

NEW APPROACH TO FULFILL ART 8 OF DIRECTIVE 2009/128: A RISK ASSESSMENT PROCEDURE FOR PESTICIDE APPLICATION EQUIPMENT

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ABSTRACT

All pesticide application equipment in professional use shall be subject to inspections at regular intervals according to the EU Directive 2009/128/EC on the sustainable use of pesticides. Article 8.3 allows the Member States to derogate from the mandatory inspection at regular intervals or to apply different timetables and inspection intervals for certain types of pesticide application equipment based on a risk assessment for human health and environment and an assessment of the scale of use. In order to fulfill Article 8.3, a risk assessment protocol was developed in Belgium within the framework of the SIRA-APESTICON project. It is then applied on the Belgian equipment in use. Therefore, risk is evaluated for the human health and the environment. The assessment is based on technical parameters subject to inspections, their occurrences and severities, but also on national scale of use of the PAE types. Results are expressed at different scale levels: the defect, the machine and the country. They also can be used to help in elaboration of new inspection protocols. This new procedure offers guidelines about the necessity to carry out an inspection of every PAE in use.

INTRODUCTION

The EU Directive 2009/128/EC on the sustainable use of pesticides requires that Member States (MS) shall ensure that all Pesticide Application Equipment (PAE) in professional use shall be subject to inspection at regular intervals (Art. 8.1 and 8.2). However, Article 8.3 of the Directive allows the MS to derogate from the mandatory inspection at regular intervals or to apply different timetables and inspection intervals for certain types of PAE based on a Risk Assessment (RA) for human health and environment and an assessment of the Scale of Use. The RA process should demonstrate the usefulness of the inspection to significantly decrease the risk of the use of the PAE. The Belgian method from the SIRA-APESTICON project defines the risk by a combination of two factors: 1. the severities of harm on exposed subjects and 2. the occurrences of hazard. In the context of this work, harm is the consequence of technical defects: over-dosage, under-dosage, or injuries induced by the use of PAE during the pesticide applications. Occurrences of defects are defined by PAE technical inspection. Risk is calculated for the health of the operator, the health of the consumer and for the environment. This paper shows an overview of the results for Belgium.

MATERIALS AND METHODS

Risk is the result of the combination of occurrence and severity of harm: In this case, occurrence is relative to PAE technical defect. They were extracted from the data of 2011, 2012 and 2013 of the Belgian inspection services. Harms result of the hazard and of the way of exposure. In this case, this can be over- or under-dosages or injuries induced by the use of PAE presenting technical defects. Values of severities of harm were defined

based on an international enquiry submitted in particular to European experts from the SPISE (Standardized Procedure for the Inspection of Sprayers in Europe) community.

The risk calculation was made using two methods to combine the severity of harm and the occurrence: “Defects only” or “Defects + residual risk”. Formulations are given in Table 1. The “residual risk” is the risk induced by potential undetectable (at the inspection) small deficiencies combined with the risk inherent to the use of PAE even without any defect. Risks are calculated at three different scales: 1. the defect individually, 2. the entire machine (sum of defect’s risks) and 3. the country or for all machines of a given PAE type on the national territory, thanks to the factor of scale of use. These scales of use were based on a combination of the frequencies of use (obtained by a national enquiry) of the different PAE types and the weight (kg) of pesticide potentially applied. Sales of active substances in Belgium (kg) were selected for the years 2011, 2012 and 2013 from the Eurostat database. An estimation of the human part of risk (behaviour of the operator) can be added to the technical risk to obtain a total risk of pesticide application. Therefore, the partition between the technical part and the human behaviour part of risk (% of a total risk) was determined by an enquiry submitted to European experts. Each risk calculation is performed “before” and “after inspection”. In one hand, “Before inspection” illustrates the presence of a defect, above tolerance level of inspection and without defect correction. In another hand, “After inspection” illustrates a defect repaired regarding the inspection tolerance level or an absence of defect. The objective is to evaluate the potential risk reduction induced by the inspection.

