see above)
	17% of dosage after 1 day	(see above)
	23% of dosage after 2 days	(see above)
	33% of dosage after 5 days	(see above)
	36% of dosage after 8 days	(see above)
	38% of dosage after 13 days	(see above)
	40% of dosage after 22.5 days	(see above)

compound:	**heptachlor**
	(insecticide, organochlorines group, $VP_{Tomlin,1994}$=53 mPa (25 ^{o}C, pure),
	$S_{water,Tomlin,1994}$=0.056 mg l^{-1} (25-29 ^{o}C), $S_{cyclohexane,Tomlin,1994}$=1 190 000 mg l^{-1} (20 ^{o}C),
	$K_{ow,Tomlin,1994}$=209, Stable under all conditions, Systemic action=unknown, but heptachlor epoxide
	found as metabolite in leaves (Tomlin,1994))
formulation:	commercial Velsicol Corporation (in mix with dieldrin)
date/place:	July 12, 1973, Beltsville, Md., USA
duration:	23 d
application:	tractor-mounted field sprayer with 6.4 m boom, sprayed at appr. 10.00 local time (mid-time)
dosage:	5.6 kg ha^{-1} active ingredient (spray dosage)
method:	field measurements using Aerodynamic (AD) Method with sampling heights at 0.1, 0.2, 0.3, 0.5, and 1.0 m

plant/crop:	type: grass (Dactylis glomerata L., variety: orchard, stage: NA)
	height: 0.10 m (until 2 days after application)
	area cover canopy: unknown
	spray interception: 54% (estimated, see residue and note)

soil: soil type and properties: fine sandy loam:OM=1.2% (after Glotfelty, Smit et al., 1997, cb55), $\rho_{dry\,soil,estimated}$=1400 kg m^{-3}, $\theta_{sat.,estimated}$=47%

area (LxW): 244 x 82 m (2.00 ha)

temperature: NA

spray interception: 5.7% (estimated, see residue and note)

water regime: total rainfall: 49.5 mm, 12 mm (day 9), 7.5 mm (day 10), 30 mm (days 18 and 19)
$\theta_{estimated}$=10% (whole period and estimated close to wilting point)

micro-climate: air temperature (at 1.2m): 20 ^{o}C (day 0, application time); 14-32 ^{o}C (23), (range day temperatures whole period); weather hot, hazy, and generally dry, with thunderstorms on days 9, 10, 18, and 19 after day of application

wind speed (at 1.2m): 4.2 m s^{-1} (day 0, application time)

RH (at 1.2m): 40% (day 0, application time)

residue: plant:

heptachlor	*heptachlor epoxide*		
54%	unknown %	of dosage after 0 hours	(13%+CV$_{0-3h}$)
13±3%	0%	of dosage after 2.9 hours	(mean of 5 samples)
8.8%	0.04%	of dosage after 1.0 day	(linear interpolation)
4.1±1.8%	0.08%	of dosage after 2.0 days	(mean of 5 samples)
1.6%	0.16%	of dosage after 5.0 days	(linear interpolation)
1.5±0.5%	0.16%	of dosage after 5.1 days	(mean of 5 samples)
0.80±0.18%	-	of dosage after 8.0 days	(see above)
0.74%	0.23%	of dosage after 13 days	(linear interpolation)
0.64±0.16%	0.32%	of dosage after 22 days	(mean of 5 samples)
0.62%	0.31%	of dosage after 22.5 days	(linear interpolation)
0.21±0.04%	0.16%	of dosage after 35 days	(mean of 5 samples)
0.18±0.05%	0.14%	of dosage after 55 days	(see above)
0.07±0.01%	0.11%	of dosage after 79 days	(see above)
0.04±0.02%	-	of dosage after 107 days	(see above)

soil:

heptachlor	*heptachlor epoxide*		
5.7%	unknown %	of dosage after 0 hours	(estimated)
5.7±1.8%	0%	of dosage after 2.9 hours	(mean of 5 samples)
5.6%	0%	of dosage after 1.0 day	(linear interpolation)
5.5±1.4%	0%	of dosage after 2.0 days	(mean of 5 samples)
5.4%	0%	of dosage after 5.0 days	(linear interpolation)
5.4±1.3%	0%	of dosage after 5.1 days	(mean of 5 samples)
4.1±0.7%	0%	of dosage after 8.0 days	(see above)
4.4%	0.18%	of dosage after 13 days	(linear interpolation)
4.8±1.3%	0.50%	of dosage after 22 days	(mean of 5 samples)
4.8%	0.50%	of dosage after 22.5 days	(linear interpolation)
3.8±0.9%	0.54%	of dosage after 35 days	(mean of 5 samples)
2.0±0.4%	0.54%	of dosage after 55 days	(see above)
2.3±0.4%	1.1%	of dosage after 79 days	(see above)
1.6±0.4%	1.1%	of dosage after 107 days	(see above)

volatilization: rate$_{t=0}$=1348 g ha^{-1} h^{-1} (estimated)

rate$_{t=2h}$=822 g ha^{-1} h^{-1}

rate$_{t=6h}$=128 g ha^{-1} h^{-1}

rate$_{t=1d}$=24.0 g ha^{-1} h^{-1}

rate$_{t=2d}$=10 g ha^{-1} h^{-1}

rate$_{t=5d}$=3.5 g ha^{-1} h^{-1}

rate$_{t=8d}$=2.09 g ha^{-1} h^{-1}

rate$_{t=13d}$=0.65 g ha^{-1} h^{-1}

rate$_{t=22d}$= 0.62 g ha^{-1} h^{-1}

39% of dosage after 2 hours (based on estimated first hour volatilization)

66% of dosage after 6 hours (see above)

70% of dosage after 1 day (see above)

76% of dosage after 2 days (see above)

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81% of dosage after 5 days	(see above)	
83% of dosage after 8 days	(see above)	
84% of dosage after 13 days	(see above)	
85% of dosage after 22.5 days	(see above)	

Note: (1) - Time reference for volatilization values is mid-application time (10.00 local time). Time reference for residue measurements is end of application time (10.30 local time); (2) - Author does not include volatilization during first hour after (mid-) application time. Data presented here have been adapted through linear back-extrapolation of the initially measured fluxes. The difference can be considerable: 258 g ha^{-1} h^{-1} for dieldrin (author estimates 200 g ha^{-1} h^{-1}) and 1348 g ha^{-1} h^{-1} for heptachlor (author estimates 1200 g ha^{-1} h^{-1}); (3) - Initial deposits on leaves calculated as measured residue values at 2.9 hours after application and CV values during the same period: 0.275+(258/2+169*2)/5600=0.36 times applied dosage for dieldrin and 0.13+(1348/2+822*2)/5600=0.54 times applied dosage for heptachlor; (4) - Estimation for volatilization of dieldrin from bare soil under given conditions (θ=10%, ρ=1400 kg m^{-3}, T=23 ^{o}C, OM=1.2%) results in 28% of dosage after 22.5 days and 5% after 2.9 hours. For heptachlor this value is estimated at 54% of dosage and 11% after 2.9 hours (Smit et al.,1997); (5) - It is estimated by the author that appr. 0.5% of the dieldrin dosage volatilized as photodieldrin; (6) - About 40% of the dieldrin and 60% of the heptachlor dosage cannot be accounted for 3 hours after application and were probably lost as drift.

Willis, 1992

compound:	**toxaphene (camphechlor)**
	(insecticide, organochlorines group, $VP_{Hornsby,1996}$=0.533 mPa (20 ^{o}C), $VP_{Seiber, 1981}$=0.15 mPa, $S_{Hornsby,1996}$=3 mg l^{-1} (20 ^{o}C), $S_{Sanborn, 1976}$=0.4 mg l^{-1}, Systemic action=unknown)
formulation:	unknown
date/place:	August 16, 1976, Clarksdale, Miss., USA
duration:	10.7 d
application:	sprayed at 13.00 PM local time (mid-time; 6 hours total spraying-time)
dosage:	2.240±0.075 kg ha^{-1} active ingredient (spray dosage; net dosage 1.86 kg ha^{-1} a.i.)
method:	field measurements using Aerodynamic (AD) Method with sampling heights at 0.7, 1.3, and 2.1 m
plant/crop:	type: cotton (Gossypium hirsutum L, variety: unknown, stage: unknown)
	height: 0.50 m
	area cover canopy: 45% (L.A.I.=0.7)
	spray interception: 28% (see: plant residues)
soil:	soil type and properties: NA
	area: 24 000 m^2
	depth: NA
	soil temperature: NA
	spray interception: 55% (see: soil residues)
water regime:	rainfall/irrigation: 4 mm in August
micro-climate:	air temperature: 34 ^{o}C (day 0), 26.4 ^{o}C (days 0-4), 27 ^{o}C (whole period), (all day averages); drought conditions prevailed
	wind speed: 1.59 m s^{-1} (day 0), 1.34 m s^{-1} (days 0-4), (all day averages)
	RH: 49% (day 0), (day average)
residues:	plant:
	28±12% of dosage after 0 hours (measured)
	28% of dosage after 0 hours (curve fit with elapsed time as variable (r^2=0.99, n=3))
	28% of dosage after 1 hour (see above)
	28% of dosage after 2 hours (see above)
	26% of dosage after 12 hours (see above)
	24% of dosage after 1 day (see above)
	14% of dosage after 5 days (see above)
	6% of dosage after 10.7 days (see above)
	soil:
	55±1% of dosage after 0 hours
volatilization:	rate$_{t=0}$=0.7 g ha^{-1} h^{-1} (curve fit with elapsed time as variable (r^2=0.78, n=5))
	rate$_{t=1h}$=0.7 g ha^{-1} h^{-1} (see above)
	rate$_{t=2h}$=0.7 g ha^{-1} h^{-1} (see above)
	rate$_{t=12h}$=0.7 g ha^{-1} h^{-1} (see above)

rate$_{t=1d}$=0.6 g ha^{-1} h^{-1} (see above)
rate$_{t=5d}$=0.4 g ha^{-1} h^{-1} (see above)
rate$_{t=10.7d}$=0.2 g ha^{-1} h^{-1} (see above)
0.03% of dosage after 1 hour   (integration of fitted curve)
0.06% of dosage after 2 hours   (see above)
0.4% of dosage after 12 hours   (see above)
0.7% of dosage after 1 day   (see above)
2.9% of dosage after 5 days   (see above)
4.7±0.8% of dosage after 10.7 days (see above)

compound:	**toxaphene (camphechlor)**
	(insecticide, organochlorines group, VP$_{Hornsby,1996}$=0.533 mPa (20 ^{o}C), VP$_{Seiber, 1981}$=0.15 mPa, S$_{Hornsby,1996}$=3 mg l^{-1} (20 ^{o}C), S$_{Sanborn, 1976}$=0.4 mg l^{-1}, Systemic action=unknown)
formulation:	unknown (applied as mixture with DDT)
date/place:	August 27, 1976, Clarksdale, Miss., USA
duration:	32.7 d
application:	sprayed at 10.00 AM local time (mid-time; 6 hours total spraying-time)
dosage:	3.730±0.210 kg ha^{-1} active ingredient (spray dosage; net dosage 1.72 kg ha^{-1} a.i.)
method:	field measurements using Aerodynamic (AD) Method with sampling heights at 0.7, 1.3, and 2.1 m
plant/crop:	type: cotton (Gossypium hirsutum L, variety: unknown, stage: unknown)
	height: 0.55 m
	area cover canopy: 45% (L.A.I.=0.7)
	spray interception: 28% (see: plant residues)
soil:	soil type and properties: NA
	area: 24 000 m^{2}
	depth: NA
	soil temperature: NA
	spray interception: 18% (see: soil residues)
water regime:	rainfall/irrigation: 86 mm in September
micro-climate:	air temperature: 30 ^{o}C (day 0), 26.1 ^{o}C (days 0-4), 24.5 ^{o}C (days 0-9.7), 23 ^{o}C (whole period), (all day averages);
	drought conditions prevailed
	wind speed: 1.72 m s^{-1} (day 0), 1.20 m s^{-1} (days 0-4), (all day averages)
	RH: 65% (day 0), (day average)
residues:	plant:
	28±13% of dosage after 0 hours (measured)
	32% of dosage after 0 hours (curve fit with elapsed time as variable (r^{2}=0.95, n=5))
	32% of dosage after 1 hour (see above)
	32% of dosage after 2 hours (see above)
	31% of dosage after 12 hours (see above)
	30% of dosage after 1 day (see above)
	23% of dosage after 5 days (see above)
	16% of dosage after 10.7 days (see above)
	3.9% of dosage after 32.7 days (see above)
	soil:
	18±1% of dosage after 0 hours
volatilization:	rate$_{t=0}$=2.3 g ha^{-1} h^{-1} (curve fit with elapsed time as variable (r^{2}=0.96, n=6))
	rate$_{t=1h}$=2.3 g ha^{-1} h^{-1} (see above)
	rate$_{t=2h}$=2.3 g ha^{-1} h^{-1} (see above)
	rate$_{t=12h}$=2.2 g ha^{-1} h^{-1} (see above)
	rate$_{t=1d}$=2.1 g ha^{-1} h^{-1} (see above)
	rate$_{t=5d}$=1.5 g ha^{-1} h^{-1} (see above)
	rate$_{t=10.7d}$=1.0 g ha^{-1} h^{-1} (see above)
	rate$_{t=32.7d}$=0.2 g ha^{-1} h^{-1} (see above)
	0.06% of dosage after 1 hour (integration of fitted curve)
	0.1% of dosage after 2 hours (see above)
	0.7% of dosage after 12 hours (see above)
	1.4% of dosage after 1 day (see above)
	5.6% of dosage after 5 days (see above)

