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Pressure of non-professional use of pesticides on operators, aquatic organisms and bees in Belgium

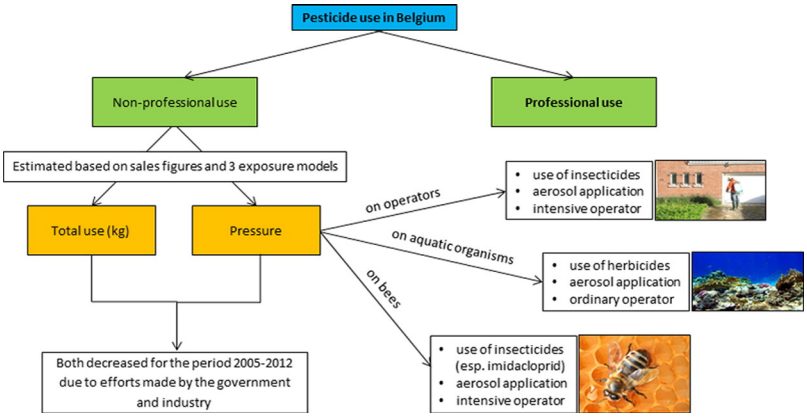
Davina Fevery *, Michael Houbraken, Pieter Spanoghe

Laboratory of Crop Protection Chemistry, Ghent University, Ghent, Belgium

HIGHLIGHTS

- Estimation of total usage and pressure of non-professional pesticide use in Belgium
- More specific: pressure on operators, aquatic organisms and bees
- Based on sales figures and three exposure models
- Both decreased for 2005–2012 due to efforts made by government and industry.

GRAPHICAL ABSTRACT



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ABSTRACT

Various studies focus on professional pesticide use, whereas pressure of non-professional use on human and the environment is often neglected. In this study, an attempt was made to estimate the pressure of non-professional use of pesticides on operators, aquatic organisms and bees in Belgium based on sales figures and by using three exposure models. A classification in non-professional use was made based on type of pesticide, application method and on intensity of non-professional use. Pressure of non-professional use on operators is highest for intensive operators, caused by the use of insecticides in an aerosol spray can. Pressure of non-professional pesticides on aquatic life is mainly generated by the use of herbicides. The aerosol spray induces the highest pressure whereas the trigger application hardly affects operator and environmental exposure. The ordinary non-professional user generates most pressure on aquatic organisms. Pressure of non-professional pesticides on bees is mainly caused by the use of insecticides, especially the active substance imidacloprid in combination with the aerosol spray can application method applied by an intensive operator. In general, both total usage (kg) and pressure of pesticides decreased for the period 2005 to 2012 due to efforts made by the government and industry. The results of this study suggest to pay special attention to aerosol spray applications and the non-professional use of insecticides.

* Corresponding author at: Coupure Links 653, 9000 Ghent, Belgium.
E-mail address: davina.fevery@ugent.be (D. Fevery).

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1. Introduction

Directive 2009/128/EC, 2009b (Article 4) of the European Parliament and of the Council of 21 October 2009 established a framework for community action to achieve a sustainable use of pesticides. It imposes the Member States of the European Union (EU) to introduce National Action Plans while setting quantitative objectives, measures and timelines to reduce risks for human health and the environment. This directive splits authorizations into two groups of users, i.e. professional and non-professional users. A professional user is defined as any person who uses pesticides in the course of their professional activities, including operators, technicians, employers and self-employed people, both in farming and other sectors (i.e. agricultural and non-agricultural users). A non-professional user on the other hand does not meet the definition of a professional user, i.e. amateur gardeners. Only ready-to-use products like aerosols and triggers and products to be diluted or dissolved in water can be authorized for non-professional use. Products that should be combined with any other product, can only be authorized for professional use (Grey et al., 2006; FOD, 2009). According to the European Commission (EC), pesticides include plant protection products and biocides (Directive 2009/128/EC, 2009a, Article 3). Pesticides evaluated in this paper however only include substances described as plant protection products (PPPs) in European legislation (Regulation (EC) No 1107/2009, 2009). These products are applied on plants as crop protection products. The term plant protection products (PPPs) will be used throughout this paper.

Plant protection products are useful in many professional non-agricultural settings in Belgium, including gardens, parks, public spaces, sport fields and outdoor leisure areas. They also help the functioning of transportation corridors such as road shoulders, airport runways and railway tracks, as well as industrial sites and drainage infrastructure. Furthermore, non-professional areas of ornamental plants and lawns also need protection against harmful pests and diseases. Householders and amateur gardeners, known as non-professional users, use products to protect plants, to grow fruits and vegetables and to control weeds that damage paths and drives (CIEH, 2015; ECPA, 2015). A PPP is only available and authorized as suitable for non-professional use when it carries a minimal risk of exposure to both operator and the environment (Grey et al., 2006; KB 18/02/2010, 2010). The profile of non-professional PPPs is hardly dangerous, i.e. (highly) toxic or corrosive products are not authorized for non-professional use (De Cock and Knaepen, 2008). Although the unit dose of an active substance used by a non-professional user can never be large, the contribution of non-professional users in the overall use of PPPs is nevertheless considerable as a result of the large number of operators. In 2004, 21.7% of all PPPs was used in non-professional settings in Belgium. In 2005, this amount even increased to 25.4% (Pissard et al., 2005; Van Bol et al., 2007; De Cock and Knaepen, 2008).