Table 1. Calculations used to apply the RA in Belgium. Two methods: Defects only and Defects+residual risk. Scales: defect, machine, Belgium, Belgium+human part. Two situations: before technical inspection and after technical inspection

Method	Calculation before technical inspection	Calculation after technical inspection
“Defects only” at the scale of the defect	$occurrence * severity_{before}$ $= Risk_{defect.before}$	$occurrence * severity_{after}$ $= Risk_{defect.after}$
“Defects only” at the scale of the machine	$\sum Risk_{defect.before}$ $= Risk_{machine.before}$	$\sum Risk_{defect.after}$ $= Risk_{machine.after}$
“Defects + residual risk” at the scale of Belgium	$(\sum Risk_{defect+resi.before}) * scale_of_use$ $= Risk_{Belgium.before}$	$(\sum Risk_{defect+resi.after}) * scale_of_use$ $= Risk_{Belgium.after}$
“Defects + residual risk” at the scale of Belgium, + human part	$(Risk_{defect+resi.before}) * scale_of_use * partition_human_vs_technical_part$ $= Risk_{Belgium+human.before}$	$(Risk_{defect+resi.after}) * scale_of_use * partition_human_vs_technical_part$ $= Risk_{Belgium+human.after}$

RESULTS AND DISCUSSION

Defects only, scale of the defect

At the scale of the defect, risk values are very useful to elaborate new inspection protocols. As they are defined before and after inspection, they inform about the risk reduction obtained by the inspection of every individual parameter. Differences in risk values are observed between defects meaning that some defects give harms more severe than others and/or that some defects occur more often than other. For a given defect, the risk varies from a PAE type to another with the variation of occurrences between PAE types. The defects for which the risk before inspection is close to zero could be exempted from inspection. By example, for the pressure deviation because of a defect in a section, the risk is below 0.025 before inspection. The defects that present the biggest risks should be inspected. For example, the readability of the tank content indicator has risks values

around 1 before inspection. The decision about inspection of a defect can also be influenced by the risk reduction induced by inspection. For example, the risk reductions induced by the replacement of an absent tank filling strainer are among the most important (-67% for the operator). In another hand, for example the nozzles individual flow rate has lowest risk reductions (-37% for the operator).

Defects only, scale of the machine

A direct effect of inspection can be observed with the method “defects only”. Analysis at the scale of the machine could be useful to evaluate the risk for the operator who is exposed to only one machine at a time. A graphic illustration is given for knapsack sprayers in Figure 1. Variations of risk values can be noticed between subjects at risk. Relative risk reduction are calculated on the risk “after inspection” as a percentage of the risk value “before inspection”. The type of defects listed can influence the final risk value because the severities of harm can be higher for some defects than for other defects and because the occurrence can also be higher. The risk reductions at the scale of the machine have to be subject of attention because they directly reflect the effects of a technical inspection. In the case of Belgium, a clear effect of inspection is observed on risk results (risk reduction of about 63%; Figure 1). For decision making, a maximum level of risk could be defined for the operator safety and another maximum level of risk can be defined for exclusion of inspection. Before to be fixed, the maximum values should be subject of discussion by decision makers with taking account of the other risk results (at the scale of the country), of the scale of use and, when justified, of the toxicity of substance applied.

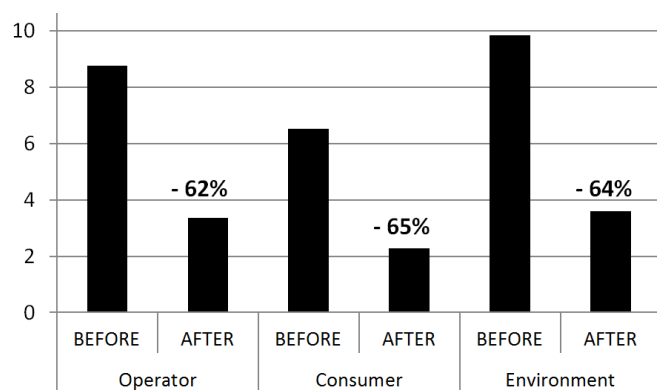


Figure 1. Results of risk calculation in absolute values for Knapsack sprayers. Risks for the operator, for the consumer and for the environment. Scale of the machine, method “defects only”. BEFORE=before inspection; AFTER=after inspection. Risk reduction between BEFORE and AFTER are indicated in percentage.