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10±2% of dosage after 10.7 days (see above)
17±3% of dosage after 32.7 days (see above)

compound: **DDT**
                 (insecticide, organochlorines group, $VP_{Hornsby,1996}$=0.025 mPa (20 ^{o}C), $VP_{Orgill,1976}$=0.096 mPa (30 ^{o}C),
                  $S_{Hornsby,1996}$=0.0055 mg l^{-1} (20 ^{o}C), Systemic action=unknown)
formulation: unknown (applied as mixture with toxaphene)
date/place: August 27, 1976, Clarksdale, Miss., USA
duration: 32.7 d
application: sprayed at 10.00 AM local time (mid-time; 6 hours total spraying-time)
dosage: 1.300±0.064 kg ha^{-1} active ingredient (spray dosage; net dosage 0.37 kg ha^{-1} a.i.)
method: field measurements using Aerodynamic (AD) Method with sampling heights at 0.7, 1.3,
                 and 2.1 m
plant/crop: type: cotton (Gossypium hirsutum L, variety: unknown, stage: unknown)
                 height: 0.55 m
                 area cover canopy: 45% (L.A.I.=0.7)
                 spray interception: 19% (see: plant residues)
soil: soil type and properties: NA
                 area: 24 000 m^2
                 depth: NA
                 soil temperature: NA
                 spray interception: 9.3% (see: soil residues)
water regime: rainfall/irrigation: 86 mm in September
micro-climate: air temperature: 30 ^{o}C (day 0), 26.1 ^{o}C (days 0-4), 24.5 ^{o}C (days 0-9.7), 23 ^{o}C (whole period),
                 (all day averages);
                 drought conditions prevailed
                 wind speed: 1.72 m s^{-1} (day 0), 1.20 m s^{-1} (days 0-4), (all day averages)
                 RH: 65% (day 0), (day average)
residues: plant:
                 19±6% of dosage after 0 hours   (measured)
                 19% of dosage after 0 hours   (curve fit with elapsed time as variable (r^2=0.97, n=5))
                 19% of dosage after 1 hour   (see above)
                 19% of dosage after 2 hours   (see above)
                 18% of dosage after 12 hours   (see above)
                 18% of dosage after 1 day   (see above)
                 14% of dosage after 5 days   (see above)
                 9.3% of dosage after 10.7 days   (see above)
                 2.1% of dosage after 32.7 days   (see above)
                 soil:
                 9.3±1% of dosage after 0 hours
volatilization: rate$_{t=0}$=0.5 g ha^{-1} h^{-1} (curve fit with elapsed time as variable (r^2=0.83, n=6))
                 rate$_{t=1h}$=0.5 g ha^{-1} h^{-1} (see above)
                 rate$_{t=2h}$=0.5 g ha^{-1} h^{-1} (see above)
                 rate$_{t=12h}$=0.5 g ha^{-1} h^{-1} (see above)
                 rate$_{t=1d}$=0.5 g ha^{-1} h^{-1} (see above)
                 rate$_{t=5d}$=0.3 g ha^{-1} h^{-1} (see above)
                 rate$_{t=10.7d}$=0.2 g ha^{-1} h^{-1} (see above)
                 rate$_{t=32.7d}$=0.04 g ha^{-1} h^{-1} (see above)
                 0.05% of dosage after 1 hour   (integration of fitted curve)
                 0.1% of dosage after 2 hours   (see above)
                 0.6% of dosage after 12 hours   (see above)
                 1.2% of dosage after 1 day   (see above)
                 5.0% of dosage after 5 days   (see above)
                 8.1% of dosage after 10.7 days   (see above)
                 11% of dosage after 32.7 days   (see above)

Note: (1) - Volatilization during first three hours after (mid-) application time are not included in measurements;
(2) - Volatilization from soil negligible due to drought conditions; (3) - Drought also caused unchanged crop
canopy and ground cover during both experiments; (4) - Toxaphene consists of a number of different active
ingredients; at least four chromatographic peaks were detected; (5) - Disappearance and volatilization rates are

apparently linearly related to the pesticide load on the plants; (6) - Volatile losses accounted for 21%, 60%, and 65% of the disappearance for toxaphene (first experiment), toxaphene (second experiment), and DDT only. No indication is given concerning loss routes of remaining fractions.

Heath, 1992

compound:	**lambda-cyhalothrin**
	(insecticide, pyrothroids group, $VP_{Hornsby,1996}=2.0 \cdot 10^{-4}$ mPa (20 ^{o}C),
	$S_{water,Hornsby,1996}=0.005$ mg l^{-1} (22.5 ^{o}C), $K_{ow,Tomlin,1994}=10^7$,
	$DT_{50,fotolysis,1994}=20$ d, Systemic action=unknown)
formulation:	EC (5.0% a.i. with radiolabelled ^{14}C, no GIFAP formulation code given)
date/place:	unknown
duration:	1 d
application:	sprayed with special, modified applicator Linomat III tcl at maximum field rate
dosage:	initial deposit on leaves not given (spray dosage appr. 6.366 ml m^{-2} formulation per leaf on 12 leaves per plant, or equivalent to appr. 0.318 kg ha^{-1})
method:	lab measurements using residue method on plant leaves (indirect method)
plant/crop:	type: dwarf French beans (variety: Phaseolus vulgaris, stage: flowering/first fruit bearing)
	height: NA
	area cover canopy: NA
	spray interception : NA
soil:	soil type and properties: NA
	area: NA
	depth: NA
	soil temperature: NA
	spray interception : Na
water regime:	rainfall/irrigation: NA
micro-climate:	air temperature: 12-23 ^{o}C (min-max)
	wind speed: >2 m s^{-1}
	RH: 40-67% (min-max)
residues:	plant:
	100% of dosage (=initial deposit) after 0 hours	(mean of duplicate)
	97.9% of dosage (=initial deposit) after 1 hour	(see above)
	100.8% of dosage (=initial deposit) after 3 hours	(see above)
	90.0% of dosage (=initial deposit) after 5 hours	(see above)
	91.3% of dosage (=initial deposit) after 7 hours	(see above)
	87.6% of dosage (=initial deposit) after 1 day	(see above)
	soil: NA
volatilization:	$rate_{t=0}$=unknown
	$rate_{t=1h}$=unknown
	$rate_{t=3h}$=unknown
	$rate_{t=6h}$=unknown
	$rate_{t=1d}$=unknown
	$rate_{t=3.125d}$=unknown
	2.1% of dosage (=initial deposit) after 1 hour	(100%-residue on plants)
	0% of dosage (=initial deposit) after 3 hours	(see above)
	10.0% of dosage (=initial deposit) after 5 hours	(see above)
	9.9% of dosage (=initial deposit) after 6 hours	(linear interpolation)
	9.7% of dosage (=initial deposit) after 7 hours	(100%-residue on plants)
	9.9% of dosage (=initial deposit) after 8 hours	(linear interpolation)
	12.4% of dosage (=initial deposit) after 1 day	(100%-residue on plants)

compound:	**fluazifop-P-butyl**
	(herbicide, propionic acids group, $VP_{Hornsby,1996}=0.033$ mPa (20 ^{o}C),
	$VP_{Heath,1992}=0.003$ mPa (20 ^{o}C), $S_{water,Hornsby,1996}=2$ mg l^{-1} (20 ^{o}C), $K_{ow,Tomlin,1994}=32\ 000$,
	Systemic action=unknown)
formulation:	EC (12.5% a.i. with radiolabelled ^{14}C, no GIFAP formulation code given)
date/place:	unknown
duration:	1 d
application:	sprayed with special, modified applicator Linomat III tcl at maximum field rate

dosage: initial deposit on leaves not given (spray dosage appr. 6.366 ml m^{-2} formulation per leaf on 12 leaves per plant, or equivalent to appr. 0.796 kg ha^{-1})

method: lab measurements using residue method on plant leaves (indirect method)

plant/crop: type: dwarf French beans (variety: Phaseolus vulgaris, stage: flowering/first fruit bearing)

     height: NA

     area cover canopy: NA

     spray interception : NA

soil: soil type and properties: NA

     area: NA

     depth: NA

     soil temperature: NA

     spray interception : Na

water regime: rainfall/irrigation: NA

micro-climate: air temperature: 14-22 ^{o}C (min-max)

     wind speed: >2 m s^{-1}

     RH: 31-37% (min-max)

residues: plant:

     100% of dosage (=initial deposit) after 0 hours   (mean of duplicate)

     102.9% of dosage (=initial deposit) after 1 hour   (see above)

     97.5% of dosage (=initial deposit) after 3 hours   (see above)

     92.0% of dosage (=initial deposit) after 5 hours   (see above)

     - % of dosage (=initial deposit) after 7 hours   (see above)

     75.0% of dosage (=initial deposit) after 1 day   (see above)

     soil: NA

volatilization: rate$_{t=0}$=unknown

     rate$_{t=1h}$=unknown

     rate$_{t=3h}$=unknown

     rate$_{t=6h}$=unknown

     rate$_{t=1d}$=unknown

     rate$_{t=3.125d}$=unknown

     0% of dosage (=initial deposit) after 1 hour   (100%-residue on plants)

     2.5% of dosage (=initial deposit) after 3 hours   (see above)

     8.0% of dosage (=initial deposit) after 5 hours   (see above)

     8.9% of dosage (=initial deposit) after 6 hours   (linear interpolation)

     - % of dosage (=initial deposit) after 7 hours   (100%-residue on plants)

     10.7% of dosage (=initial deposit) after 8 hours   (linear interpolation)

     25.0% of dosage (=initial deposit) after 1 day   (100%-residue on plants)

compound: **flurochloridon**

     (herbicide, unknown group, VP$_{Tomlin,1994}$=0.75 mPa (50 ^{o}C),

     VP$_{Heath,1992}$=0.44 mPa (25 ^{o}C), S$_{water,Tomlin,1994}$=28 mg l^{-1} (20 ^{o}C), K$_{ow,Tomlin,1994}$=2 290,

     Systemic action=unknown)

formulation: EC (25.0% a.i. with radiolabelled ^{14}C, no GIFAP formulation code given)

date/place: unknown

duration: 1 d

application: sprayed with special, modified applicator Linomat III tcl at maximum field rate

dosage: initial deposit on leaves not given (spray dosage appr. 6.366 ml m^{-2} formulation per leaf on 12 leaves per plant, or equivalent to appr. 1.592 kg ha^{-1})

method: lab measurements using residue method on plant leaves (indirect method)

plant/crop: type: dwarf French beans (variety: Phaseolus vulgaris, stage: flowering/first fruit bearing)

     height: NA

     area cover canopy: NA

     spray interception : NA

soil: soil type and properties: NA

     area: NA

     depth: NA

     soil temperature: NA

     spray interception : Na

water regime: rainfall/irrigation: NA

micro-climate: air temperature: 13-29 ^{o}C (min-max)

	wind speed: >2 m s^{-1}
	RH: 34-61% (min-max)
residues:	plant:
	100% of dosage (=initial deposit) after 0 hours (mean of duplicate)
	101.6% of dosage (=initial deposit) after 1 hour (see above)
	104.0% of dosage (=initial deposit) after 3 hours (see above)
	97.8% of dosage (=initial deposit) after 5 hours (see above)
	98.8% of dosage (=initial deposit) after 7 hours (see above)
	93.7% of dosage (=initial deposit) after 1 day (see above)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown
	rate$_{t=1d}$=unknown
	rate$_{t=3.125d}$=unknown
	0% of dosage (=initial deposit) after 1 hour (100%-residue on plants)
	0% of dosage (=initial deposit) after 3 hours (see above)
	2.2% of dosage (=initial deposit) after 5 hours (see above)
	1.7% of dosage (=initial deposit) after 6 hours (linear interpolation)
	1.2% of dosage (=initial deposit) after 7 hours (100%-residue on plants)
	1.5% of dosage (=initial deposit) after 8 hours (linear interpolation)
	6.3% of dosage (=initial deposit) after 1 day (100%-residue on plants)

compound:	**pirimicarb**
	(insecticide, carbamates group, VP$_{Hornsby,1996}$=4 mPa (30 ^{o}C),
	VP$_{Heath,1992}$=2.1 mPa (20 ^{o}C), S$_{water,Hornsby,1996}$=2 700 mg l^{-1} (25 ^{o}C), K$_{ow,Tomlin,1994}$=50,
	Systemic action=unknown)
formulation:	WP (50.0% a.i. with radiolabelled ^{14}C, no GIFAP formulation code given)
date/place:	unknown
duration:	1 d
application:	sprayed with special, modified applicator Linomat III tcl at maximum field rate
dosage:	initial deposit on leaves not given (spray dosage appr. 6.366 ml m^{-2} formulation per leaf on 12
	leaves per plant, or equivalent to appr. 3.183 kg ha^{-1})
method:	lab measurements using residue method on plant leaves (indirect method)
plant/crop:	type: dwarf French beans (variety: Phaseolus vulgaris, stage: flowering/first fruit bearing)
	height: NA
	area cover canopy: NA
	spray interception : NA
soil:	soil type and properties: NA
	area: NA
	depth: NA
	soil temperature: NA
	spray interception : Na
water regime:	rainfall/irrigation: NA
micro-climate:	air temperature: 13-21 ^{o}C (min-max)
	wind speed: >2 m s^{-1}
	RH: 66-82% (min-max)
residues:	plant:
	100% of dosage (=initial deposit) after 0 hours (mean of duplicate)
	83.1% of dosage (=initial deposit) after 1 hour (see above)
	76.3% of dosage (=initial deposit) after 3 hours (see above)
	65.0% of dosage (=initial deposit) after 5 hours (see above)
	60.9% of dosage (=initial deposit) after 7 hours (see above)
	47.4% of dosage (=initial deposit) after 1 day (see above)
	soil: NA
volatilization:	rate$_{t=0}$=unknown
	rate$_{t=1h}$=unknown
	rate$_{t=3h}$=unknown
	rate$_{t=6h}$=unknown

