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Application of the Zürich-methodology for risk assessment concerning the inspection of pesticide application equipment in use according to article 8 (3) of Directive 2009/128/EC at the example of Germany

Anwendung der Zürich-Methode zur Risikobewertung hinsichtlich der Kontrollpflicht von in Gebrauch befindlichen Pflanzenschutzgeräten nach Artikel 8 (3) der Direktive 2009/128/EC am Beispiel von Deutschland

Abstract

Article 8 of Directive 2009/128/EC (Sustainable Use Directive) demands a risk assessment for human health and the environment in order to apply different time tables and inspection intervals in selected cases for the inspection of pesticide application equipment (PAE) in use or make exemptions from inspection within the member states of EU 27. The experts of the SPISE (Standardised Procedure for the Inspection of Sprayers in Europe) Technical Working Group agreed on their meeting in March 2015 to use the Zürich-methodology as an appropriate instrument to implement the demanded risk assessment in a harmonized manner within the EU 27. The article explains the Zürich-methodology, illustrates its requirements and demonstrates the application of this method at the example of a risk assessment in case of Germany. Furthermore, it shows of what questions still have to be discussed in future by the expert in order to come up with a common and harmonized procedure being applicable for all member states of EU 27.

Key words: Directive 2009/128/EC, Sustainable Use Directive, Pesticide Application Equipment, Risk assessment, Inspection of equipment in use, Zürich-methodology

Zusammenfassung

Die Richtline 2009/128/EC (nachhaltige Verwendung von Pestiziden) fordert in Artikel 8 eine Risikobewertung mit Bezug zur menschlichen Gesundheit und zur Umwelt, um mögliche Ausnahmen bei der Kontrollpflicht für in Gebrauch befindliche Geräte umzusetzen. Diese Ausnahmen können nur für bestimmte Gerätearten angewendet werden und können zu alternativen Zeitplänen und Kontrollabständen oder auch insgesamt zum Wegfall der Kontrollpflicht bei einigen Gerätearten führen. Auf dem Treffen der SPISE (Standardised Procedure for the Inspection of Sprayers in Europe) Technical Working Group im März 2015 einigten sich die Experten darauf, die Zürich-Methode als ein geeignetes Instrument zur harmonisierten Risikobewertung in allen EU 27 Mitgliedsstaaten für diesen Fall heranzuziehen. Dieser Beitrag erklärt die Methode, zeigt ihre Anforderungen auf und demonstriert sie am Beispiel der in Gebrauch befindlichen Pflanzenschutzgeräte in Deutschland. Darüber hinaus wird aufgezeigt, welche Fragen zukünftig noch von den Experten beantwortet werden müssen, um ein europaweit harmonisiertes Verfahren anwenden zu können.

Stichwörter: Directive 2009/128/EC, Sustainable Use Directive, Anwendungsgeräte für Pestizide, Kontrolle von in Gebrauch befindlichen Geräten, Zürich-Methode

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Accepted
24 August 2015

Introduction

Article 8 (3) of Directive 2009/128/EC (Sustainable Use Directive – SUD) demands a risk assessment for human health and the environment in order to apply different time tables and inspection intervals in selected cases for the inspection of pesticide application equipment (PAE) in use. These exemptions in regard to different time tables and inspection intervals are concerning PAE

- not used for spraying pesticides,
- which are handheld application equipment,
- knapsack sprayers,
- or additional PAE that represent a very low scale of use.

Furthermore, if operators are trained for the proper use and about the specific risks linked to the application of handheld PAE and knapsack sprayers, these groups of PAE may be exempted from inspection.

A still unanswered question is how to exercise the mentioned risk assessment in a practical and harmonized manner on European level. In this context the risk matrix according to NOHL and THIEMECKE (1988), also known as Zürich-methodology, seems to be an appropriate tool to assess the risks related to the utilization of PAE in use. The general idea and suitability of the Zürich-methodology in the context of an assessment of PAE in use was already presented by GANZELMEIER (2012) during SPISE IV Workshop hold in Lana (Italy). Based on this general idea WEGENER (2015) improved this approach under consideration of an equal treatment of all different kinds of PAE and described the general procedure in detail. In 2014 this approach was discussed with several European experts during SPISE V Workshop in Montpellier (France). One result of the discussion was to run through the procedure using statistical material from practice in order to judge about the practicability of this approach. Another important result was that the suggested method to figure out the probability of occurrence-levels needs to be developed further in order to be applicable for all member states since their quantities of equipment within the different groups of PAE vary strongly from country to country. Aim of this paper is to derive a risk assessment based on the Zürich-methodology at the example of available statistics about PAE in use in Germany being applicable for all member states of the EU. A first draft of the improved approach was already presented and discussed in March 2015 during the SPISE Technical Working Group meeting in Braunschweig (Germany). This paper contains the latest status of the discussion and presents some further suggestions for improvement of this method.