Defects + residual risk, scale of Belgium (technical risk)

The advantage of the analysis of technical risk at Belgian scale is to obtain a global view on the total technical risk for one PAE type or to compare different PAE types (Figure 2). The differences of risk values between PAE types are mainly due to the scales of use that are specific to each PAE type. In Belgium the field crop sprayers have the biggest scale of use with 78% of the total scale of use. The orchard, knapsack and fixed and semi mobile sprayers have scales of use corresponding respectively to 5%, 7% and 4% of the total. Percentages of risk reductions with the method (“Defect only+residual risk”) are smaller (~10%) than with the method “Defects only” (~65%). This observation is explained by the fact that “residual risks” is equally distributed between “before” and “after inspection” and take a big part in the total risk. Absolute values of risk are above 10 000 (results of

calculation haven't standard unit). The national scale is interesting concerning the risk for the consumer and the risk for the environment because they are targeted by pollution related to broad crop surfaces. For decision making, a maximum level of risk can be tolerated excluding inspection of certain types of PAE.

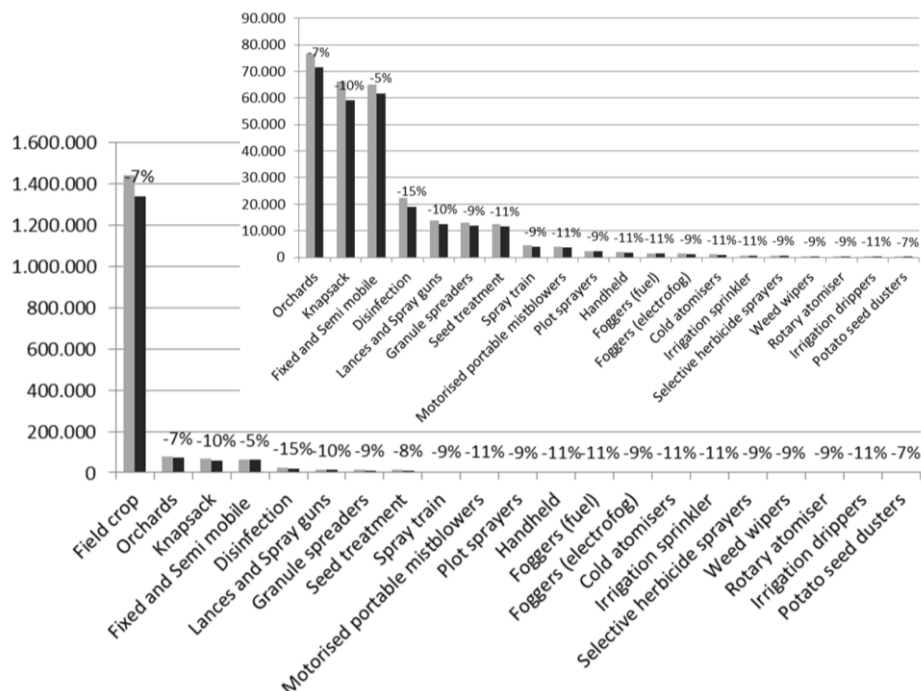


Figure 2. Risks calculated by the method “Defects only+residual risk” at the scale of Belgium for different PAE types (technical risk). Risk values are average of risk for the operator, risk of the consumer and risk for the environment. Grey: risk values before technical inspection; Black: risk values after technical inspection; Values in percentage: risk reductions between the risk before and risk after technical inspection

Defects + residual risk, scale of Belgium (technical and human part of risk)

This last method of risk calculation is interesting to compare pesticide application of the different PAE types (Figure 3). That is the most complete, including defects and residual technical risks, scale of use and human behaviour part of risk. As previously, differences in risk values between PAE types are mainly due to the scale of use. However, risks related to pesticide application are, for some PAE types, more dependent of user's behaviour (e.g.: knapsack sprayers). For other PAE types, as spray train or irrigating systems, the technical part of risk is more dominating. The percentage of risk reduction is very low (~5%) because the residual risk and the human part of risk are added equally to the risks value before and after inspection. The partition between human and technical part of risk could justify the inspection in order to significantly reduce the total risk.