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rate$_{t=1d}$=unknown
rate$_{t=3.125d}$=unknown
16.9% of dosage (=initial deposit) after 1 hour   (100%-residue on plants)
23.7% of dosage (=initial deposit) after 3 hours   (see above)
35.0% of dosage (=initial deposit) after 5 hours   (see above)
37.1% of dosage (=initial deposit) after 6 hours   (linear interpolation)
39.1% of dosage (=initial deposit) after 7 hours   (100%-residue on plants)
39.9% of dosage (=initial deposit) after 8 hours   (linear interpolation)
52.6% of dosage (=initial deposit) after 1 day   (100%-residue on plants)

compound: **prosulfocarb**
                   (herbicide, thiocarbamates group, VP$_{Tomlin,1994}$=0.069 mPa (25 ^{o}C),
                   VP$_{Heath,1992}$=6.91 mPa (25 ^{o}C), S$_{water,Tomlin,1994}$=13.2 mg l^{-1} (20 ^{o}C), K$_{ow,Tomlin,1994}$=44 700,
                   Systemic action=unknown)
formulation: WP (80.0% a.i. with radiolabelled ^{14}C, no GIFAP formulation code given)
date/place: unknown
duration: 1 d
application: sprayed with special, modified applicator Linomat III tcl at maximum field rate
dosage: initial deposit on leaves not given (spray dosage appr. 6.366 ml m^{-2} formulation per leaf on 12
                   leaves per plant, or equivalent to appr. 5.093 kg ha^{-1})
method: lab measurements using residue method on plant leaves (indirect method)
plant/crop: type: dwarf French beans (variety: Phaseolus vulgaris, stage: flowering/first fruit bearing)
                   height: NA
                   area cover canopy: NA
                   spray interception : NA
soil: soil type and properties: NA
                   area: NA
                   depth: NA
                   soil temperature: NA
                   spray interception : Na
water regime: rainfall/irrigation: NA
micro-climate: air temperature: 14-22 ^{o}C (min-max)
                   wind speed: >2 m s^{-1}
                   RH: 21-35% (min-max)
residues: plant:
                   100% of dosage (=initial deposit) after 0 hours   (mean of duplicate)
                   97.1% of dosage (=initial deposit) after 1 hour   (see above)
                   91.7% of dosage (=initial deposit) after 3 hours   (see above)
                   88.9% of dosage (=initial deposit) after 5 hours   (see above)
                   78.5% of dosage (=initial deposit) after 7 hours   (see above)
                   53.3% of dosage (=initial deposit) after 1 day   (see above)
                   soil: NA
volatilization: rate$_{t=0}$=unknown
                   rate$_{t=1h}$=unknown
                   rate$_{t=3h}$=unknown
                   rate$_{t=6h}$=unknown
                   rate$_{t=1d}$=unknown
                   rate$_{t=3.125d}$=unknown
                   2.9% of dosage (=initial deposit) after 1 hour   (100%-residue on plants)
                   8.3% of dosage (=initial deposit) after 3 hours   (see above)
                   11.1% of dosage (=initial deposit) after 5 hours   (see above)
                   16.3% of dosage (=initial deposit) after 6 hours   (linear interpolation)
                   21.5% of dosage (=initial deposit) after 7 hours   (100%-residue on plants)
                   23.0% of dosage (=initial deposit) after 8 hours   (linear interpolation)
                   46.7% of dosage (=initial deposit) after 1 day   (100%-residue on plants)

Note: (1) - All compounds are relatively stable in sunlight and water with half-life times exceeding 4 days;
(2) - No translocation of pesticides to other plant parts detected.

Annex 2 Physico-chemical properties of pesticides used for regression analysis

Chemical group and compound name	Molecular mass (g mole^{-1})	Vapour pressure at room temp. (mPa)	Water solubility at room temp. (mg l^{-1})	Henry coeff. K_{Henry} (-)	octanol-water partition coeff. (-)
aryloxyalkanoic acids					
2,4-D acid (H)	221.04 (2)	1 (2)	890 (2)	10^{-7} (2)	507 (1)
carbamates					
aminocarb (I)	208.3 (2)	2.3 (2)	915 (2)	$1.5\ 10^{-7}$ (2)	79 (4)
mexacarbate (I)	222 (2)	10 000 (2)	100 (2)	$8\ 10^{-3}$	367.3 (4)
pirimicarb (I)	238.3 (2)	4 (2)	2 700 (2)	$5\ 10^{-8}$	50 (1)
morpholines					
fenpropimorph (F)	303.5 (1)	2.3 (1)	4.3 (1)	$6.7\ 10^{-1}$ (1)	398 (1)
organochlorines					
camphechlor/toxapheen (I)	413.8 (2)	0.5 (2)	3 (2)	$3\ 10^{-5}$ (2)	10^5 (2)[2]
pp-DDT (I)	354.5 (2)	0.025 (2)	0.0055 (2)	$7.3\ 10^{-4}$ (2)	$2\ 10^6$ (2)[2]
dieldrin (I)	380.9 (2)	0.4 (2)	0.2 (2)	$4\ 10^{-4}$ (2)	251 000 (5)
heptachlor (I)	373.3 (2)	53 (2)	0.056 (2)	0.13 (2)	25 119 (6)
lindane/HCH (I)	290.8 (1)	5.6 (1)	7.3 (1)	$9.5\ 10^{-5}$ (1)	1360 (3)[1]
organophosphorus					
fenithrothion (I)	277.2 (1)	0.8 (2)	21 (1)	$3\ 10^{-6}$ (1)	2 690 (1)
mevinphos (A,I)	224.15 (2)	17 (2)	600 000 (2)	$3\ 10^{-9}$ (2)	21.9 (1)
parathion-ethyl (I)	291.3 (1)	0.89 (1)	11 (1)	$9.7\ 10^{-6}$ (1)	6 760 (1)
parathion-methyl (I)	263.21 (2)	2 (2)	60 (2)	$4.6\ 10^{-6}$ (2)	1 000 (1)
propionic acids					
fluazifop-P-butyl (H)	383.4 (1)	0.033 (2)	2 (2)	$3\ 10^{-6}$ (2)	32 000 (1)
pyrethroids					
deltamethrin (I)	505.2 (1)	<0.0133 (1)	<$2\ 10^{-4}$ (1)	$9\ 10^{-3}$ (1)	40 000 (1)
lambda-cyhalothrin (I)	449.9 (2)	$2\ 10^{-4}$ (2)	0.005 (2)	$8\ 10^{-6}$ (2)	10^7 (1)
thiocarbamates					
prosulfocarb (H)	251.4 (1)	0.069 (1)	13.2 (1)	$2.8\ 10^{-7}$ (1)	44 700 (1)
ureas					
isoproturon (H)	206.3 (1)	0.0033 (1)	65 (1)	$4.6\ 10^{-9}$ (1)	320 (1)
other					
chlorothalonil (F)	265.9 (1)	0.076 (1)	0.9 (1)	$6\ 10^{-6}$ (1)	776 (1)
flurochloridon (H)	312.1 (1)	0.75 (1)	28 (1)	$8.9\ 10^{-8}$ (1)	2 290 (1)

References:
(1) - Tomlin, 1994
(2) - Hornsby et al., 1996
(3) - Linders et al., 1994
(4) - Sangster, 1993
(5) - DeBruijn, 1989
(6) - Calahan, 1979

Abbreviations:
H - herbicide
I - insecticide
B - bactericide
A - acaricide
F - fungicide

Remarks:
[1] value derived from K_{om}
[2] value derived from K_{oc}

Annex 3 Physico-chemical properties of pesticides approved in The Netherlands

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass (g/mole)	LitRef	Vapour Pressure at temp (mPa)	(degC)	LitRef	Solubility in water at temp (mg/l)	(degC)	LitRef	K_henry Calculated (-)	Kow (-)	LitRef	Kow Calculated from Kom	Kow Selected	DT50 hydrolysis (days)	LitRef	DT50 photolysis (days)	LitRef
1-naphtylacetamide	185.2	Tomlin'94	0.01	25	Tomlin'94	39	40	Tomlin'94	2.025E-08								
1-naphtylacetic acid	186.2	Tomlin'94	0.01	25	Tomlin'94	420	20	Tomlin'94	9.409E-10								
abamectine 1a	873.1	Homsby'96	2E-04	22.5	Homsby'96	5	20	Homsby'96	1.028E-08			5883.69498	5883.69498				
acephate	183.16	Homsby'96	0.23	22.5	Homsby'96	818000	20	Homsby'96	1.515E-11	0.13	Tomlin'94	77.0608523	0.13	8.5	Tomlin'94		
aclonifen	264.7	Tomlin'94	0.016	20	Tomlin'94	1.4	20	Tomlin'94	1.241E-06	23400	Tomlin'94	7134.58158	23400				
acrinathrin (acrinate)	541.4	Tomlin'94	3.9E-04	20	Tomlin'94	0.02	25	Tomlin'94	2.691E-06	180000	Tomlin'94	82035.247	180000				
alachlor	269.77	Homsby'96	1.9	25	Homsby'96	240	22.5	Homsby'96	4.971E-07			263.641935	263.641935				
aldicarb	190.3	Tomlin'94	13	20	Tomlin'94	4930	20	Tomlin'94	2.059E-07			11.5950338	11.5950338				
alloxydim-sodium	345.4	Tomlin'94	0.133	25	Tomlin'94	2E+06	30	Tomlin'94	6.989E-12	0.63	Tomlin'94	9.91306623	0.63				
Al-fosfide																	
amitraz	293.4	Homsby'96	0.35	25	Homsby'96	1	22.5	Homsby'96	0.0000239	3.1E+06	Tomlin'94	1231.34289	3.1E+06	0.92	Tomlin'94		
amitrol	84.08	Homsby'96	0.059	22.5	Homsby'96	360000	22.5	Homsby'96	4.447E-12			171.132567	171.132567				
(NH4)2SO4																	
amm-thiocyanaat																	
ancymidol	256.31	Homsby'96	0.03	25	Homsby'96	650	22.5	Homsby'96	2.754E-09	80.6	Tomlin'94	156.859713	80.6				
anilazine	275.54	Homsby'96	8.3E-04	20	Homsby'96	8	22.5	Homsby'96	1.286E-08	1050	Tomlin'94	215.328594	1050				
antrachinon																	
asulam	230.2	Tomlin'94	1	20	Tomlin'94	5000	22.5	Tomlin'94	2.072E-08			146.687341	146.687341				
atrazine	215.69	Homsby'96	0.0385	25	Homsby'96	33	22.5	Homsby'96	4.153E-08	320	Tomlin'94	160.034599	320				
azaconazole	300.1	Tomlin'94	0.0086	20	Tomlin'94	300	20	Tomlin'94	3.530E-09	148	Tomlin'94	148	148				
azamethifos	324.7	Tomlin'94	0.0049	20	Tomlin'94	1100	20	Tomlin'94	5.935E-10					11	Tomlin'94		
azinphos-methyl	317.3	Homsby'96	0.03	20	Homsby'96	29	25	Homsby'96	1.617E-07	912	Tomlin'94	1836.08353	912	50	Tomlin'94		
azocyclotin	436.2	Tomlin'94	6.00E-08	25	Tomlin'94	0.12	20	Tomlin'94	4.629E-11			1.000E-20	1.000E-20				
Bacillus thuringiensis																	
Bacillus thuringiensis (combi)																	
benazolin	243.7	Tomlin'94	1E-04	20	Tomlin'94	500	20	Tomlin'94	2.000E-11	21.9	Tomlin'94	31.1648552	21.9			3.5	Tomlin'94
benazolin-ethyl	271.7	Tomlin'94	0.37	25	Tomlin'94	47	20	Tomlin'94	4.540E-07	315.3	Tomlin'94	31.1648552	315.3				
bendiocarb	223.23	Homsby'96	4.7	25	Homsby'96	40	25	Homsby'96	6.686E-06	52	Tomlin'94	65.688433	52	4	Tomlin'94		
benfuracarb	410.5	Tomlin'94	0.0266	20	Tomlin'94	8	20	Tomlin'94	5.600E-07	20000	Tomlin'94	20000	20000			0.125	Tomlin'94
benodanil	323.1	Homsby'96	1.0E-05	20	Homsby'96	20	20	Homsby'96	6.628E-11			870.647996	870.647996				
benomyl	290.3	Homsby'96	1E-05	25	Homsby'96	2	25	Homsby'96	3.700E-10			2121.13148	2121.13148				
bensultap	431.6	Tomlin'94	0.21	22	Tomlin'94	0.75	30	Tomlin'94	0.00005447	2300	Tomlin'94	1395.57619	2300				
bentazone	240.3	Tomlin'94	0.46	20	Tomlin'94	570	20	Tomlin'94	7.957E-08	0.35	Tomlin'94	1.05776869	0.35				
benzalkoniumchloride																	
benzoylprop																	
benzyladenine																	
bifenox	342.14	Homsby'96	0.32	30	Homsby'96	0.398	25	Homsby'96	0.00003707	30000	Tomlin'94	2982.38726	30000			0.2	Tomlin'94
bifenthrin	422.88	Homsby'96	0.024	22.5	Homsby'96	0.1	22.5	Homsby'96	0.00003276	1E+06	Tomlin'94	206180.619	1E+06				
bitertanol-A	337.4	Tomlin'94	2.20E-07	20	Tomlin'94	2.9	20	Tomlin'94	1.050E-11	13000	Tomlin'94	13000	13000				
boraten																	
borax																	
brodifacoum	523.4	Tomlin'94	0.04	25	Tomlin'94	10	20	Tomlin'94	4.443E-07	3.2E+08	Tomlin'94	320000000	320000000				
bromacil	261.1	Tomlin'94	0.041	25	Tomlin'94	700	25	Tomlin'94	3.898E-09	74.5	Tomlin'94	43.4168088	74.5				
bromadiolone																	
bromofenoxim	461	Tomlin'94	1E-03	22.5	Linders'94	0.6	20	Tomlin'94	2.939E-07	1480	Tomlin'94	1217.87855	1480				
bromophos-ethyl	394	Worthing'87	6.1	30	Worthing'87	0.14	20	Worthing'87	0.00192611			24.1508818	24.1508818				
bromopropylate	428.1	Tomlin'94	0.011	20	Tomlin'94	0.5	20	Tomlin'94	3.864E-06	250000	Tomlin'94	215.328594	250000				
bromoxynil	276.9	Tomlin'94	1	20	Tomlin'94	130	25	Tomlin'94	1.050E-06			245.165458	245.165458				
buminaphos	347	Tomlin'94	100	22.5	Linders'94	170	22.5	Linders'94	0.00006588			193.267301	193.267301				
bupirimate	316.4	Tomlin'94	0.1	25	Tomlin'94	22	25	Tomlin'94	3.666E-07	7900	Tomlin'94	658.301704	7900				
buprofezin	305.4	Tomlin'94	1.25	25	Tomlin'94	0.9	20	Tomlin'94	0.00009002	20000	Tomlin'94	20000	20000				
butocarboxim	190.3	Tomlin'94	10.6	20	Tomlin'94	35000	20	Tomlin'94	2.365E-08	12.9	Tomlin'94	12.9	12.9				
butoxycarboxim	222.3	Tomlin'94	0.266	20	Tomlin'94	209000	20	Tomlin'94	1.161E-10	12.9	Tomlin'94	12.9	12.9	18	Tomlin'94		
calciumcyanide																	
Ca(NO3)2																	
captafol	349.1	Homsby'96	0.001	22.5	Homsby'96	1.4	22.5	Homsby'96	8.048E-08			3581.40716	3581.40716				
captan	300.61	Homsby'96	0.011	25	Homsby'96	5.1	22.5	Homsby'96	1.509E-07	610	Tomlin'94	171.132567	610				
carbaryl	201.23	Homsby'96	0.16	24	Homsby'96	120	30	Homsby'96	8.610E-08	38.9	Tomlin'94	79.3292589	38.9	12	Tomlin'94		
carbendazim	191.19	Homsby'96	6.5E-05	20	Homsby'96	8	20	Homsby'96	6.374E-10	32	Tomlin'94	173.349613	32				
carbetamide	236.3	Homsby'96	1E-20	25	Smit'97	3500	20	Homsby'96	1.433E-28	0.026	Tomlin'94	119.882952	0.026				
carbophenothion	342.9	Homsby'96	1.1	25	Homsby'96	0.34	20	Homsby'96	0.00023545			55140.0872	55140.0872				
carbofuran	221.25	Homsby'96	0.08	22.5	Homsby'96	351	25	Homsby'96	1.579E-08	33.1	Tomlin'94	30.1659285	33.1				
carboxin	235.31	Homsby'96	0.024	25	Homsby'96	195	20	Homsby'96	6.147E-09	150	Tomlin'94	30.4657058	150			<0.1	Tomlin'94
chlorbromuron	293.5	Homsby'96	0.053	22.5	Homsby'96	35	20	Homsby'96	1.308E-07			955.143736	955.143736				
chlorbufam																	
chlorfacinon																	
chlorfenvinphos	359.6	Tomlin'94	1	25	Tomlin'94	145	23	Tomlin'94	5.145E-07	7080	Tomlin'94	1163.37816	7080				
chloralhydrate																	
chloridazon	221.6	Tomlin'94	0.01	20	Tomlin'94	340	20	Tomlin'94	2.674E-09	15.5	Tomlin'94	146.687341	15.5			6	Tomlin'94
chlormequat	158.1	Tomlin'94	0.01	20	Tomlin'94	1E+06	20	Tomlin'94	6.487E-13	1.59	Tomlin'94	110.9111	1.59				
chloroflurenol																	