Material and Methods

The risk matrix according to NOHL and THIEMECKE (1988) is a common method for technical risk assessment also known as Zürich-methodology. It is applied for the assessment of safety risks of aerial railways or even for the assessment of risks arising from the operation of nuclear power plants. A technical risk is the product of probability of occurrence of a certain failure and the extent of the subsequent damage. These two elements of a technical risk can be presented in a matrix distinguished in different qualitative classes (Fig. 1). Aim of the matrix is to define how high a risk might be.

The advantage of the Zürich-methodology concerning the risk assessment of PAE is that the risk assessment can be reduced to those technical parameters which are the focus of the inspection of PAE in use. This means that parameters being fraught with risks could be eliminated by inspection for that pesticide application equipment being obliged to inspection.

In order to use this approach for the risk assessment of PAE in use the extent of damage was discharged by a qualitative analyses of equipment components being part of the inspection (acc. EN 13790) and their impact in case of technical disorder on human health and the environment. Therefore, each category of PAE has to be judged about the impact of their different components by using qualitative measures. A first attempt was done by GANZELMEIER (2012) and presented during SPISE IV Workshop (Tab. 1). He used the following qualitative measures and quantified them by using a point system: ++ = 20 points, + = 15 points, 0 = 10 points, − = 5 points and -- = 0 points. Afterwards, he formed the sum of each category and ordered the groups by size. In this way the axis describing the probability of occurrence was discharged within the risk matrix (cf., Fig. 1).

The probability of occurrence is normally figured out by taking the number of incidents of each group of PAE into account. Since there are no such statistics available on a national level of all member states (SPISE, 2014) this lack of information has to be solved by taking the number of different PAE used in practice into account since these numbers should be proportional to the frequency of incidents. The numbers of PAE in use (Fig. 2)

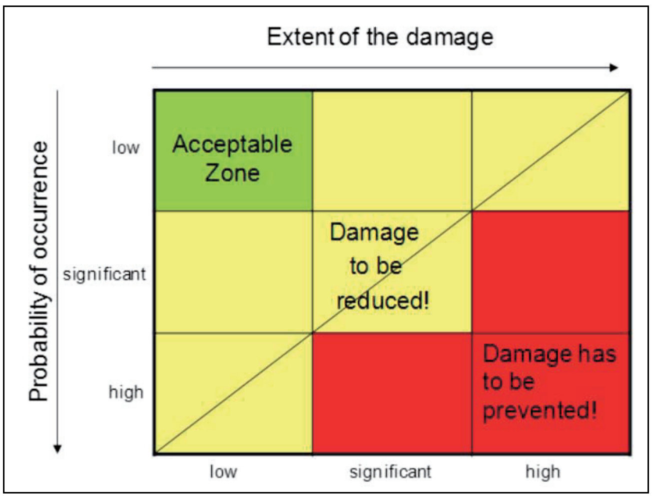

Fig. 1. Risk matrix according to NOHL and THIEMECKE (1988).

Tab. 1. Different categories of Pesticide Application Equipment and the qualitative impact of their components on human health and the environment: ++ = very high, + = high, 0 = average, – = low, -- = very low (Ganzelmeier, 2012)

	Pesticide Application Equipment (PAE)							
Equipment components	Spraying (incl. fogging)	Hand-operated	Not used for spraying	Handheld	Knapsack sprayers	Additional/ low scale use	Additional/ train	Additional/ aircraft
Power transmission parts	++	+	0	--	--	0	+	+
Pump	+	+	+	0	0	0	+	+
Agitation	+	+	0	--	–	–	++	++
Spray liquid tank	++	+	+	--	--	+	++	++
Pipes and hoses	+	++	++	--	--	0	++	++
Spray boom	+	0	0	--	--	–	+	++
Filter	0	0	0	–	–	0	0	0
Nozzles	++	++	+	–	–	0	++	++
Controls	0	0	0	–	0	0	+	+
Regulation systems	+	0	0	–	–	+	++	++
Distribution/drift	+	0	0	–	0	0	++	++
Cleaning	++	0	0	–	–	0	++	++
Blowers	+	–	–	–	–	–	–	–
Sum	**205**	**165**	**150**	**45**	**60**	**125**	**215**	**230**
Priority by sum	**6**	**5**	**4**	**1**	**2**	**3**	**7**	**8**

were defined by Ganzelmeier (2012) into six different levels (level 1 = 1,000 PAE, level 2 = 2,000 PAE, level 3 = 5,000 PAE, level 4 = 10,000 PAE, level 5 = 20,000 PAE, level 6 = 50,000 PAE). An unanswered question during SPISE IV was how to define the risk tolerance line. Therefore, Wegener (2015) expanded the matrix by multiplying each category of PAE (1–8) with each probability of occurrence level (1–6). Afterwards, in order to have an equal treatment of all PAE considered, the legal exemptions mentioned within article 8 (3) of the SUD concerning the necessity of inspections were drawn into the matrix (Fig. 2, green and red boxes). At the end the risk tolerance was generally defined by taking into account the highest acceptable risk which was calculated within the green box (Fig. 2, purple box).

