INFRASTRUKTURA I EKOLOGIA TERENÓW WIEJSKICH
INFRASTRUCTURE AND ECOLOGY OF RURAL AREAS

No IV/3/2017, POLISH ACADEMY OF SCIENCES, Cracow Branch, pp. 1867–1876
Commission of Technical Rural Infrastructure

DOI: http://dx.medra.org/10.14597/infraeco.2017.4.3.141

STATE OF THE ENVIRONMENT, HEALTH AND SAFETY AND PRINCIPLES OF APPLICATION OF PLANT PROTECTION PRODUCTS

Przemysław Przygodziński, Piotr Rybacki, Andrzej Osuch, Ewa Osuch
Poznań University of Life Sciences

Abstract

The aim of the study was to analyse the state of environmental, health and safety rules (EHS) during the use of plant protection chemicals with regard to residues and packaging procedure, based on applicable regulations. The results obtained from the farms of the Wielkopolska Region were analysed. Its results prove failure to comply with applicable health and safety regulations (majority of users do not use personal protective equipment) and rules for handling and dealing with liquid chemicals. The use of plant protection chemicals is in most cases, carried out by sprayers subjected to periodic technical inspections.

Keywords: plant protection chemicals, liquid chemicals, health, environment

INTRODUCTION

One of the key factors in the modern farming process is the usage of the crop protection chemicals. Their goal is to protect plants and eradicate weeds, diseases and vermins. Plant protection chemicals consist of active substance, safeners and synergists which have general or directed influence on living organisms, plants, their parts and products (Dz.U. 2013 poz. 455). They can be used preventively or actively and are able to control metabolic processes along with the environment by modifying the growing conditions during vegetation. The

use of plant protection chemicals is widespread not only in wholesale productions but also in amateur vegetable and flower gardens.

According to Urban (2014), Poland noted a 36% increase of plant protection chemicals use during the years 2005-2012. The scale of using plant protection chemicals has a decisive meaning when judging the impact on the environment, consumer health and users, both professional and amateur.

Advantages of using plant protection chemicals are clear and undeniable because they allow us to increase the production to a level which satisfies our needs.

AIM, RANGE AND METHOD OF RESEARCH

The aim is to determine the EHS (Environmental and Health Safety) levels in farms, while using plant protection chemicals, and the procedures for leftovers and packaging.

In order to reach the aim, an anonymous survey has been conducted among 202 farmers from Wielkopolska Region which contained questions listed below:

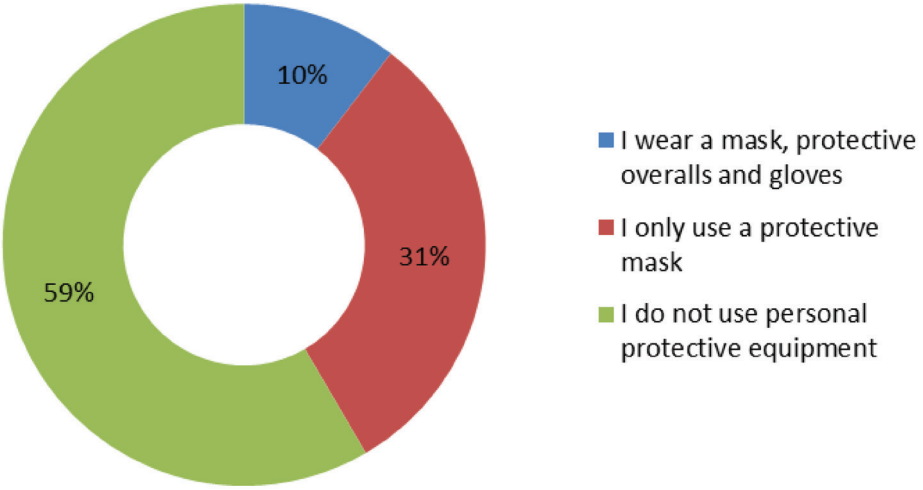
1. Do you use personal protection measures while using plant protection chemicals?
2. How do you store plant protection chemicals?
3. Does your field sprayer undergo periodic maintenance?
4. What is your procedure with the leftover concentrated liquid?
5. What is your procedure with waste created by cleaning the field sprayer?
6. What is your procedure with packaging of the plant protection chemicals?
7. What is your procedure with overdue or useless plant protection chemicals?