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass		Vapour Pressure at temp			Solubility in water at temp			K_henry Calculated	Kow		Kow Calculated from Kom	Kow Selected	DT50 hydrolysis		DT50 photolysis	
	(g/mole)	LitRef	(mPa)	(degC)	LitRef	(mg/l)	(degC)	LitRef	(-)	(-)	LitRef			(days)	LitRef	(days)	LitRef
chlorothalonil	265.9	Tomlin'94	0.076	25	Tomlin'94	0.9	25	Tomlin'94	5.723E-06	776	Tomlin'94	10196.4124	776				
chlorotoluron	212.7	Tomlin'94	0.017	25	Tomlin'94	74	25	Tomlin'94	1.246E-08	320	Tomlin'94	298.614889	320				
chloroxuron	290.75	Homsby'96	5.2E-04	25	Homsby'96	2.5	22	Homsby'96	1.382E-08			2220.01053	2220.01053				
chlorpropham	213.67	Homsby'96	1	20	Homsby'96	89	25	Homsby'96	1.183E-06			553.55417	553.55417				
chlorpyriphos-ethyl	350.62	Homsby'96	2.7	25	Tomlin'94	1.4	25	Tomlin'94	0.00020369	50000	Tomlin'94	7103.87526	50000				
chlorthal-dimethyl (DCPA)	331.99	Homsby'96	0.21	25	Tomlin'94	0.5	25	Homsby'96	0.00003554	19000	Tomlin'94	5883.69498	19000				
chlorthiamid																	
clodinafop-propargyl	349.8	Tomlin'94	0.00319	25	Tomlin'94	4	25	Tomlin'94	7.111E-08	7900	Tomlin'94	1740.7907	7900	0.3	Tomlin'94		
clofentezine	303.1	Tomlin'94	1.3E-04	25	Tomlin'94	0.0025	25	Tomlin'94	4.017E-06	1300	Tomlin'94	311.698381	1300	1.4	Tomlin'94		
cloquintoceet-mexyl (CGA 185072)	335.8	Tomlin'94	0.00531	25	Tomlin'94	0.59	25	Tomlin'94	7.703E-07	107000	Tomlin'94	107000	107000				
copper oxychloride																	
creosote																	
cresol																	
chlorcresol																	
coumatetralyl	292.3	Tomlin'94	8.5E-06	20	Tomlin'94	425	20	Tomlin'94	2.399E-12	2880	Tomlin'94	2880	2880			0.04	Tomlin'94
cyanamide	42	Tomlin'94	500	20	Tomlin'94	4.59E+06	20	Tomlin'94	1.877E-09	0.15	Tomlin'94	1.000E-20	0.15				
cyanazine	240.7	Homsby'96	2.1E-04	20	Homsby'96	170	25	Homsby'96	1.465E-10	130	Tomlin'94	126.598996	130				
cycloate	215.37	Homsby'96	213	25	Homsby'96	95	25	Homsby'96	0.00012308	7590	Tomlin'94	54.2583222	7590				
cycloxydim	325.5	Tomlin'94	0.01	25	Tomlin'94	40	20	Tomlin'94	3.339E-08	22.9	Tomlin'94	140.000669	22.9			0.03	Tomlin'94
cyfluthrin	434.3	Homsby'96	0.0021	22.5	Homsby'96	0.002	20	Homsby'96	0.00013419	955000	Tomlin'94	64829.1731	955000				
cyhexatin	385.2	Homsby'96	1E-20	25	Smit'97	1	25	Homsby'96	9.819E-25			443.911552	443.911552				
cymiazole																	
cymoxanil	198.2	Tomlin'94	0.08	25	Tomlin'94	890	20	Tomlin'94	3.781E-09	4.7	Tomlin'94	24.1508818	4.7				
cypermethrin (cis)	416.3	Homsby'96	1.9E-04	20	Homsby'96	0.004	20	Homsby'96	8.113E-06	4.0E+06	Tomlin'94	4436.87638	4.0E+06				
cypermethrin (trans)	416.3	Homsby'96	1.9E-04	20	Homsby'96	0.004	20	Homsby'96	8.113E-06	4.0E+06	Tomlin'94	4436.87638	4.0E+06				
alpha-cypermethrin	416.3	Tomlin'94	2.3E-02	20	Tomlin'94	0.01	25	Tomlin'94	0.00047182	8.7E+06	Tomlin'94	4436.87638	8.7E+06				
cyproconazole	291.8	Tomlin'94	0.0346	20	Tomlin'94	140	25	Tomlin'94	3.554E-08	819	Tomlin'94	484.841482	819				
cyprofuram	279.7	Worthing'87	0.0066	25	Worthing'87	574	22.5	Worthing'87	7.486E-10			413.682959	413.682959	37	Worthing'87		
cyromazine	166.19	Homsby'96	4.48E-04	25	Homsby'96	13600	22	Homsby'96	1.251E-12			133.304718	133.304718				
dalapon	143	Tomlin'94	0.01	20	Tomlin'94	900000	25	Tomlin'94	7.830E-13			1.31392185	1.31392185				
daminozide	160.2	Homsby'96	0.001	22.5	Homsby'96	100000	25	Homsby'96	5.662E-13	0.031	Tomlin'94	4.562406	0.031				
dazomet	162.3	Homsby'96	0.4	20	Homsby'96	3000	20	Homsby'96	8.879E-09	1.4	Tomlin'94	14.0198837	1.4				
deltamethrin	505.2	Tomlin'94	0.0133	25	Tomlin'94	2E-04	25	Tomlin'94	0.00856343	40000	Tomlin'94	1013516.69	40000			9	Tomlin'94
demeton-S-methylsulfon	262.3	Worthing'87	0.005	22.5	Linders'94	3300	22.5	Linders'94	1.283E-10			1.000E-20	1.000E-20				
desmedipham	300.32	Homsby'96	4E-04	20	Homsby'96	8	20	Homsby'96	3.187E-09	2450	Tomlin'94	461.157994	2450	0.8	Tomlin'94		
desmetryn	213.3	Tomlin'94	0.133	20	Tomlin'94	580	20	Tomlin'94	2.007E-08	240	Tomlin'94	268.020575	240				
diallate	270.2	Homsby'96	20	25	Homsby'96	14	25	Homsby'96	0.00009839			627.816682	627.816682				
dial.dichl.aceetamid(cdaa)	173.6	Homsby'96	1300	20	Homsby'96	20000	22.5	Homsby'96	5.078E-06			27.4973327	27.4973327				
diazinon	304.3	Homsby'96	8	20	Homsby'96	60	22	Homsby'96	0.00001586	2000	Tomlin'94	1231.34289	2000	185	Tomlin'94		
dicamba	221	Tomlin'94	4.5	25	Tomlin'94	6500	25	Tomlin'94	3.900E-08	0.16	Tomlin'94	1.000E-20	0.16				
dichlobenil	172.02	Homsby'96	133	25	Homsby'96	21.2	25	Homsby'96	0.00029227	500	Tomlin'94	281.144193	500			15	Tomlin'94
dichlofenthion												26.4947069	26.4947069				
dichlofluanid	333.2	Tomlin'94	0.021	20	Tomlin'94	1.3	20	Tomlin'94	2.208E-06	5000	Tomlin'94	33.4921282	5000				
dichloromethane																	
dichlorprop	235.1	Tomlin'94	0.01	20	Tomlin'94	350	20	Tomlin'94	2.756E-09	59.1	Tomlin'94	1.000E-20	59.1				
dichlorprop-P	235.1	Tomlin'94	0.062	20	Tomlin'94	590	20	Tomlin'94	1.014E-08	89	Tomlin'94	89	89				
dichlorvos	221	Homsby'96	2666	25	Homsby'96	10000	20	Homsby'96	0.00001535	79	Tomlin'94	197.685153	79	2.9	Tomlin'94	1.7	Tomlin'94
dicloran	207	Tomlin'94	0.16	20	Tomlin'94	6.3	20	Tomlin'94	2.157E-06	63	Tomlin'94	929.818682	63			2.5	Tomlin'94
dicofol (op)	370.51	Homsby'96	0.053	22.5	Homsby'96	0.8	25	Homsby'96	8.675E-06	19000	Tomlin'94	446.068405	19000	3.4	Tomlin'94	2.5	Tomlin'94
dicofol (pp)	370.51	Homsby'96	0.053	22.5	Homsby'96	0.8	25	Homsby'96	8.675E-06	19000	Tomlin'94	446.068405	19000	3.4	Tomlin'94	2.5	Tomlin'94
didecyldimethylammoniumchloride																	
dienochlor	474.6	Homsby'96	1.3	25	Homsby'96	25	20	Homsby'96	5.238E-06	7000	Tomlin'94	259.261185	7000				
diethatyl-ethyl	311.8	Homsby'96	0.43	30	Homsby'96	105	25	Homsby'96	1.721E-07			224.13439	224.13439				
diethofencarb	267.3	Tomlin'94	8.4	20	Tomlin'94	26.6	20	Tomlin'94	0.00003463	1050	Tomlin'94	353.027619	1050				
difenacoum																	
difenoconazole	406.3	Tomlin'94	3.3E-05	25	Tomlin'94	16	25	Tomlin'94	2.136E-10	16000	Tomlin'94	3836.38452	16000				
difenoxuron	286.3	Worthing'87	1.24E-06	20	Worthing'87	20	20	Worthing'87	7.283E-12			749.822341	749.822341				
difenzoquat																	
difethialon																	
diflubenzuron	310.69	Homsby'96	1.2E-04	25	Homsby'96	0.08	25	Homsby'96	1.188E-07	7760	Tomlin'94	235.127585	7760			>150	Tomlin'94
diflufenican	394.3	Tomlin'94	0.07	30	Tomlin'94	0.05	25	Tomlin'94	0.00007438	4.9	Tomlin'94	2429.71201	4.9				
dikegulac-sodium	296.3	Tomlin'94	0.0013	25	Tomlin'94	590000	25	Tomlin'94	1.664E-13			1.000E-20	1.000E-20				
dimefuron	338.8	Tomlin'94	0.1	20	Tomlin'94	16	20	Tomlin'94	8.688E-07	324	Tomlin'94	891.793376	324				
dimethachlor	255.7	Tomlin'94	2.1	20	Tomlin'94	2100	20	Tomlin'94	1.049E-07	160	Tomlin'94	160	160				
dimethoate	229.2	Tomlin'94	1.1	25	Tomlin'94	23800	20	Tomlin'94	2.248E-09	5.06	Tomlin'94	40.4470862	5.06			11.5	Tomlin'94
dimethomorph (E-isomer)	387.9	Tomlin'94	9.7E-04	25	Tomlin'94	50	21.5	Tomlin'94	1.688E-09	427	Tomlin'94	555.697291	427				
dimethomorph (Z-isomer)	387.9	Tomlin'94	1E-03	25	Tomlin'94	50	21.5	Tomlin'94	1.741E-09	537	Tomlin'94	555.697291	537				
dinocap	364.41	Homsby'96	0.0053	20	Homsby'96	4	22.5	Homsby'96	2.173E-07	34400	Tomlin'94	688.745825	34400	2.3	Tomlin'94		
dinoseb	240.2	Homsby'96	6.7	25	Homsby'96	52	22.5	Homsby'96	7.204E-06			54.2583222	54.2583222				
dinoseb-acetate	282.2	Worthing'87	1E-20	25	Smit'97	2200	22.5	Homsby'96	2.986E-28			83.860488	83.860488				
dinoterb	240.2	Tomlin'94	20	20	Tomlin'94	4.5	20	Tomlin'94	0.00043802			164.476381	164.476381				

