Sprayer inspection parameters as a basis for risk assessment for human health and the environment

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Introduction

Article §8 (3) of Sustainable Use Directive (SUD) provides 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 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.

In this context the question arises with which methodology such a risk assessment could be done following practical and professional consideration. Some general aspects concerning this topic were already presented by Ganzelmeier (2012).

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.

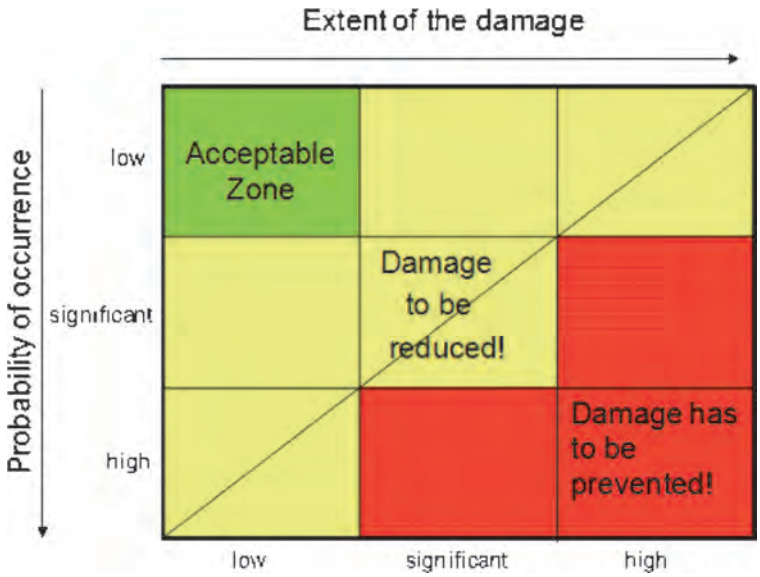

Fig. 1. Risk matrix according to Nohl and Thiemecke (1988).

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. Aim of this contribution is to present and discuss the basic necessities being mandatory for the potential use of the Zürich-methodology in the context of risk assessment for PAE in use in order to achieve a consistent risk assessment methodology within the EU member states. It will be shown how a risk assessment could be done in order to achieve an equal treatment of all PAE on basis of the SUD. Moreover, open questions which need to be discussed by the experts will be elucidated.

Material and Methods

In order to use the Zürich-method for the question of sprayer inspection the extent of damage and the probability of occurrence have to be determined. The extent of damage can be discharged by a qualitative analyses of equipment components being part of the inspection (acc. EN 13790) and their impact on human health and the environment. Therefore, each category of PAE is judged about the impact of their different components by using qualitative measures (Tab. 1). Afterwards, the qualitative results are quantitated by using a point system: ++ = 20 points, + = 15 points, 0 = 10 points, - = 5 points and -- = 0 points. Accordingly, the sum of each category is formed. For the axis describing the probability of occurrence within the risk matrix, at the end the categories are ordered by size (cf., Fig. 2).

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).

Pesticide Appl. Equipment (PAE) / Equipment components	spraying (incl. fogging)	hand-operated	not used for spraying	handheld	knapsack sprayers	additional	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	+	-	-	-	-	-	-	-
	205	165	150	45	60	125	215	230
	⑥	⑤	④	①	②	③	⑦	⑧

The probability of occurrence can be figured out by taking the number of incidents of each group of PAE into account. Unfortunately, there are no such statistics available on a national level of all member states. This lack of information can be solved by taking the number of different PAE used in practice into account, since this is proportional to the frequency of incidents. For these figures even rough estimations could be a basis for this qualitative approach. In the following six different kind of probability of occurrence-levels

were chosen according to the following numbers of PAE in use: 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.

In the next step the discharged extend of damage and the defined probability of occurrence-level are registered in the matrix (Fig. 2). The risk is calculated by multiplying the extent of the damage (1-8) with the probability of occurrence-level (1-6) throughout the whole matrix.

Extent of the damage →

Probability of occurrence - level - / Pesticide Appl. Equipment (PAE)		① handheld	② knapsack sprayers	③ additional / low scale use	④ not used for spraying	⑤ hand-operated	⑥ spraying (incl. fogging)	⑦ additional/ train	⑧ additional/ aircraft
1	(1˙)	1	2	3	4	5	6	7	8
2	(2˙)	2	4	6	8	10	12	14	16
3	(5˙)	3	6	9	12	15	18	21	24
4	(10˙)	4	8	12	16	20	24	28	32
5	(20˙)	5	10	15	20	25	30	35	40
6	(50˙)	6	12	18	24	30	36	42	48

Risk tolerance = 12

( ) number of PAE in thousands

Fig. 2. Risk matrix with calculated risks for each point of the matrix.

To determine the risk tolerance line which defines the difference between those risks which are tolerated (= exemption on inspection) and those which are not tolerated (= no exemptions on inspection) some basic ideas of the SUD have to be taken into account in order to have an equal treatment of all PAE.

Article 8 (3a) designates the categories "spraying (incl. fogging)", "train" and "aircraft" as being mandatory for inspection. This means that they have to be underneath the risk tolerance line. On the other side article 8 (3b) exempts "handheld PAE" and "knapsack sprayers" from inspection, if operators are trained. Taking the discharged risk matrix into account means that the highest risk which can be tolerated without inspection is at the level of 12 (Fig. 3).