Fig. 3 shows the general risk matrix established based on the aforementioned considerations. Within the red zone one can find all cases within the matrix being either above the risk tolerance level of 12 or being within the group of PAE where inspection is mandatory due to the legal statements of the SUD. The green zone represents those cases which may be exempted from inspection if

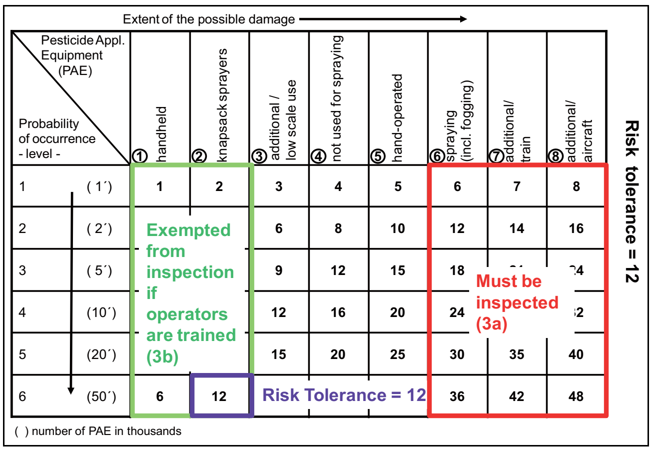

Fig. 2. Risk tolerance based on Sustainable Use Directive (Wegener, 2015).

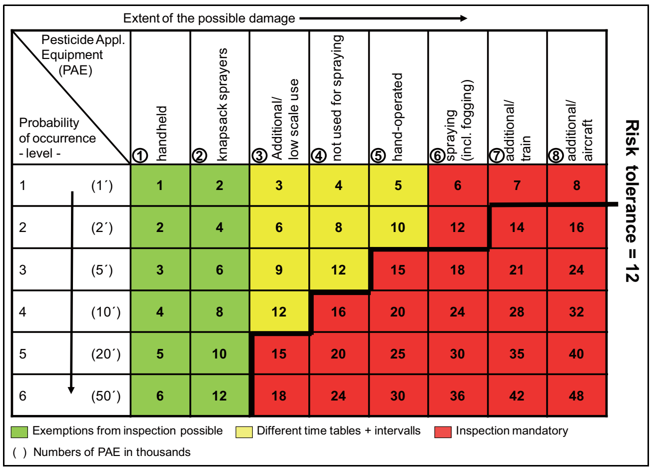

Fig. 3. Risk matrix for the need of inspection of different categories of PAE (Wegener, 2015).

operators are trained, whereas the yellow zone represents those cases where different time tables and inspection intervals can be applied.

Within a discussion during SPISE Technical Working Group meeting in Braunschweig (Germany) in March 2015 some more suggestions were made in order to improve the methodology and to make it universal for all member states. It was agreed

1. to consider within the matrix that the order of the PAE categories is non-linear concerning the individual sum of the calculated extend of damage (e.g. Tab. 1, last line),
2. to have a linear scale for the probability of occurrence levels, and
3. to find an appropriate method for scaling the probability of occurrence levels being representative for all member states within the EU.

Concerning the first point the methodological improvement can be made by adopting the sum of each category of PAE from Tab. 1 into the first line of the matrix, representing the first level of probability of occurrence. Then, these figures can be multiplied within the matrix by the number of levels considered in total.

The second and third point can be solved by relating the country-specific number of PAE of each group to the total area under cultivation for each country. This approach considers differences between member states concerning their individual structures of the agricultural sector within the EU. It follows the hypothesis that a state with a high amount of small scale farms having more PAE per e.g. one million of hectares of agricultural used land has a higher risk for incidents compared to a state with a lower amount of PAE per one million of hectares. The definite scale for the probability of occurrence levels and its linear division can only be determined finally when all of the statistical data-sets for EU 27 are collected.