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass (g/mole)	LitRef	Vapour Pressure at temp (mPa)	(degC)	LitRef	Solubility in water at temp (mg/l)	(degC)	LitRef	K_henry Calculated (-)	Kow (-)	LitRef	Kow Calculated from Kom	Kow Selected	DT50 hydrolysis (days)	LitRef	DT50 photolysis (days)	LitRef
diquat-dibromide	344.06	Homsby'96	1E-20	25	Smit'97	718000	20	Homsby'96	1.017E-30	0.000025	Tomlin'94	11786.3912	0.000025			74	Tomlin'94
dithianon	296.3	Tomlin'94	0.066	25	Tomlin'94	0.5	20	Tomlin'94	8.301E-06	1585	Tomlin'94	232.930161	1585			0.8	Tomlin'94
diuron	233.1	Homsby'96	0.0092	25	Homsby'96	42	25	Homsby'96	1.301E-08	700	Tomlin'94	512.78798	700				
DNOC	198.1	Tomlin'94	14	25	Tomlin'94	130	15	Tomlin'94	3.746E-06			48.7477512	48.7477512				
dodemorph	281.5	Tomlin'94	0.48	20	Tomlin'94	100	20	Tomlin'94	5.544E-07	13800	Tomlin'94	10922.4613	13800				
dodine												2818.96855	2818.96855				
endosulfan	406.91	Homsby'96	0.023	25	Homsby'96	0.32	22	Homsby'96	6.684E-06	55000	Tomlin'94	14222.8004	55000				
endothal-sodium																	
EPTC	189.3	Homsby'96	2626	24	Homsby'96	344	22.5	Homsby'96	0.00047205	1600	Tomlin'94	140.000669	1600				
esfenvalerate	419.9	Homsby'96	0.0015	25	Homsby'96	0.002	25	Homsby'96	0.00008027	1.66E+06	Tomlin'94	20457.8657	1.66E+06				
ethephon	144.5	Homsby'96	0.01	20	Homsby'96	1.239E+06	22.5	Homsby'96	5.248E-13	0.00631	Tomlin'94	140.000669	0.00631				
ethiofencarb	225.3	Tomlin'94	0.45	20	Tomlin'94	1800	20	Tomlin'94	2.311E-08	110	Tomlin'94	26.4947069	110				
ethofumesate	286.3	Homsby'96	0.65	25	Homsby'96	50	25	Homsby'96	9.487E-07	500	Tomlin'94	191.05728	500				
ethoprophos	242.3	Homsby'96	51	25	Homsby'96	750	22.5	Homsby'96	3.835E-06	3890	Tomlin'94	137.76974	3890				
ethoxylated fatty amines																	
ethyleneglycol																	
ethylkwikbromide																	
etofenprox	376.5	Tomlin'94	32	100	Tomlin'94	1E-06	25	Tomlin'94	1.2993156	1.12E+07	Tomlin'94	1.12E+07	1.12E+07	103	Tomlin'94		
etridazole	247.53	Homsby'96	13	20	Homsby'96	50	25	Homsby'96	0.00003171	2340	Tomlin'94	313.877398	2340	16	Worthing'87		
etrimfos	292.3	Worthing'87	8.6	20	Worthing'87	40	23	Worthing'87	0.0000288			40.4470862	40.4470862				
fenaminosulf	251.2	Homsby'96	1E-20	25	Smit'97	20000	25	Homsby'96	3.201E-29			26.4947069	26.4947069				
fenamiphos	303.4	Homsby'96	0.1	30	Homsby'96	400	22.5	Homsby'96	8.845E-09	2000	Tomlin'94	381.223743	2000	2920	Tomlin'94		
fenarimol	331.2	Homsby'96	0.029	25	Homsby'96	14	25	Homsby'96	1.749E-07	4900	Tomlin'94	749.518844	4900				
fenbutatinoxide	1052.7	Homsby'96	2.4E-06	25	Homsby'96	0.0127	20	Homsby'96	4.222E-08	160000	Tomlin'94	2766.38345	160000				
fenchlorazole-ethyl	403.5	Tomlin'94	8.9E-04	20	Tomlin'94	0.9	20	Tomlin'94	1.637E-07			476.233274	476.233274	5.5	Tomlin'94		
fenfuram	201.2	Homsby'96	0.02	20	Homsby'96	100	20	Homsby'96	1.651E-08			382.152231	382.152231				
fenitrothion	277.2	Tomlin'94	0.8	22.5	Linders'94	21	20	Tomlin'94	3.108E-06	2690	Tomlin'94	250.493202	2690	84.3	Tomlin'94		
fenoxaprop-ethyl	361.8	Homsby'96	0.0043	25	Homsby'96	0.8	22.5	Homsby'96	4.527E-07			35.814717	35.814717				
fenoxaprop-P-ethyl	361.8	Tomlin'94	5.3E-04	20	Tomlin'94	0.9	25	Tomlin'94	1.050E-07	38000	Tomlin'94	21.0938938	38000	100	Tomlin'94		
fenoxycarb	301.3	Homsby'96	0.0017	25	Homsby'96	6	22.5	Homsby'96	1.987E-08	11700	Tomlin'94	1231.34289	11700				
fenpiclonil	237.1	Tomlin'94	1.1E-06	25	Tomlin'94	4.8	25	Tomlin'94	1.385E-11	7240	Tomlin'94	2429.71201	7240				
fenpropathrin	349.41	Homsby'96	0.73	22.5	Homsby'96	0.33	25	Homsby'96	0.00027317	1E+06	Tomlin'94	1324.58089	1E+06				
fenpropidin	273.5	Tomlin'94	17	25	Tomlin'94	530	25	Tomlin'94	2.236E-06	389	Tomlin'94	3145.54658	389				
fenpropimorph	303.5	Tomlin'94	2.3	20	Tomlin'94	4.3	20	Tomlin'94	6.66E-06	398	Tomlin'94	4311.72708	398				
fentin-acetate	409	Tomlin'94	1.9	60	Tomlin'94	9	20	Tomlin'94	3.160E-07	2700	Tomlin'94	2737.157	2700	<0.1	Tomlin'94		
fentin-hydroxide	367	Tomlin'94	0.047	50	Tomlin'94	1	20	Tomlin'94	1.841E-07	2700	Tomlin'94	2737.157	2700				
fenvalerate	419.9	Homsby'96	0.0015	25	Homsby'96	0.002	25	Homsby'96	0.00008027	102000	Tomlin'94	2839.4106	102000				
ferbam	416.5	Tomlin'94	1E-20	25	Smit'97	130	22.5	Tomlin'94	7.458E-27	6.3	Tomlin'94	382.152231	6.3				
FeSO4																	
fluazifop-butyl	327.3	Homsby'96	0.055	20	Homsby'96	2	20	Homsby'96	3.693E-06	32000	Tomlin'94	3581.40716	32000				
fluazifop-p-butyl	383.4	Homsby'96	0.033	20	Homsby'96	2	20	Homsby'96	2.596E-06	32000	Tomlin'94	6682.68929	32000				
fluazinam												10784.8389	10784.8389				
flucycloxuron	483.9	Tomlin'94	4.4	20	Tomlin'94	0.001	20	Tomlin'94	0.87359146	9.33E+06	Tomlin'94	4103.58304	9.33E+06			15	Tomlin'94
flurenol(-butyl)	282.3	Tomlin'94	0.13	25	Tomlin'94	36.5	20	Tomlin'94	2.134E-07	302	Tomlin'94	270.209115	302				
flurochloridon	312.1	Tomlin'94	0.75	50	Tomlin'94	28	20	Tomlin'94	8.923E-08	2290	Tomlin'94	171.132567	2290				
fluroxypyr	255	Tomlin'94	3.78E-06	20	Tomlin'94	91	20	Tomlin'94	4.346E-12	0.0578	Tomlin'94	81.5957857	0.0578				
fluroxypyr 1-methylheptylester	367.2	Tomlin'94	0.001349	20	Tomlin'94	0.09	20	Tomlin'94	2.258E-06	34185	Tomlin'94	18718.458	34185	454	Tomlin'94		
flusilazole	315.4	Tomlin'94	0.039	25	Tomlin'94	54	20	Tomlin'94	4.835E-08	5550	Tomlin'94	2044.82116	5550				
flutolanil	323.3	Tomlin'94	1.77	20	Tomlin'94	9.6	20	Tomlin'94	0.00002446			874.878252	874.878252				
fluvalinate	502.93	Homsby'96	0.01	25	Homsby'96	0.001	20	Homsby'96	0.0010674	18200	Tomlin'94	147893.988	18200	22.5	Tomlin'94	13	Tomlin'94
folpet	296.6	Tomlin'94	1.3	20	Tomlin'94	1	22.5	Tomlin'94	0.00017351	1279	Tomlin'94	1279	1279	4.3	Tomlin'94		
fonofos	246.32	Homsby'96	28	25	Tomlin'94	16.9	22.5	Homsby'96	0.00009499	8710	Tomlin'94	1075.48107	8710	101	Tomlin'94	12	Tomlin'94
formaldehyde																	
formothion	257.3	Tomlin'94	0.133	20	Tomlin'94	2600	24	Tomlin'94	6.256E-09			9.91306623	9.91306623	<1	Tomlin'94		
fosetyl-aluminium	354.1	Homsby'96	0.01	22.5	Homsby'96	120000	20	Homsby'96	8.683E-12	0.002	Tomlin'94	30.4657058	0.002				
foxim																	
fuberidazol	184.2	Tomlin'94	2E-06	20	Tomlin'94	71	25	Tomlin'94	2.557E-12	468	Tomlin'94	468	468				
furalaxyl	301.3	Tomlin'94	0.07	20	Tomlin'94	230	20	Tomlin'94	3.762E-08	500	Tomlin'94	92.9020519	500				
furathiocarb	382.5	Tomlin'94	0.0039	25	Tomlin'94	11	25	Tomlin'94	3.457E-08	40000	Tomlin'94	817.718467	40000				
gibberellin																	
gluphosinate-amm.	198.19	Homsby'96	1E-20	25	Smit'97	1.37E+06	22.5	Homsby'96	3.367E-31	1	Tomlin'94	215.328594	1				
glyphosate	169.1	Tomlin'94	1E-20	25	Smit'97	12000	25	Tomlin'94	3.592E-29			6568.72493	6568.72493				
glyphosate-trimesium (glyph,part)	245.2	Tomlin'94	0.04	25	Tomlin'94	1E+06	25	Smit'97	2.500E-12			13143.4135	13143.4135				
glyphosate-trimesium (trim,part)	245.2	Tomlin'94	0.04	25	Tomlin'94	1E+06	25	Smit'97	2.500E-12			1900.22132	1900.22132				
guazatine										1E-20	Tomlin'94	22.9765282	1.000E-20				
haloxyfop ethoxyethyl	433.8	Tomlin'94	1.64E-05	20	Tomlin'94	1.91	20	Tomlin'94	1.528E-09	21400	Tomlin'94	254.878287	21400	5	Tomlin'94		
heptenophos	250.6	Tomlin'94	65	15	Tomlin'94	2200	20	Tomlin'94	6.009E-06	209	Tomlin'94	209	209				
hexaconazole	314.2	Tomlin'94	0.01	20	Tomlin'94	17	20	Tomlin'94	7.583E-08	7900	Tomlin'94	1301.58845	7900				
hexazinone	252.3	Homsby'96	0.027	25	Homsby'96	33000	25	Homsby'96	5.262E-11	11.3	Tomlin'94	38.1329428	11.3				
hexythiazox	352.9	Homsby'96	0.0031	25	Homsby'96	0.5	25	Homsby'96	5.577E-07	340	Tomlin'94	4362.20301	340			16.7	Tomlin'94
hymexazol	99.1	Tomlin'94	133	25	Tomlin'94	85000	25	Tomlin'94	3.952E-08	0.22	Tomlin'94	0.22	0.22				