The use of PPPs varies between professional and non-professional users. A non-professional user is often not acquainted with the used PPPs or not able to deal with the PPPs in an effective way. A non-professional user often takes fewer precautions or does not read the instructions on the PPP well (Mostin, 2007; De Cock and Knaepen, 2008). An observational study in the United Kingdom found that few participants read the label of PPPs, that they often found it hard to understand and that compliance with instruction was low (Weale and Goddard, 1998). A survey conducted in Flanders (Belgium) in 2015 indicated that 44% of non-professional users found the label of non-professional PPPs not clear enough (Fevery et al., 2015a). In general, non-professional users of PPPs are less cautious than professional agricultural users (De Cock and Knaepen, 2008; Rushton and Mann, 2009). Recent studies have generated data that identify potential dermal and inhalation exposure during the application of non-professional PPPs (Sanborn et al., 2004; Harrington et al., 2005; Grey et al., 2006; Lessenger, 2006; Rushton and Mann, 2009; Sanborn et al., 2012). According to Harrington et al. (2005) potential exposure to non-professional PPPs is highest during mixing and loading, and this mainly at the height of the hands and chest. Furthermore, exposure during application is negligible compared to exposure during mixing and loading (Van Hemmen, 1992). The product formulation (liquid, powder, granule, etc.) also influences the potential exposure to non-professional PPPs. The use of liquids for example may result in dermal contact, while the use of powders could cause inhalation exposure (Tyvaert et al., 1999). All of these elements can lead to an increase of the health risk for non-professional users (Waichman et al., 2007).

Due to the non-specificity of PPPs and losses during application, a portion of the applied PPP ends up in non-target areas, e.g. surface water (VMM, 2015). The quality of surface water is very important for aquatic life. Too high concentrations of PPPs may be toxic to aquatic organisms. Annex X of the Water Framework Directive specifies a number of priority substances (including some herbicides) that pose a risk to the aquatic environment (Directive 2008/105/EC, 2008). Surface water measurements by the Flemish Environment Agency (VMM) indicate that many active substances exceed the water quality standards in Flanders (Belgium), which can lead to acute or chronic effects on aquatic life. Especially herbicides prove to be problematic to aquatic life (VMM, 2015). The portion of PPPs by non-professional use in surface waters should be seen in perspective of the professional agricultural use. A study on household glyphosate use and its major metabolite aminomethylphosphonic acid (AMPA) in surface water drains illustrates the contribution of non-professional use. The study concludes that when glyphosate is used correctly, contribution from non-professional users of PPPs is very small compared to professional use (Ramwell et al., 2014).

Bumblebees and honeybees are wide-range pollinators. They are not only essential in ecosystems but also of crucial importance for seed and fruit production in many agricultural crops (Fuchs and Muller, 2004; Parmentier et al., 2014). Given their considerable importance, the apparent global decline of pollinators has led to growing concern (Ghazoul, 2005; Goka, 2010; Potts et al., 2010; Szabo et al., 2012; Parmentier et al., 2014). This decline seems to be a result of several causes, i.e. habitat degradation, pests and diseases, pollution and PPP use (Ghazoul, 2005; Mommaerts et al., 2010; Potts et al., 2010; Szabo et al., 2012; Whitehorn et al., 2012; Parmentier et al., 2014). Although PPPs have a negative impact on bumblebees at the individual or colony level, Szabo et al. (2012) determined that PPPs are not a main contributor to declines of these species when their entire ranges are considered. On the other hand, according to Mommaerts et al. (2010), certain concentrations of PPPs that are not lethal for bees can have a negative influence on their foraging behavior. Especially neonicotinoid insecticides are known to negatively affect the foraging behavior of bees (e.g. imidacloprid). These insecticides occur at trace levels in nectar and the pollen of crop plants (Whitehorn et al., 2012). Since 2013, non-professional use of neonicotinoid insecticides is prohibited (Commission Implementing Regulation (EU) No 485/2013, 2013).

Various studies focus on professional use of PPPs, whereas pressure of non-professional use is often neglected. In this study, an attempt was made to estimate the pressure of non-professional PPP use on operators, aquatic organisms and bees. Exposure of operators and the environment to non-professional PPP use was illustrated based on sales figures of non-professional PPPs. Furthermore, pressure of non-professional use of PPPs was calculated by using various indicators for the period 2005–2012.

2. Materials and methods

2.1. PPP sales figures

In order to calculate the pressure of non-professional PPP use, data concerning their use were collected. Reliable data on usage of PPPs are critical for the development of indicators of the effects of PPPs on