Risk Assessment at the example of Germany

In order to apply the Zürich-methodology for the risk assessment of PAE at the example of Germany an expert survey was started during the period from December 2014 to March 2015. Thirteen experts from the Federal Plant Protection Services (not considered were the City-states of Bremen, Hamburg and Berlin) were asked to provide statistical information (if available) or estimations about the numbers of PAE in professional use within the aforementioned eight categories (e.g. Fig. 3) concerning their area of responsibility. Tab. 2 shows the results of the expert survey as aggregated data-set for Germany. Moreover, it shows the amount of machinery for each category of PAE per one million hectares according to the total area of cultivation in Germany in 2013 (= 16.7 million hectares, e.g. Statistisches Bundesamt, 2014).

Results

Taking the numbers presented in Tab. 2 into account the probability of occurrence levels can be aligned by the highest number of PAE per one million hectares (in this case 23,952). In order to have a linear scale the increment of the scale is considered to be 5,000 in this case. All these figures and the above mentioned considerations are incorporated in Fig. 4. The matrix includes the non-linear correlation between the different groups of PAE concerning the extent of damage by adopting the sum of each category (e.g. Tab. 1, last line) within the first probability of occurrence level. These figures are multiplied by the different probability of occurrence levels following within the next lines. The highest acceptable risk being discharged by the number of knapsack

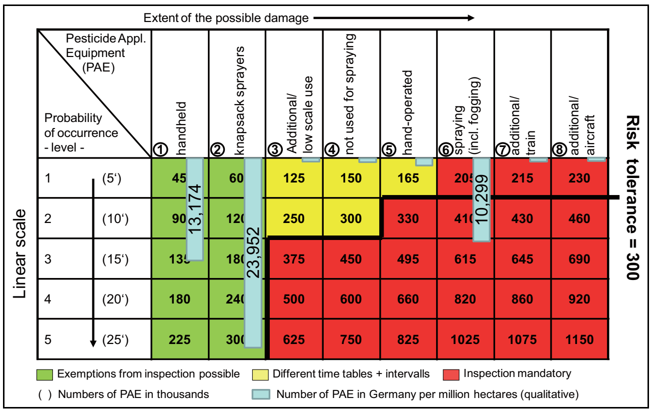

Fig. 4. Risk matrix for the need of inspection of different categories of PAE at the example of Germany.

Tab. 2. Estimated numbers of PAE in professional use in Germany (Wehmann, 2015)

Germany: (16.7 m. ha)	Handheld	Knapsack sprayer	Additional/ low scale use	Not used for spraying	Hand-operated	Spraying (incl. Fogging)	Additional/ train	Additional/ aircraft
PAE	220,000	400,000	5,000	13,500	32,000	172,000	30	8
PAE per m. ha	13,174	23,952	299	808	1,916	10,299	1.8	0.5

sprayers is at the level of 300 and defining the risk tolerance line in this case.

Based on the described procedure and figures the presented risk assessment for the case of Germany would allow different time tables and inspection intervals for the PAE categories "Additional/low scale use", "not used for spraying" and "hand-operated" according to article 8 (3) of the SUD.

Discussion

The presented risk assessment can determine which type of the relevant PAE has a low, a significant and a high risk with regard to human health and the environment from a technical point of view on a qualitative measure. It cannot judge the risk which is coming from unprofessional use of PAE by the operator or due to other not technical circumstances. But, taking into account that the reason for the risk assessment is the question of considering exemptions from inspection, risks other than technical ones cannot be the focus in this context.

The presented methodology takes those technical parameters into account, which are components being checked by inspection (e.g. Wegener, 2015). This approach limits the area of consideration concerning the risks to that one which can be suppressed by a technical inspection. Furthermore, it puts the same criteria to all different categories of PAE so that all of them are treated in an equal way concerning the question if exemptions from inspection are possible or not.

The risk assessment presented here is a qualitative one. It is lacking in accuracy at different steps of the approach due to subjective measures or due to a lack of information which are not existent and could maybe only be roughly estimated. But, the example of Germany demonstrates that the presented Zürich-methodology is applicable if Member States can provide (estimated) national figures about the different groups of PAE in use. The question is, if a more sophisticated approach would really come up with another ranking of the PAE categories within the extent of damage?

What is needed in any case is that an expert panel confirms the qualitative judgement made during the process of the determination of the extent of the damage and that they give a written statement about the specific evaluation of each point which clearly informs about why and how the estimations were made. Unfortunately, there are no notations available justifying the assessment made by Ganzelmeier (e.g. Tab. 1). Furthermore, there are two options for the classification of the figures used for the probability of occurrence-levels which have to be discussed by the experts. One possibility is to have a general risk tolerance line being valid for all European member states. This can be defined not until all numbers of different categories of PAE for all member states are collected. The country with the highest amount of either handheld or knapsack sprayers per one million of hectares would define the total number of probability of occurrence levels within the matrix being necessary and also define the general European risk tolerance line. Another option would be to have country specific risk tolerance lines being discharged at national levels as presented in this study.

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