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass (g/mole)	LitRef	Vapour Pressure at temp (mPa)	(degC)	LitRef	Solubility in water at temp (mg/l)	(degC)	LitRef	K_henry Calculated (-)	Kow (-)	LitRef	Kow Calculated from Kom	Kow Selected	DT50 hydrolysis (days)	LitRef	DT50 photolysis (days)	LitRef
imazalil	297.2	Tomlin'94	0.158	20	Tomlin'94	180	20	Tomlin'94	1.070E-07	6610	Tomlin'94	4736.6503	6610				
imazamethabenz-methyl (m-isomer)	288.35	Homsby'96	0.0015	22.5	Homsby'96	1370	22.5	Homsby'96	1.019E-10	66	Tomlin'94	146.687341	66				
imazamethabenz-methyl (p-isomer)	288.35	Homsby'96	0.0015	22.5	Homsby'96	857	22.5	Homsby'96	1.629E-10	35	Tomlin'94	128.835355	35				
imazapyr	261.3	Tomlin'94	0.013	60	Tomlin'94	11300	25	Tomlin'94	1.321E-12	1.3	Tomlin'94	14.7006501	1.3				
imidacloprid	255.7	Tomlin'94	2E-04	20	Tomlin'94	510	20	Tomlin'94	4.114E-11	3.7	Tomlin'94	322.589108	3.7				
ioxynil	370.9	Tomlin'94	1	20	Tomlin'94	50	25	Tomlin'94	3.655E-06			265.831516	265.831516				
iprodione	330.2	Tomlin'94	5E-04	25	Tomlin'94	13	20	Tomlin'94	2.695E-09	1010	Tomlin'94	617.747297	1010	4	Tomlin'94		
isofenphos	345.4	Homsby'96	0.4	20	Homsby'96	24	20	Homsby'96	2.362E-06	11000	Tomlin'94	346.511719	11000				
iso-octylphenolpolyglycolether												1.000E-20	1.000E-20				
isoproturon	206.3	Tomlin'94	0.0033	20	Tomlin'94	65	22	Tomlin'94	4.627E-09	320	Tomlin'94	144.459453	320				
isoxaben	332.4	Homsby'96	0.053	25	Homsby'96	1	22.5	Homsby'96	4.101E-06	8.645	Tomlin'94	1081.48732	8.645				
kasugamycine	379.4	Tomlin'94	1E-05	25	Tomlin'94	125000	25	Tomlin'94	1.006E-14	90	Tomlin'94	90	90				
lambda-cyhalothrin	449.9	Homsby'96	2.0E-04	20	Homsby'96	0.005	22.5	Homsby'96	8.098E-06	1E+07	Tomlin'94	329822.608	1E+07			20	Tomlin'94
coppernaphtanate																	
copperhydroxide																	
copperoxychinolate																	
copperoxychloride																	
HgO																	
lenacil	234.3	Tomlin'94	2E-04	25	Tomlin'94	6	25	Tomlin'94	1.991E-09	203	Tomlin'94	47.3673566	203				
lindane	290.85	Homsby'96	5.6	20	Homsby'96	7	20	Homsby'96	0.00009547			1360.09198	1360.09198				
linuron	249.11	Homsby'96	2.3	22.5	Homsby'96	75	25	Homsby'96	2.700E-06	1010	Tomlin'94	514.93585	1010				
MgO																	
malathion	330.3	Homsby'96	1	20	Homsby'96	130	22.5	Homsby'96	1.062E-06	560	Tomlin'94	179.995864	560				
maleine-hydrazide	112.1	Homsby'96	1E-20	25	Smit'97	6000	25	Homsby'96	4.762E-29	0.011	Tomlin'94	320.100752	0.011			58	Tomlin'94
mancozeb	330	Smit'97	1E-20	25	Smit'97	6	25	Homsby'96	1.402E-25			2415.04466	2415.04466	0.7	Tomlin'94		
maneb	265.29	Homsby'96	1E-20	25	Smit'97	6	25	Homsby'96	1.127E-25			2415.04466	2415.04466	<1	Tomlin'94		
MCPA	200.6	Tomlin'94	0.023	20	Tomlin'94	734	25	Tomlin'94	3.097E-09	2.9	Tomlin'94	67.9671978	2.9				
mecoprop	214.6	Tomlin'94	0.31	20	Tomlin'94	734	25	Tomlin'94	4.466E-08	1.26	Tomlin'94	1.000E-20	1.26				
mecoprop-P	214.6	Tomlin'94	0.4	20	Tomlin'94	860	20	Tomlin'94	4.095E-08	1.29	Tomlin'94	1.29	1.29				
mefluidide	310.3	Homsby'96	1E-20	25	Smit'97	180	25	Homsby'96	4.394E-27			257.696113	257.696113				
mepiquat.chloride	149.7	Homsby'96	1E-20	25	Smit'97	1E+06	20	Homsby'96	3.177E-31	0.00151	Tomlin'94	1013516.69	0.00151				
mercaptodimethur																	
metalaxyl	279.3	Homsby'96	0.7498	25	Homsby'96	8400	22	Homsby'96	5.698E-09	56.2	Tomlin'94	63.4073729	56.2				
metaldehyde	176.2	Homsby'96	1E-20	25	Smit'97	230	22.5	Homsby'96	1.783E-27			24.1508818	24.1508818				
metam-sodium	129.18	Homsby'96	1E-20	25	Smit'97	963000	22.5	Homsby'96	3.122E-31	10	Tomlin'94	504.193876	10	7.5	Tomlin'94	0.07	Tomlin'94
metamitron	202.2	Tomlin'94	8.6E-04	20	Tomlin'94	1700	20	Tomlin'94	4.197E-11	6.8	Tomlin'94	226.334256	6.8	31	Tomlin'94		
metazachlor	277.8	Tomlin'94	0.049	20	Tomlin'94	430	20	Tomlin'94	1.299E-08	135	Tomlin'94	184.422731	135				
methabenzthiazuron	221.3	Tomlin'94	0.0059	20	Tomlin'94	59	20	Tomlin'94	9.080E-09	437	Tomlin'94	881.222525	437				
methamidophos	141.1	Tomlin'94	2.3	20	Tomlin'94	2E+05	20	Homsby'96	6.658E-10	0.2	Tomlin'94	12.3136508	0.2	5	Tomlin'94		
methidathion	302.3	Homsby'96	0.449	25	Homsby'96	220	22	Homsby'96	1.410E-07	160	Tomlin'94	217.531006	160				
methiocarb	225.3	Tomlin'94	0.015	20	Tomlin'94	27	20	Tomlin'94	5.136E-08	2190	Tomlin'94	1094.09729	2190	<35	Tomlin'94	11	Tomlin'94
methomyl	162.2	Homsby'96	6.7	25	Homsby'96	58000	25	Homsby'96	4.776E-09	1.24	Tomlin'94	28.8325263	1.24				
methylbromide	94.94	Homsby'96	2.4E+08	25	Homsby'96	13400	25	Homsby'96	0.43902808			6.03408683	6.03408683				
methyldodecylbenzyltrimethyl...																	
methyldodecylxylyleen-bis...																	
methylisothiocyanate	73.11	Homsby'96	2.7E+06	20	Homsby'96	7600	20	Homsby'96	0.01065681	23.5	Tomlin'94	7.49532351	23.5	20.4	Tomlin'94		
methylkwikbenzoate																	
metiram	1088.7	Homsby'96	1E-20	25	Smit'97	0.1	22.5	Homsby'96	2.534E-23	2	Tomlin'94	516755.07	2				
metobromuron	259.1	Tomlin'94	0.4	20	Tomlin'94	330	20	Tomlin'94	1.289E-07	257	Tomlin'94	281.144193	257				
metolachlor	283.8	Homsby'96	4.179	25	Homsby'96	530	20	Homsby'96	4.749E-07	790	Tomlin'94	232.930161	790				
metoxuron	228.7	Tomlin'94	4.3	20	Tomlin'94	678	24	Tomlin'94	6.894E-07	40	Tomlin'94	370.38649	40	24	Tomlin'94		
metribuzin	214.3	Tomlin'94	0.058	20	Tomlin'94	1050	20	Tomlin'94	4.857E-09	37.6	Tomlin'94	74.7905073	37.6			20	Tomlin'94
metsulfuron-methyl	381.4	Homsby'96	3.3E-07	25	Homsby'96	9500	22.5	Homsby'96	3.084E-15	0.018	Tomlin'94	65.688433	0.018				
mevinphos	224.15	Homsby'96	17	20	Homsby'96	600000	22.5	Homsby'96	2.858E-09	21.9	Tomlin'94	40.4470862	21.9	35	Tomlin'94		
mineral oil																	
mineral oil (herbicide)																	
monolinuron	214.6	Homsby'96	20	21	Homsby'96	735	25	Homsby'96	2.518E-06	160	Tomlin'94	428.804982	160				
myclobutanil	288.78	Homsby'96	0.21	25	Homsby'96	142	25	Homsby'96	1.089E-07	871	Tomlin'94	775.303459	871			25	Tomlin'94
nitrothal-isopropyl	295.3	Tomlin'94	0.01	20	Tomlin'94	0.39	20	Tomlin'94	3.107E-06	110	Tomlin'94	1953.96584	110				
nonylphenolp.glycol.eth																	
nonylphenol-eth.glyc.																	
n-propyl-3t-butylphenoxy acetic acid																	
nuarimol	314.7	Tomlin'94	0.0027	25	Tomlin'94	26	25	Tomlin'94	8.330E-09	1500	Tomlin'94	751.946715	1500				
omethoate	213.2	Tomlin'94	3.3	20	Tomlin'94	1E+06	25	Smit'97	3.467E-10	0.176	Tomlin'94	31.8635499	0.176	17	Tomlin'94		
oxamyl	219.3	Homsby'96	31	25	Homsby'96	282000	25	Homsby'96	7.561E-09	0.36	Tomlin'94	5.05430971	0.36	8	Tomlin'94		
oxycarboxim	267.3	Tomlin'94	0.0056	25	Tomlin'94	1000	25	Tomlin'94	3.815E-10	5.92	Tomlin'94	125.000896	5.92	44	Tomlin'94		
oxydemeton-methyl	246.29	Homsby'96	3.9	20	Homsby'96	1E+06	22.5	Homsby'96	4.322E-10	0.18	Tomlin'94	101.918127	0.18	46	Tomlin'94		
paclobutrazol	293.8	Homsby'96	0.001	20	Homsby'96	35	22.5	Homsby'96	3.777E-09	1600	Tomlin'94	505.421863	1600				
paraformaldehyde																	
paraquat	257.2	Tomlin'94	1E-20	25	Smit'97	700000	20	Tomlin'94	7.798E-31			186295.423	186295.423				
parathion	291.27	Homsby'96	0.89	20	Tomlin'94	11	20	Tomlin'94	9.669E-06	6760	Tomlin'94	3645.77924	6760	260	Tomlin'94		