Inseparable danger coming from the use of plant protection chemicals is their toxicity for a human. The way how the chemicals work can be either destructive or disruptive depending on the type of the chemical and the organism it influences. Taking into consideration the reaction of the organism to toxicity we distinguish two groups of effects: short and long terms (IMW 2012). The second group of results is incredibly hard to diagnose because of other factors affecting an organism. Some of the long terms results are tumours, genetic mutations and nervous system pathology etc.

A user is endangered by the chemicals through their contact to:

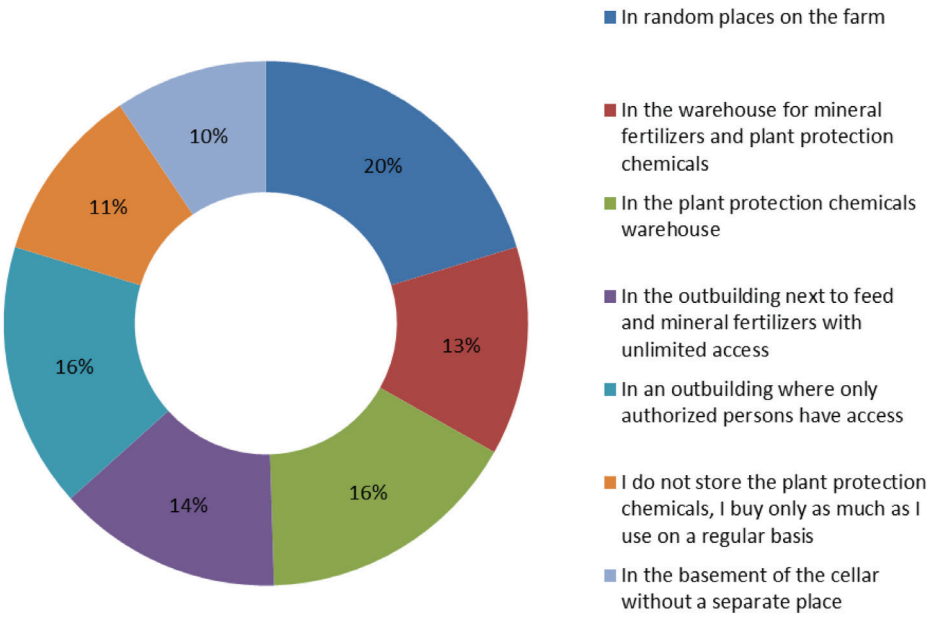
- skin and mucous tissue,
- respiratory system,
- digestive system.

Taking into account the above, the most important is to use protective clothes, proper shoes, gloves and face protection which includes masks (Doruchowski 2012). According to the research, the majority of farmers (59%) do not use any protective accessories or use it only partially (31%) as specified in Figure 1.