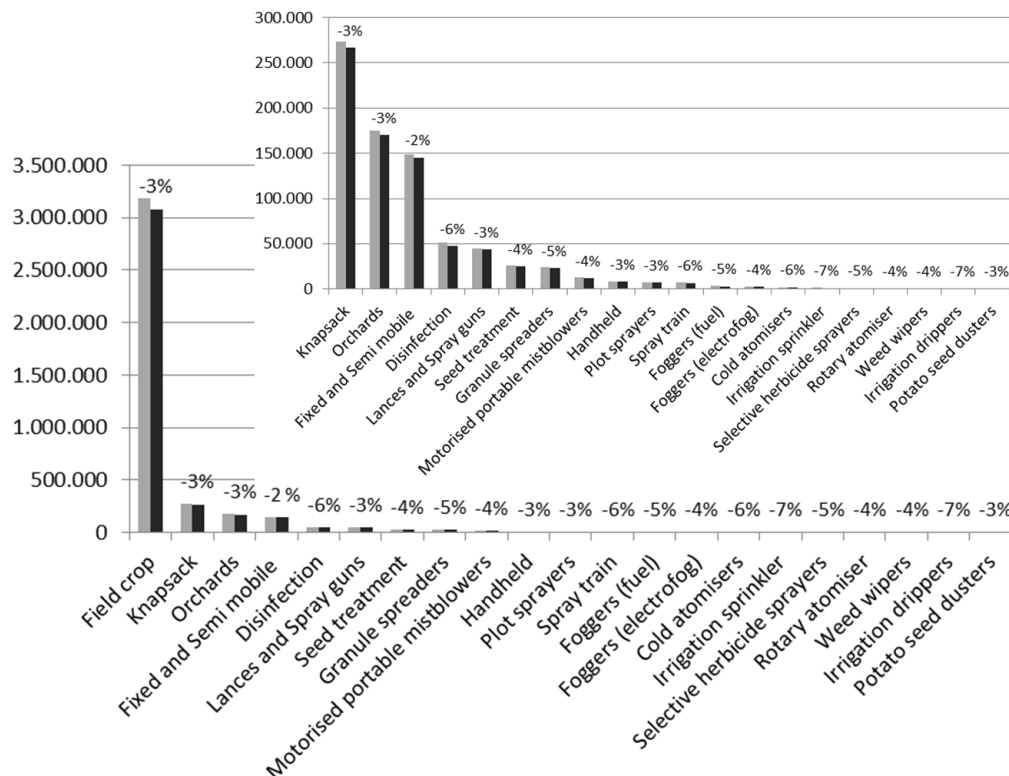


Figure 3. Risks calculated by the method “Defects only+residual risk” at the scale of Belgium for different PAE types and added to the human part of risk (technical risk + human risk). Risk values are average of risk for the operator, risk of the consumer and risk for the environment. Grey: risk values before technical inspection; Black: risk values after technical inspection; Values in percentage: risk reductions between the risk before and risk after technical inspection

CONCLUSION

Results of the method applied in Belgium illustrate the effects of inspection of each PAE type and the variation of scales of uses between all of them. Risks can be calculated for an unlimited number of PAE types. Risk reductions give indication on potential efficiencies of inspection for all PAE types. It distinguished different targets (operator, consumer, and environment) and the results can be obtained at different scales of calculation (the technical defect, the machine or the scale of the country). Absolute values of the risk increase with the scales of calculation. They are around 0-1.5 for the scale of the defect, until 13 for the scale of the machine, until 1 500 000 for the scale of Belgium and until 3 250 000 for the scale of Belgium with the addition of the human part of risk. Risk reductions expressed in percentage are similar trough all PAE types but absolute values of reduction are proportional to absolute value of risks that vary between PAE types. These last are mainly due to the complexity of the PAE and its inspection protocol when analysis is made at the scale of the machine. On the other hand, they are mainly due to scale of use when analysis is made at the scale of Belgium. Risk values and risk reduction values at every step of the risk assessment are strong theoretical basis to support decision making. Regarding risk results, PAE types already inspected in Belgium are those for that inspections are the most useful (field crop, orchard, fixed and semi mobile, disinfection equipment).

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