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass		Vapour Pressure at temp			Solubility in water at temp			K_henry Calculated	Kow		Kow Calculated from Kom	Kow Selected	DT50 hydrolysis		DT50 photolysis	
	(g/mole)	LitRef	(mPa)	(degC)	LitRef	(mg/l)	(degC)	LitRef	(-)	(-)	LitRef			(days)	LitRef	(days)	LitRef
parathion-methyl	263.21	Homsby'96	2	20	Homsby'96	60	25	Homsby'96	4.588E-06	1000	Tomlin'94	316.055975	1000	40	Tomlin'94		
penconazole	284.2	Tomlin'94	0.21	20	Tomlin'94	73	20	Tomlin'94	3.354E-07	5250	Tomlin'94	2462.55758	5250				
pencycuron	328.8	Tomlin'94	5E-07	20	Tomlin'94	0.3	20	Tomlin'94	2.248E-10	47900	Tomlin'94	2121.13148	47900				
pendimethalin	281.3	Tomlin'94	4	25	Tomlin'94	0.3	20	Tomlin'94	0.00079603	152000	Tomlin'94	250.493202	152000				
pentachlorophenol	266.3	Tomlin'94	16000	100	Tomlin'94	80	30	Tomlin'94	6.857E-06			40.7773596	40.7773596				
permethrin	391.3	Homsby'96	0.0017	25	Homsby'96	0.006	20	Homsby'96	0.00002353	1300	Tomlin'94	743.448168	1300				
phenmedipham	300.32	Homsby'96	1E-06	25	Homsby'96	4.7	20	Homsby'96	1.356E-11	3890	Tomlin'94	1005.73599	3890	0.6	Tomlin'94		
phosalone	367.82	Homsby'96	0.07	22.5	Homsby'96	3	22.5	Homsby'96	2.905E-06	20000	Tomlin'94	2829.19011	20000				
phosmet	317.33	Homsby'96	0.065	25	Homsby'96	20	22.5	Homsby'96	2.401E-07	891	Tomlin'94	461.157994	891	<0.5	Tomlin'94		
phosphamidon	299.7	Homsby'96	2.2	25	Homsby'96	1E+06	22.5	Homsby'96	1.535E-10	6.2	Tomlin'94	12.3136508	6.2	54	Tomlin'94		
piperonylbutoxide	338.4	Tomlin'94	0.117	20	Tomlin'94	0.001	22.5	Smit'97	0.01781657	56200	Tomlin'94	26.4947069	56200				
pirimicarb	238.3	Homsby'96	4	30	Homsby'96	2700	25	Homsby'96	4.757E-08	50	Tomlin'94	999.416075	50			<1	Tomlin'94
pirimiphos-methyl	305.34	Homsby'96	2	20	Homsby'96	9	20	Homsby'96	0.00002784	16000	Tomlin'94	448.224956	16000			1	Tomlin'94
prochloraz	376.7	Homsby'96	0.15	20	Homsby'96	34	25	Homsby'96	8.189E-07	24000	Tomlin'94	627.816682	24000				
procymidon	284.1	Homsby'96	19	22.5	Homsby'96	4.5	25	Homsby'96	0.00042394	1380	Tomlin'94	1826.02845	1380				
propham	179.2	Tomlin'94				250	20	Tomlin'94				26.4947069	26.4947069				
prometryn	241.4	Homsby'96	0.165	25	Homsby'96	33	20	Homsby'96	2.562E-07	1300	Tomlin'94	489.14392	1300				
propachlor	211.69	Homsby'96	31	22.5	Homsby'96	613	25	Homsby'96	3.784E-06	91.2	Tomlin'94	92.9020519	91.2				
propamocarb	224.7	Tomlin'94	0.8	25	Tomlin'94	867000	25	Tomlin'94	5.285E-11	0.0018	Tomlin'94	398.544885	0.0018				
propaquizafop	443.9	Tomlin'94	4.4E-08	25	Tomlin'94	0.63	25	Tomlin'94	7.902E-12	60300	Tomlin'94	534.255132	60300				
propazine	229.7	Tomlin'94	0.0039	20	Tomlin'94	5	20	Tomlin'94	7.351E-08			133.304718	133.304718				
propetamphos	281.3	Tomlin'94	1.9	20	Tomlin'94	110	24	Tomlin'94	2.309E-06	6600	Tomlin'94	6600	6600				
profenofos	373.6	Tomlin'94	0.124	25	Tomlin'94	28	25	Tomlin'94	4.217E-07	27500	Tomlin'94	2415.04466	27500	14.6	Tomlin'94		
propiconazole	342.2	Homsby'96	0.056	25	Homsby'96	110	20	Homsby'96	3.697E-08	5250	Tomlin'94	1535.17753	5250				
propoxur	209.25	Homsby'96	1.3	20	Homsby'96	1800	20	Homsby'96	6.201E-08	36.3	Tomlin'94	38.1329428	36.3			7.5	Tomlin'94
propylbutylphenoxyac.																	
propyzamide	256.1	Tomlin'94	0.058	25	Tomlin'94	15	25	Tomlin'94	2.524E-07	1569	Tomlin'94	263.641935	1569			35	Tomlin'94
prosulfocarb	251.4	Tomlin'94	0.069	25	Tomlin'94	13.2	20	Tomlin'94	2.789E-07	44700	Tomlin'94	2112.8856	44700	25	Tomlin'94		
pyrazophos	373.4	Tomlin'94	0.1	22.5	Linders'94	4.2	25	Tomlin'94	3.142E-06	6300	Tomlin'94	819.837516	6300				
pyrethrins	328.43	Homsby'96	0.001	22.5	Homsby'96	0.001	22.5	Homsby'96	0.000106			20.1507717	20.1507717				
pyridate	378.9	Tomlin'94	1.3E-04	20	Tomlin'94	1.5	20	Tomlin'94	1.347E-08	1000	Tomlin'94	1000	1000				
pyridathioben (pyridaben)	364.9	Tomlin'94	0.25	20	Tomlin'94	0.012	20	Tomlin'94	0.00311912	2.34E+06	Tomlin'94	12491.8724	2.34E+06				
pyrifenox	295.2	Tomlin'94	1.7	25	Tomlin'94	150	25	Tomlin'94	8.528E-07	5010	Tomlin'94	579.256014	5010				
quatern.ammonium..																	
quinmerac	221.6	Tomlin'94	0.01	20	Tomlin'94	240000	20	Tomlin'94	3.788E-12	0.078	Tomlin'94	12.5529162	0.078				
quintozeen	295.3	Tomlin'94	12.7	25	Tomlin'94	0.1	20	Tomlin'94	0.00795953	5E+05	Tomlin'94	6415.92256	5E+05				
quizalofop-ethyl	372.8	Tomlin'94	8.66E-07	20	Tomlin'94	0.3	20	Tomlin'94	4.415E-10			2263.22965	2263.22965			20	Tomlin'94
quizalofop-P-ethyl	372.8	Tomlin'94	1.1E-04	20	Tomlin'94	0.4	20	Tomlin'94	4.206E-08	45700	Tomlin'94	2263.22965	45700				
rimsulfuron	431.4	Tomlin'94	0.0015	25	Tomlin'94	7300	25	Tomlin'94	2.259E-11	0.034	Tomlin'94	81.5957857	0.034	7.2	Tomlin'94		
sethoxydim	327.5	Homsby'96	0.021	25	Homsby'96	4390	20	Homsby'96	3.325E-10	44.7	Tomlin'94	67.9671978	44.7				
silicone																	
simazine	201.66	Homsby'96	0.00295	25	Homsby'96	6.2	22	Homsby'96	1.716E-08	130	Tomlin'94	135.537762	130				
sodiumdimethyldithiocarbamate																	
streptomycine																	
strychnine																	
sulpher																	
sulfotep	322.3	Tomlin'94	14	20	Tomlin'94	10	20	Tomlin'94	0.00018513	9800	Tomlin'94	9800	9800	8.2	Tomlin'94		
TCA	185.4	Homsby'96	1E-20	25	Smit'97	1.2E+06	25	Homsby'96	3.938E-31			1.000E-20	1.000E-20				
tar acids and oils																	
tebuconazole	307.8	Tomlin'94	0.0013	20	Tomlin'94	32	20	Tomlin'94	5.131E-09	5000	Tomlin'94	1318.31138	5000				
teflubenzuron	381.1	Tomlin'94	8E-07	20	Tomlin'94	0.019	23	Tomlin'94	7.354E-09	20000	Tomlin'94	20000	20000				
tefluthrin	418.7	Tomlin'94	8	20	Tomlin'94	0.02	20	Tomlin'94	0.06871682	3.2E+06	Tomlin'94	213397.534	3.2E+06				
temephos	466.5	Tomlin'94	0.0095	25	Sparenburg'91	0.03	25	Tomlin'94	0.00009187	80900	Tomlin'94	108146.783	80900			<2	Sp'burg'91
terbufos	288.43	Tomlin'94	34.6	25	Tomlin'94	4.5	27	Tomlin'94	0.00060721	33000	Tomlin'94	1353.82729	33000				
terbutryn	241.4	Homsby'96	0.28	25	Homsby'96	22	22	Homsby'96	7.022E-07	4470	Tomlin'94	849.487709	4470				
terbutylazine	229.7	Tomlin'94	0.15	25	Tomlin'94	8.5	20	Tomlin'94	8.603E-07	1096	Tomlin'94	400.708474	1096			>40	Tomlin'94
tetrachloorvinphos	366	Homsby'96	0.0056	20	Homsby'96	11	20	Homsby'96	7.645E-08			1111.50415	1111.50415	44	Tomlin'94		
tetradifon	356	Tomlin'94	3.2E-05	20	Tomlin'94	0.08	20	Tomlin'94	5.843E-08	40700	Tomlin'94	986.772751	40700				
thiabendazole	201.2	Homsby'96	1E-20	25	Smit'97	50	22.5	Homsby'96	9.367E-27			2999.88076	2999.88076				
thifensulfuron-methyl	387.4	Homsby'96	1.7E-05	25	Homsby'96	2400	25	Homsby'96	6.995E-13	0.02	Tomlin'94	45.0640856	0.02	10.4	Tomlin'94		
thiocyclam hydrogen oxalate	271.4	Tomlin'94	0.545	20	Tomlin'94	16300	20	Tomlin'94	3.723E-09	0.85	Tomlin'94	28.8325263	0.85	6	Tomlin'94		
thiodicarb	354.5	Tomlin'94	5.7	20	Tomlin'94	35	25	Tomlin'94	0.00002845			199.893002	199.893002				
thiofanate-methyl	342.4	Homsby'96	0.01	20	Homsby'96	3.5	20	Homsby'96	4.014E-07			508.491454	508.491454				
thiofanox	218.3	Tomlin'94	22.6	25	Tomlin'94	5200	22	Tomlin'94	2.168E-07			24.1508818	24.1508818				
thiometon	246.3	Tomlin'94	23	20	Tomlin'94	200	25	Tomlin'94	0.00001396	2880	Tomlin'94	959.362672	2880				
thiram	240.4	Tomlin'94	2.3	25	Tomlin'94	18	22.5	Tomlin'94	7.150E-06	53.7	Tomlin'94	10.394417	53.7				
tolclofos-methyl	301.1	Homsby'96	57	22.5	Homsby'96	0.3	23	Homsby'96	0.01880451	36300	Tomlin'94	3263.68301	36300				
tolylfluanid	347.2	Tomlin'94	0.016	20	Tomlin'94	0.9	22.5	Tomlin'94	2.778E-06	8900	Tomlin'94	26.4947069	8900	1.2	Tomlin'94		
tri-allate	304.66	Homsby'96	15	22.5	Homsby'96	4	22.5	Homsby'96	0.00038415			2458.45258	2458.45258				
triadimefon	293.76	Homsby'96	0.002	20	Homsby'96	71.5	20	Homsby'96	3.371E-09	1290	Tomlin'94	382.152231	1290				
triadimenol	295.8	Homsby'96	4.1E-05	20	Homsby'96	47	20	Homsby'96	1.059E-10	1410	Tomlin'94	300.796606	1410				

Active ingredient names from Pandoras' box and compiled by v/d Linden	Molecular Mass (g/mole)	LitRef	Vapour Pressure at temp (mPa)	(degC)	LitRef	Solubility in water at temp (mg/l)	(degC)	LitRef	K_henry Calculated (-)	Kow (-)	LitRef	Kow Calculated from Kom	Kow Selected	DT50 hydrolysis (days)	LitRef	DT50 photolysis (days)	LitRef
triapenthenol												195.476589	195.476589				
triazophos	313.3	Tomlin'94	0.39	30	Tomlin'94	35	20	Tomlin'94	3.917E-07	2200	Tomlin'94	461.157994	2200				
trichlorfon	257.4	Tomlin'94	0.21	20	Tomlin'94	120000	20	Tomlin'94	1.848E-10	2.7	Tomlin'94	26.4947069	2.7	1.9	Tomlin'94		
trichloronaat	333.6	Homsby'96	2	20	Homsby'96	50	20	Homsby'96	5.475E-06			505.421863	505.421863				
triclopyr	256.5	Tomlin'94	0.2	25	Tomlin'94	8100	20	Tomlin'94	1.344E-09	2.8	Tomlin'94	74.7905073	2.8			<0.5	Tomlin'94
tridemorph	297.5	Tomlin'94	6.4	20	Tomlin'94	11.7	20	Tomlin'94	0.00006677	15800	Tomlin'94	2090.20462	15800	0.7	Tomlin'94		
triflumizole	345.7	Tomlin'94	0.186	25	Tomlin'94	12500	20	Tomlin'94	1.092E-09	25	Tomlin'94	58.83801	25			1.2	Tomlin'94
trifluralin	335.28	Homsby'96	15	25	Homsby'96	0.3	25	Homsby'96	0.00358334	67900	Tomlin'94	7713.03791	67900				
triforine	435	Tomlin'94	0.027	25	Tomlin'94	9	20	Tomlin'94	2.770E-07	158	Tomlin'94	409.35946	158				
validamycine																	
vamidothion																	
vinclozolin	286.1	Tomlin'94	0.016	20	Tomlin'94	3.4	20	Tomlin'94	5.524E-07	1000	Tomlin'94	350.856043	1000				
warfarin	308.3	Tomlin'94	0.9	23	Mensink'93	17	20	Tomlin'94	4.497E-06	1E+06	Mensink'93	1E+06	1E+06				
zineb	275.8	Homsby'96	0.01	20	Homsby'96	10	22.5	Homsby'96	1.241E-07	20	Tomlin'94	1231.34289	20				
ziram	305.8	Homsby'96	0.013	22.5	Homsby'96	65	25	Homsby'96	2.162E-08	12.19	Tomlin'94	19.4425921	12.19				
1,3-dichloropropene	111	Tomlin'94	2.9E+06	20	Tomlin'94	2250	25	Tomlin'94	0.07049876	111	Tomlin'94	35.814717	111				
cis-dichloropropene	111	Tomlin'94	3.5E+06	20	Tomlin'94	2180	25	Tomlin'94	0.08781678	115	Tomlin'94	35.814717	115				
2,4-D (pH soil < 5)												508.491454					
2,4-D (pH soil > 5)	221.04	Homsby'96	1	20	Homsby'96	890	25	Homsby'96	1.224E-07	507	Tomlin'94	61.12393	507				
Other pesticides from literature study																	
aminocarb	208.3	Homsby'96	2.3	22.5	Homsby'96	915	20	Homsby'96	1.541E-07	79	Sangster'93	131.389818	79				
chlorpyrifos-methyl	322.5	Tomlin'94	5.6	25	Tomlin'94	4	24	Tomlin'94		17300	Tomlin'94	17300	17300				
2,4-D-propylene glycolbutyl ether ester	221.04	Homsby'96	1	20	=acid H'96	100	25	Homsby'96				43.4168088	43.4168088				
2,4,5-T-propylene glycolbutyl ether ester	367.7	Homsby'96	0.00086	25	Nash'89	50	22.5	Homsby'96				105.774963	105.774963				
dicamba dimethylammonium	266.1	Tomlin'94	0.0046	25	Beste'83	850000	25	Homsby'96				2.93408892	2.93408892				
pp-DDT	354.5	Homsby'96	0.025	20	Homsby'96	0.0055	22.5	Homsby'96	0.00072511			1987820.02	1987820.02				
dieldrin	380.9	Homsby'96	0.4	20	Homsby'96	0.2	22.5	Homsby'96	0.00035016	251000	DeBruijn'89	13776.7257	251000				
fenoprop-butoxypropyl ester (2,4,5-TP)	269.5	Homsby'96	0.01	22.5	=acid H'96	140	25	Homsby'96				382.152231	382.152231				
heptachlor	373.3	Homsby'96	53	22.5	Homsby'96	0.056	27	Homsby'96	0.13412617	25119	Calahan'79	27020.4246	25119				
mexacarbate	222	Homsby'96	10000	22.5	Homsby'96	100	25	Homsby'96	0.00784595	367.3	Sangster'93	382.152231	367.3				
nitrapyrin	230.9	Homsby'96	370	23	Homsby'96	40	22.5	Homsby'96		2111.5	Tomlin'94	713.072964	2111.5	2	Tomlin'94		
picloram	241.5	Tomlin'94	0.082	35	Tomlin'94	430	25	Homsby'96				22.136642	22.136642			2.6	Tomlin'94
picloram-potassium salt	279.6	Tomlin'94	0.000005	25	Beste'83	400000	25	Tomlin'94				99.3445587	99.3445587				
prometon	225.3	Tomlin'94	0.306	20	Tomlin'94	750	20	Tomlin'94				194.845438	194.845438				
toxaphene	413.8	Homsby'96	0.5	20	Homsby'96	3	22.5	Homsby'96	0.00003103			108146.783	108146.783				