Source: Author's own study

Figure 1. The use of personal protective equipment

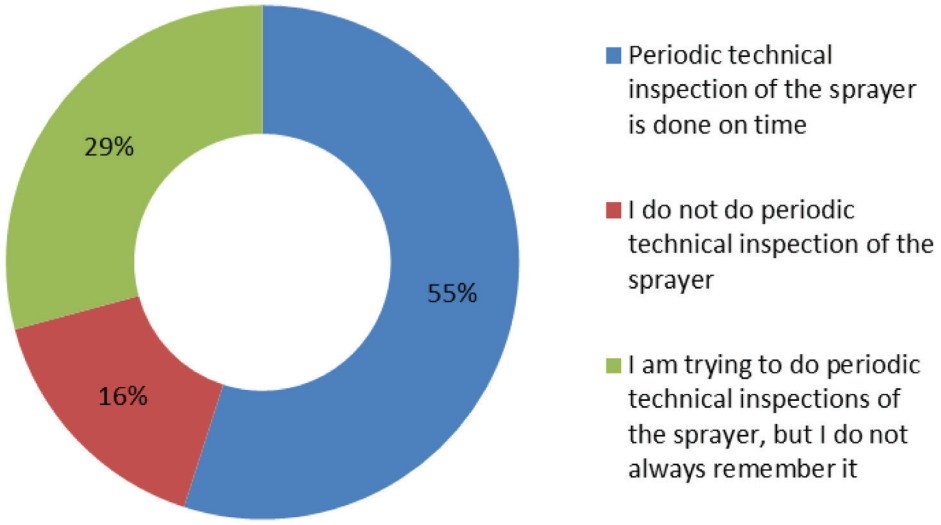


Source: Author's own study

Figure 2. Storage of pesticides on the farm

Low awareness of the potential dangers which occur during a direct contact with the chemicals creates the wrong approach. The direct contact with skin without protective gloves creates a serious risk for health because of high concentration of a hazardous substance. The lack of protective mask, especially while dealing with powder based chemicals, brings the potential danger of inhaling a substance and irritating mucous tissue. Regulation that refers to the controlling, the use and storage of plant protection chemicals is The Regulation of the Agricultural Minister from 24th June 2002 on EHS while using and storing of plant protection chemicals, mineral fertilizers and organic-mineral fertilizers (Dz.U. 2002 nr 99 poz. 896).

Storage of the plant protection chemicals brings also the risk for the environment. The fundamental principle of security is to choose the right place with access limited to authorized and trained people. Moreover, storing should be done according to producers advices and the place should be properly labelled and have a restricted access for children. As shown in the results of the research, storing place is usually random and not adjusted to the potential dangers. Figure 2 indicates that 20% of the farmers store their chemicals in random places at a farm.



Source: Author's own study

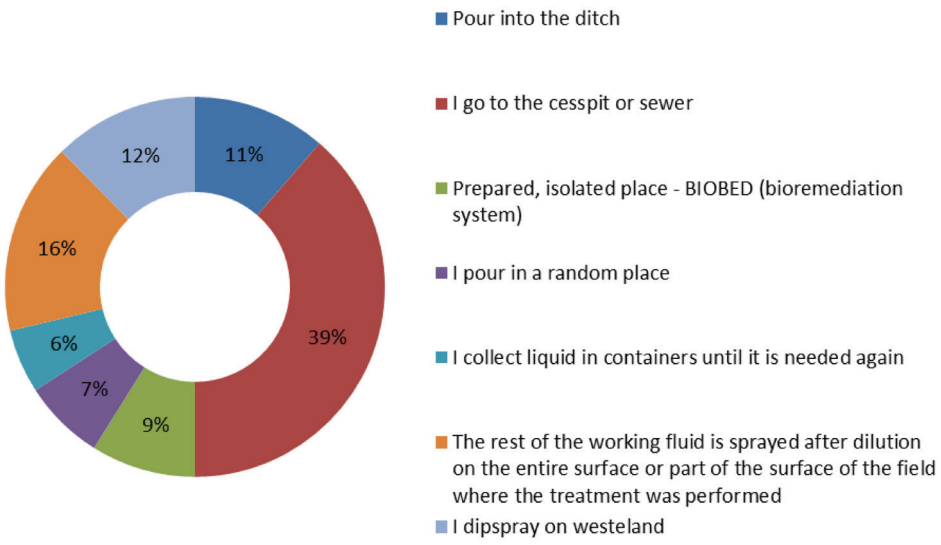
Figure 3. Doing of periodic maintenance

The lack of appropriate storage is probably the result of a limited infrastructure and budget in Polish farms. Farmers apply plant protection chemicals by appropriate equipment; depending on the type of farm there might be used

various types of sprayers e. g. placed on airplanes or helicopters and other vehicles (sprayers). The most common equipment are sprayers towed by a tractor or attached to them but also autonomous sprayers. The proper condition of the equipment is essential in order to minimize the negative impact on people and environment.