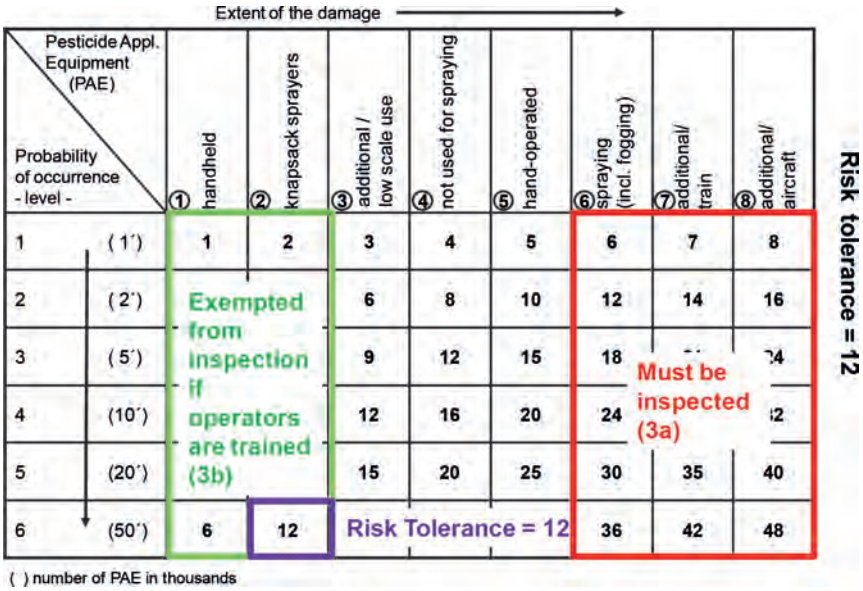

Fig. 3. Risk tolerance based on Sustainable Use Directive (SUD).

Results

The stated risk tolerance line in Fig. 4 divides all the risks being higher as 12 from those which are smaller. There are four exceptions within the categories "spraying (incl. fogging)", "additional/train" and "additional/aircraft" (second and third line). The reason why these are within the red zone is because these categories are as mentioned mandatory for inspection. The green zone represents all PAE which are exempted from inspection according to SUD §8 (3b), if the operators are trained. The yellow zone defines those cases where different time tables and inspection intervals can be applied.

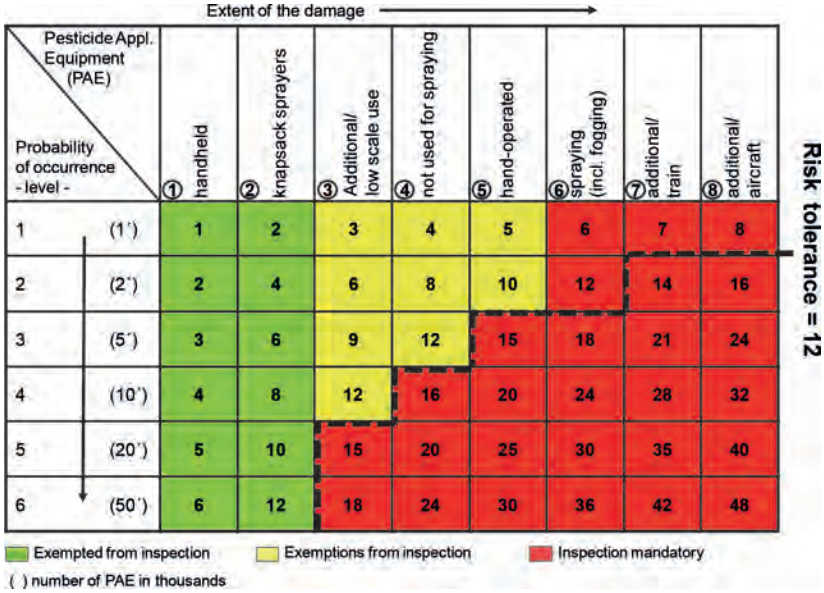

Fig. 4. Risk matrix for the need of inspection of different categories of PAE.

Discussion

The 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. But since we are talking about the necessity of an inspection for certain categories of PAE and inspection does not train the operator, the risk of use cannot be the question.

The presented methodology just takes those technical parameters into account, which are components being proved by inspection. 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 categories of PAE so that all of them are treated in an equal way concerning the question if exceptions from inspection are needed 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. The question is if a more sophisticated approach would really come up with another ranking of the PAE categories as shown in Tab. 1 and Fig. 2? What is needed in any case is that an expert panel confirms the qualitative judgment made in Tab. 1 and gives a written statement about the specific evaluation of each point which clearly informs about the estimations made. Further questions which need to be discussed among the experts of the member states is if the numbers used for probability of occurrence-level are the right standard or not and are their statistics or at least rough estimation available on the level of the member states about the number of relevant PAE in use.

Literature

Nohl, J., Thiemecke, H. (1988): Systematik zur Durchführung von Gefährdungsanalysen. Bremerhaven: Wirtschaftsverlag NW (Schriftenreihe der Bundesanstalt für Arbeitsschutz Fb 536).

Ganzelmeier, H. (2012): Risk assessment for human health and the environment – SPISE Working Group – Proposal. In: Ganzelmeier, H., Wehmann, H.J. (Hrsg.): Fourth European Workshop on Standardized Procedure for the inspection of sprayer – SPISE IV– Lana (South Tyrol), March 27.-29. 2012, p. 94-100.