Annex 4 Cumulative volatilization from crops estimated with new method

Cumulative Volatilization from leaves after spraying with pesticides

Name active ingredient in ISBEST	CumulVolat (in % of dosage) after day: 7	Remarks
1-naphtylacetamide	3	
1-naphtylacetic acid	3	
abamectine 1a	1	{3}
acephate	15	
aclonifen	5	
acrinathrin (acrinate)	-	{1}
alachlor	-	{1}
aldicarb	-	{1}
alloxydim-sodium	-	{1}
Al-fosfide	-	{1}
amitraz	15	{5},{7}
amitrol	8	{7}
(NH4)2SO4	-	{1}
amm-thiocyanaat	-	{1}
ancymidol	-	{1}
anilazine	1	{7}
antrachinon	-	{1}
asulam	34	{3}
atrazine	5	
azaconazole	4	
azamethifos	-	{1}
azinphos-methyl	7	{6}
azocyclotin	0	
Bacillus thuringiensis	-	{1}
Bacillus thuringiensis (combi)	-	{1}
benazolin	0	
benazolin-ethyl	-	{1}
bendiocarb	-	{1}
benfuracarb	-	{1}
benodanil	-	{1}
benomyl	0	{3}
bensultap	-	{1}
bentazone	23	
benzalkoniumchloride	-	{1}
benzoylprop	-	{1}
benzyladenine	-	{1}
bifenox	11	{6},{7}
bifenthrin	5	
bitertanol-A	0	{11}
boraten	-	{1}
borax	-	{1}
brodifacoum	-	{1}
bromacil	-	{1}
bromadiolone	-	{1}
bromofenoxim	1	{3}
bromophos-ethyl	-	{1}
bromopropylate	4	
bromoxynil	34	{3},{9}
buminaphos	100	
bupirimate	8	
buprofezin	28	
butocarboxim	100	{7}
butoxycarboxim	-	{1}
calciumcyanide	-	{1}
Ca(NO3)2	-	{1}
captafol	-	{1}
captan	3	{7}
carbaryl	11	
carbendazim	0	
carbetamide	0	
carbophenothion	-	{1}
carbofuran	9	
carboxin	-	{1}
chlorbromuron	7	
chlorbufam	-	{1}
chlorfacinon	-	{1}
chlorfenvinphos	25	
chloralhydrate	-	{1}
chloridazon	4	{3},{10}
chlormequat	4	{3},{7}
chloroflurenol	-	{1}
chlorothalonil	7	
chlorotoluron	4	
chloroxuron	-	{1}
chlorpropham	34	
chlorpyriphos-ethyl	41	
chlorthal-dimethyl (DCPA)	-	{1}
chlorthiamid	-	{1}
clodinafop-propargyl	2	{5},{7}
clofentezine	0	{5}
cloquintoceet-mexyl (CGA 185072)	2	{5},{7}
copper oxychloride	-	{1}
creosote	-	{1}
cresol	-	{1}
chlorcresol	-	{1}
coumatetralyl	-	{1}
cyanamide	-	{1}
cyanazine	1	
cycloate	-	{1}
cycloxydim	4	{3},{6},{7}
cyfluthrin	-	{1}
cyhexatin	0	
cymiazole	-	{1}

Basic data field application:

Period:	7 day(s)
Crop code:	3
Average day temperature	20 degree Celsius

Tabel crop codes:

cereals	= 1
sugar beets	= 2
potatoes	= 2
vegetables	= 2
aggregated	= 3

Statistics:

Number active ingredient	374
Number CV values:	206
Score CV/a.i.	0.55
Regression (R2):	0.767949

Legend remarks:

{1}	no crop application
{2}	no data
{3}	vapour pressure overestimated
{4}	vapour pressure estimated
{5}	hydrolyses (DT50 < 3 weeks)
{6}	fotolyses (DT50 < 3 weeks)
{7}	transforms fast (DT50 < few days)
{8}	acid
{9}	base
{10}	salt
{11}	A-isomer
{12}	z-isomer
{13}	p-isomer
{14}	gamma-isomer
{15}	cis-isomer
{16}	isomer or enantiomer mixture
{17}	see dichlobenil
{18}	butyl
{19}	tau
{20}	etotyl
{21}	see also methyl isothiocyanate (MITC)
{22}	methyl

Cumulative Volatilization
from leaves after spraying
with pesticides

Name active ingredient in ISBEST	CumulVolat (in % of dosage) after day: 7	Remarks
cymoxanil	8	{4},{7}
cypermethrin (cis)	1	{16}
cypermethrin (trans)	-	{1}
alpha-cypermethrin	-	{1}
cyproconazole	7	
cyprofuram	-	{1}
cyromazine	1	
dalapon	-	{1}
daminozide	1	{7}
dazomet	-	{1}
deltamethrin	3	{3},{6}
demeton-S-methylsulfon	2	
desmedipham	1	{5},{7}
desmetryn	13	
diallate	-	{1}
dial.dichl.aceetamid(cdaa)	-	{1}
diazinon	89	
dicamba	50	{8}
dichlobenil	100	{6}
dichlofenthion	-	{1}
dichlofluanid	6	{7}
dichloromethane	-	{1}
dichlorprop	-	{1}
dichlorprop-P	9	
dichlorvos	100	{5},{7}
dicloran	-	{1}
dicofol (op)	7	{5},{16}
dicofol (pp)	7	{5},{16}
didecyldimethylammoniumchloride	-	{2}
dienochlor	28	{4},{6}
diethatyl-ethyl	-	{1}
diethofencarb	91	{7}
difenacoum	-	{1}
difenoconazole	0	
difenoxuron	0	
difenzoquat	-	{1}
difethialon	-	{1}
diflubenzuron	0	{7}
diflufenican	5	
dikegulac-sodium	1	{3}
dimefuron	-	{1}
dimethachlor	-	{1}
dimethoate	26	{6}
dimethomorph (E-isomer)	-	{1}
dimethomorph (Z-isomer)	-	{1}
dinocap	-	{1}
dinoseb	-	{1}
dinoseb-acetate	-	{1}
dinoterb	100	
diquat-dibromide	0	{10}
dithianon	7	{6},{7}
diuron	3	
DNOC	85	{8}
dodemorph	24	{15}
dodine	-	{1}
endosulfan	-	{1}
endothal-sodium	-	{1}
EPTC	-	{1}
esfenvalerate	1	
ethephon	4	{3},{7}
ethiofencarb	23	
ethofumesate	20	
ethoprophos	-	{1}
ethoxylated fatty amines	-	{2}
ethyleneglycol	-	{1}
ethylkwikbromide	-	{1}
etofenprox	-	{1}
etridiazole	100	
etrimfos	92	
fenaminosulf	-	{1}
fenamiphos	-	{1}
fenarimol	5	
fenbutatinoxide	0	
fenchlorazole-ethyl	1	
fenfuram	-	{1}
fenitrothion	-	{1}
fenoxaprop-ethyl	-	{1}
fenoxaprop-P-ethyl	1	{7}
fenoxycarb	1	
fenpiclonil	-	{1}
fenpropathrin	25	{6},{7}
fenpropidin	-	{1}
fenpropimorph	50	
fentin-acetate	5	{5}
fentin-hydroxide	1	
fenvalerate	1	
ferbam	-	{1}
FeSO4	-	{1}
fluazifop-butyl	-	{1}
fluazifop-p-butyl	7	{7}
fluazinam	-	{2}
flucycloxuron	67	{3},{6}
flurenol(-butyl)	-	{1}

**Cumulative Volatilization
from leaves after spraying
with pesticides**

Name active ingredient in ISBEST	CumulVolat (in % of dosage) after day: 7	Remarks
flurochloridon	-	{1}
fluroxypyr	0	
fluroxypyr 1-methylheptylester	-	{1}
flusilazole	-	{1}
flutolanil	44	
fluvalinate	-	{1}
folpet	38	
fonofos	100	{6}
formaldehyde	-	{2}
formothion	13	{5},{7}
fosetyl-aluminium	3	{3},{7}
foxim	-	{1}
fuberidazol	-	{1}
furalaxyl	10	
furathiocarb	-	{1}
gibberellin	-	{2}
gluphosinate-amm.	0	
glyphosate	0	
glyphosate-trimesium (glyph,part)	6	{7}
glyphosate-trimesium (trim,part)	-	{1}
guazatine	-	{1}
haloxyfop ethoxyethyl	0	{5},{7},{20}
heptenophos	100	{7}
hexaconazole	-	{1}
hexazinone	-	{1}
hexythiazox	2	{6}
hymexazol	100	{3}
imazalil	14	
imazamethabenz-methyl (m-isomer)	-	{1}
imazamethabenz-methyl (p-isomer)	-	{1}
imazapyr	-	{1}
imidacloprid	1	
ioxynil	34	{3},{8}
iprodione	1	{5},{6}
isofenphos	-	{1}
iso-octylphenolpolyglycolether	-	{2}
isoproturon	2	
isoxaben	-	{1}
kasugamycine	0	{3}
lambda-cyhalothrin	1	{6}
coppernaphtanate	-	{1}
copperhydroxide	-	{1}
copperoxychinolate	-	{1}
copperoxychloride	-	{2}
HgO	-	{1}
lenacil	0	
lindane	75	{14}
linuron	43	
MgO	-	{1}
malathion	34	{7}
maleine-hydrazide	0	{7},{8}
mancozeb	0	{5},{7}
maneb	0	{5}
MCPA	6	{8}
mecoprop	-	{1}
mecoprop-P	22	{8}
mefluidide	-	{1}
mepiquat.chloride	-	{1}
mercaptodimethur	-	{1}
metalaxyl	22	
metaldehyde	-	{1}
metam-sodium	-	{1}
metamitron	1	{6}
metazachlor	8	
methabenzthiazuron	3	
methamidophos	50	{5},{7}
methidathion	17	{7}
methiocarb	5	{6}
methomyl	60	
methylbromide	-	{1}
methyldodecylbenzyltrimethyl...	-	{1}
methyldodecylxylyleen-bis...	-	{1}
methylisothiocyanate	-	{1}
methylkwikbenzoate	-	{1}
metiram	0	
metobromuron	22	
metolachlor	48	
metoxuron	67	
metribuzin	9	{6}
metsulfuron-methyl	0	
mevinphos	100	{7}
mineral oil	-	{2}
mineral oil (herbicide)	-	{2}
monolinuron	100	
myclobutanil	12	
nitrothal-isopropyl	4	{3},{7}
nonylphenolp.glycol.eth	-	{2}
nonylphenol-eth.glyc.	-	{2}
n-propyl-3t-butylphenoxy acetic acid	-	{2}
nuarimol	2	{3}
omethoate	59	{5},{7}
oxamyl	100	
oxycarboxim	-	{1}

**Cumulative Volatilization
from leaves after spraying
with pesticides**

Name active ingredient in ISBEST	CumulVolat (in % of dosage) after day: 7	Remarks
oxydemeton-methyl	64	{7}
paclobutrazol	1	
paraformaldehyde	-	{1}
paraquat	0	
parathion	32	
parathion-methyl	47	
penconazole	16	
pencycuron	0	{4}
pendimethalin	47	{6}
pentachlorophenol	-	{1}
permethrin	1	{16}
phenmedipham	0	{5},{6}
phosalone	8	{3},{7}
phosmet	-	{1}
phosphamidon	36	{7}
piperonylbutoxide	12	
pirimicarb	35	{6}
pirimiphos-methyl	47	{6}
prochloraz	14	
procymidon	100	
propham	-	{2}
prometryn	11	
propachlor	100	{7}
propamocarb	22	
propaquizafop	0	{7}
propazine	3	
propetamphos	-	{1}
profenofos	-	{1}
propiconazole	6	
propoxur	38	{6}
propylbutylphenoxyac.	-	{1}
propyzamide	7	
prosulfocarb	7	
pyrazophos	10	
pyrethrins	1	{4},{16}
pyridate	1	{7}
pyridathioben (pyridaben)	18	
pyrifenox	32	
quatern.ammonium..	-	{1}
quinmerac	4	{3}
quintozeen	-	{1}
quizalofop-ethyl	0	{7}
quizalofop-P-ethyl	0	{7}
rimsulfuron	1	{7}
sethoxydim	4	{7}
silicone	-	{2}
simazine	1	
sodiumdimethyldithiocarbamate	-	{1}
streptomycine	-	{2}
strychnine	-	{1}
sulpher	-	{2}
sulfotep	-	{1}
TCA	-	{1}
tar acids and oils	-	{2}
tebuconazole	2	
teflubenzuron	0	
tefluthrin	-	{1}
temephos	3	
terbufos	-	{1}
terbutryn	14	
terbutylazine	10	
tetrachloorvinphos	-	{1}
tetradifon	-	{1}
thiabendazole	-	{1}
thifensulfuron-methyl	-	{1}
thiocyclam hydrogen oxalate	25	{7}
thiodicarb	-	{1}
thiofanate-methyl	4	{3},{7}
thiofanox	-	{1}
thiometon	100	{7}
thiram	37	{5}
tolclofos-methyl	100	
tolylfluanid	5	{7}
tri-allate	100	
triadimefon	2	
triadimenol	0	{16}
triapenthenol	-	{1}
triazophos	12	
trichlorfon	16	{5},{16}
trichloronaat	-	{1}
triclopyr	12	{8}
tridemorph	80	
triflumizole	11	
trifluralin	-	{1}
triforine	5	
validamycine	-	{2}
vamidothion	-	{2}
vinclozolin	5	
warfarin	-	{1}
zineb	4	{3},{7}
ziram	4	
1,3-dichloropropene	-	{1}
cis-dichloropropene	-	{1}

**Cumulative Volatilization
from leaves after spraying
with pesticides**

Name active ingredient in ISBEST	CumulVolat (in % of dosage) after day: 7	Remarks
2,4-D	34	{8}

Annex 5 List of reports published in the Environmental Planning Bureau series

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1. Kruijne, R. and R.C.M. Merkelbach, 1997. Ontwikkeling van het prototype instrumentarium PEGASUS; Pesticide Emission to Groundwater And SUrface waterS. DLO-Staring Centrum, Wageningen (f 25,--).
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3. Kros, J., 1998. Verbetering, verfijning en toepassing van SMART2 ten behoeve van de Milieubalans, Milieuverkenning en Natuurverkenning. DLO Winand Staring Centre, Wageningen, The Netherlands (f 25,--).
4. Smit, A.A.M.F.R., M. Leistra and F. van den Berg, 1998. Estimation method for the volatilization of pesticides from plants. DLO Winand Staring Centre, Wageningen, The Netherlands (f 25,--).
5. Leistra, M., 1998. Extent of photochemical transformation of pesticides on soil and plant surfaces. DLO Winand Staring Centre, Wageningen, The Netherlands (f 25,--).