All sprayers used for plant protection chemicals at farms have to undergo periodic maintenance by a competent authority. Appropriate condition is a key factor in proper plant protection and safety of the procedure. However, inappropriate application of the pesticides caused by for example the leaks could be dangerous not only for the environment but also for the operator and products consumers. Therefore, the equipment has to undergo a periodic maintenance. The survey shows that the majority (55%) perform this responsibility stated by regulations (Figure 3); unfortunately, this is fulfilled by 29% while 16% never performs periodic maintenance of a sprayer. Lack of supervision in this matter decreases the effectiveness of the plant protection and results in loss in yield while increasing the cost of weed growth prevention.

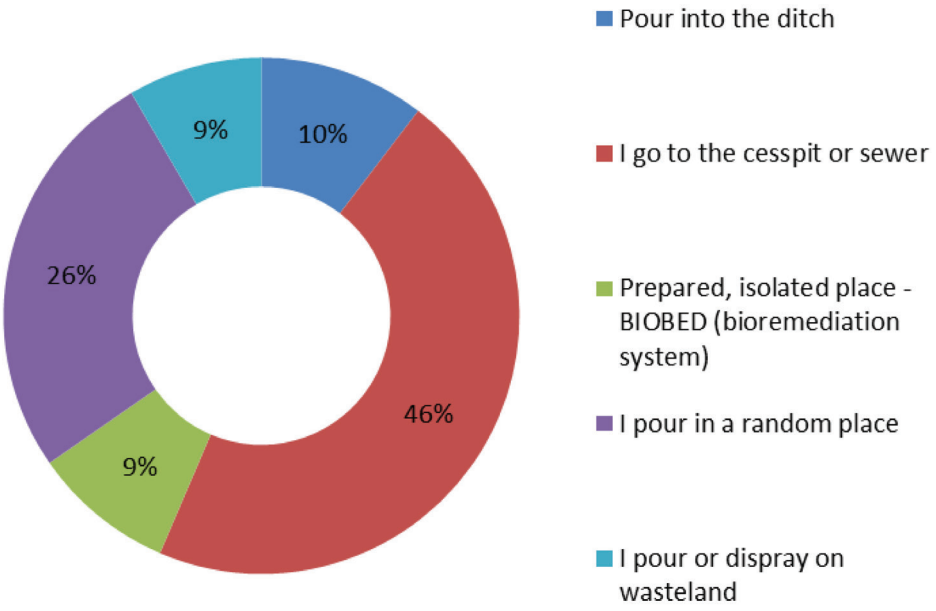
During protective actions, even with a modern field sprayer that calculates and controls the dose of concentrated liquid, it is unavoidable to remain leftovers of the concentrated liquid. The amount varies from few to tens of litters depending on the sprayer.



Source: Author's own study

Figure 4. Methods of dealing with liquid residue

The analysis highlights the lack of awareness among users about the correct dealing with chemical residue. Only a small part follows the rules. The procedure involves diluting the residue and spraying it again over previously applied area, 16% of the surveyed do it. It is acceptable to spill small amount, but no more than few litters, on a pre-made spot with a bio-remedy system (9% of the surveyed). Another way is to store leftovers until next use (6% of the surveyed), however, it should only be done in special conditions and this method is only viable for a short time and with certain pesticides. Spilling in random places or into a sewage system can contaminate groundwater or lead to accidental poisoning of people of animals. Regrettably, over 50% of the responders choose this method (Figure 4).



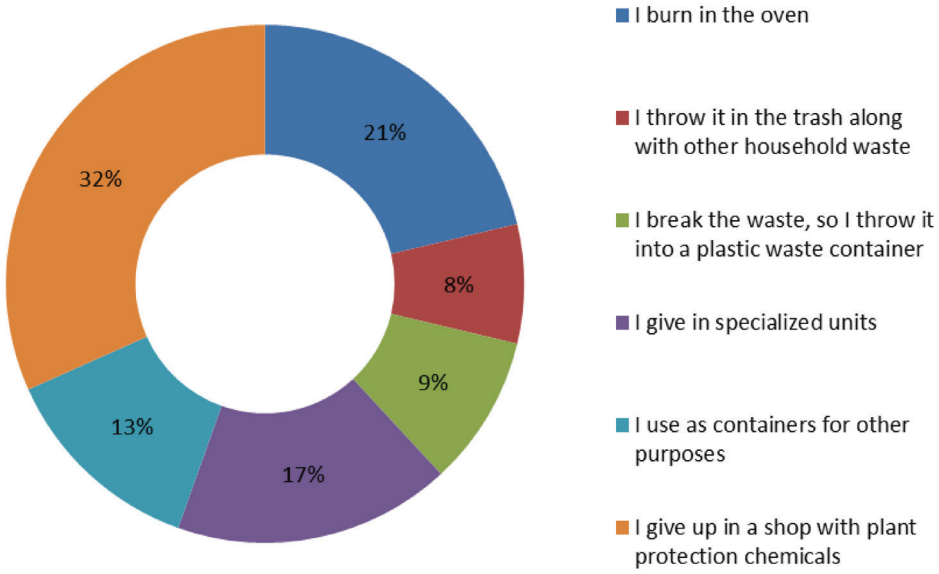
Source: Author's own study

Figure 5. Treatment of waste created by cleaning sprayer

Similar situation applies to waste created by cleaning sprayers (Figure 5). The minority of the respondents is conscious about the need to adjust a farm to protective procedures toward plants. The proper place to clean a field sprayer is a specially designed station equipped with bio-remedy system BIOBED (Świechowski *et al.* 2011). Other treatments bring immediate danger to people and animals and cause environmental degradation.

Lack of appropriate stations with BIOBED system is probably connected with unfavourable financial conditions of farms. Many Polish farms do not

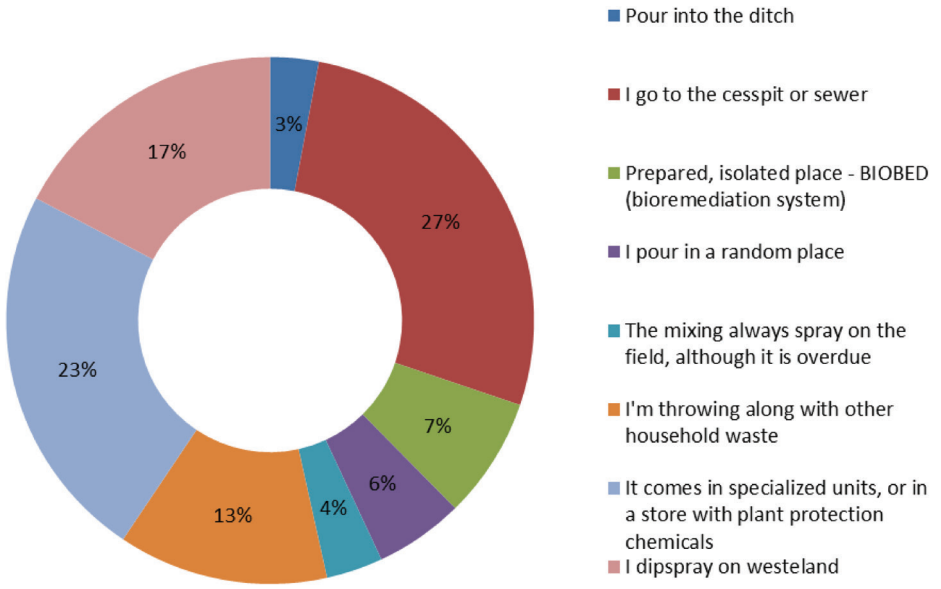
have sufficient funds for necessary investments (Muzalewski 2000, Osuch 2015, Osuch *et al.* 2015a, Osuch *et al.* 2015b). Almost half of the investigated group (49%) declares that they return empty packaging to distribution centres or specialised subjects (Figure 6). But, it is a small part considering the danger pesticide packaging cause.



Source: Author's own study

Figure 6. Methods of dealing with the packaging

Almost 32% of the surveyed returns packaging back to the place of purchase. It is partially dictated by the existence of a return deposit. The rest of respondents perceive packaging as communal waste and burn them (21%) or throw away (8%). Moreover, 12% of the asked treat them as containers for other substances used on a farm not taking into account the possible danger of chemical reactions. It could lead to poisoning through respiratory system and the effects might be visible after a long period but not to be associated to improper actions. Packaging of plant protection chemicals and overdue chemicals are considered ‚hazardous material'. The Act of Managing Packaging and Packaging Waste from 13th June 2013 regulates packaging management responsibilities of plant protection products (Dz.U. 2013 poz. 888). Membership of Poland in European Union creates a responsibility for reducing the negative impact of packaging on an environment (Boer and Boer 2007, Osuch *et al.* 2016). That is why it is crucial to adhere to all existing regulations.



Source: Author's own study

Figure 7. Methods of dealing with overdue or unnecessary pesticides

Only 23% of the surveyed acts properly with overdue or unnecessary pesticides by returning them to competent subjects (Figure 7). Such a low share might be connected with the lack of awareness about damaging effects of high concentrated substances. Even though small doses of concentrated liquid can be spilled in station with a bio-remedy system, it is too arduous for the system to neutralise unnecessary or overdue chemicals. They are utilised, by specialised subjects, by incinerating them in temperatures exceeding 1200°C (Doruchowski *et al.* 2014). Increasing awareness in this area is mandatory and a proper method of utilising unnecessary or overdue chemicals by handing them to specialised subjects does not cause additional costs to farmers.

CONCLUSIONS

The research and analysis allows forming certain conclusions:

1. Knowledge and awareness about EHS, among farmers, while using pesticides is not satisfactory despite mandatory training. Such state could have negative influence on users' and consumers health not to mention natural environment.

2. Both residue of concentrated liquid and waste created by cleaning sprayers are neutralised improperly which is probably a result of low level of knowledge and limited funds for investments.
3. Despite the legal obligation to carry on a periodic maintenance on field sprayers, many machines are not subjected to technical inspection, or the maintenance is overdue. This could lead not only to a negative influence on the environment but also lower the effectiveness of protective treatments.
4. Users of plant protection chemicals, in majority, do not utilise properly packaging or overdue chemicals. Information campaign should be held in order to raise awareness about ways to utilise aforementioned waste.

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Corresponding Author: Eng. Przemysław Przygodziński, MSc
Poznań University of Life Sciences
The Institute of Biosystem Engineering
ul. Wojska Polskiego 50, 60-637 Poznań
E-mail: p.przygodzinski@up.poznan.pl

Eng. Andrzej Osuch MSc
Poznań University of Life Sciences
The Institute of Biosystem Engineering
ul. Wojska Polskiego 50, 60-637 Poznań
E-mail: andrzej.osuch@up.poznan.pl

Eng. Piotr Rybacki, Phd DSc
Poznań University of Life Sciences
The Institute of Biosystem Engineering
ul. Wojska Polskiego 50, 60-637 Poznań
E-mail: rybacki@up.poznan.pl

Eng. Ewa Osuch, PhD
Poznań University of Life Sciences
The Institute of Biosystem Engineering
ul. Wojska Polskiego 50, 60-637 Poznań
E-mail: ewa.osuch@up.poznan.pl

Received: 04.05.2017
Accepted: 01.12.2017