

The importance of sprayer inspections in the EU from a chemical industry perspective

Manfred Roettel¹; Volker Laabs²; Steward Rutherford³

¹ BetterDecisions, Kandern, Germany

² BASF SE, Agricultural Solutions, Limburgerhof, Germany

³ ECPA, Brussels, Belgium

Summary

The legal requirements for sprayer inspection schemes reflect that Crop Protection has to be seen as a process, which includes the user, the application equipment, the infrastructure and the Plant Protection Product (PPP). EU directives set the legal framework for crop protection product registration and practices. For sprayers, or pesticide application equipment (PAE), the EU Directive on Sustainable Use of Pesticide (SUD), with its focus on risk reduction, requires the implementation of regular sprayer inspection and certified repeated trainings for users, advisers and stakeholders. The EU Machinery directive amendment lists the technical requirements a sprayer should fulfil which include environmental aspects for the first time. Standards are used to define technical performance requirements and how these should be tested. In Europe the CE label certifies that the PAE complies with the harmonized standards. The Crop Protection industry supports the implementation of PAE inspection schemes and supports the main objectives. These cover all aspects of operator safety, to optimize efficacy and to reduce PPP losses and reduce unintended environmental impacts. According to the relevant directive, all sprayers in use should have been tested at least once by 2016, however this has not yet been achieved. Implementation of inspection procedures are not yet well harmonized, which makes it difficult to compare tests results. Current inspections are mainly developed for field crop and bush / tree crop sprayers. Inspections for other types of PAE are generally not available, mainly because the respective technical standards are missing. TOPPS surveys in EU countries show that the need for advice on spraying is considered largely insufficient and varies significantly between EU member states. Countries with many farmers and a large variety of crops in general have higher needs for advice. The established sprayer inspection stations represent a possible opportunity to develop further competences in order to give application advice to farmers. This would require an appropriate training program for the sprayer inspectors, so that advice on e.g. better adjustment of sprayers can be further transferred by them to farmers. PAE will be a key element in further risk reduction requirements and may become more regulated and integrated in crop certification schemes. Therefore, it is necessary to follow comparable and consistent procedures which are both auditable and broadly accepted. The SPISE working groups gather experts from various countries eager to find solutions to the challenges.

Keywords: plant protection, sprayer testing, SPISE, harmonization, EU legal framework, standards (ISO/CEN), certification schemes, risk reduction, PAE

Introduction

Since humans changed their lifestyle about 12,000 years ago and cultivated plants to stabilize their food supply they have been involved in fighting against diseases, pests and weeds. Harvests have historically represented only what diseases, pests and weeds left untouched. The effort to reduce such crop losses to a minimum is what we call crop protection (1). First simple scratch ploughs were used to give the cultivated plants a competitive advantage over the weeds by improving their germination conditions. Weed control was further improved with the invention of ploughs turning the soil about 2000 years ago (e.g. mouldboard plough) (2). Spray applications and dusting for crop protection started in Europe around 120 years ago with the application of copper (Bordeaux Mix) and sulphur against diseases and further natural toxins like nicotine and arsenic to control pests (ref 1, 3). The basic principles for spray applications are mainly the same today: spray liquid in a tank is applied through

nozzles / dispersers with pressure produced by a pump to protect crops. For field applications, the spray reaches the target mainly through gravity forces when downward spraying, while in bush and tree crops additional air support is used to transport the spray to the target by upward and sideward spraying.

Legal Framework for crop protection increasingly focus on the crop protection process

In the last 40 years the regulatory requirements for chemical plant protection products (PPP) in the EU have steadily increased. This has resulted in use restrictions and losses of registrations for many active ingredients. Beside the efficacy and safe use of the PPP for humans, also environmental aspects have gained more importance in regulatory risk assessments. In 2009 two new EU directives were published which focussed on the use phase of the PPP and the application equipment. These are the Directive on Sustainable Use of Pesticides (SUD)(2009/128/EU) and the amendment of the Machinery Directive (2009/127/EC), where environmental aspects related to sprayers are mentioned for the first time and requirements for Pesticide Application Equipment are expressed.

Focus of the SUD (2009/128/EU) is on the use phase of PPP, aiming at risk reduction (4)

The implementation of the following actions are required by EU Member States:

- Set up of National Action Plans (NAPs) containing objectives and timetables to reduce risks and impacts of pesticide use;
- ***Training: Professional pesticide users, distributors and advisors must receive proper training on the safe use and handling of PPP (sprayer licence);***
- ***Establish competent authorities and certification systems for trainings;***
- Minimise or prohibit PPP use where necessary in certain critical areas for environmental or health reasons;
- ***Inspecting application equipment in use: All PPP application equipment should have been inspected at least once by 2016 (except knapsack sprayers) and subsequently at ongoing intervals (3 to 5 years).***

Machinery directive amendment (2009/127/EC) to the directive (2006/42/EC) (5)

The amendment defines specific requirements for crop protection machinery concerning the protection of the environment. All new machines entering the market from 2011 onwards should fulfil the harmonized standards of the machinery directive. Machinery for pesticide application must be designed and constructed in such a way that the machinery can be operated, adjusted and maintained without unintended exposure of the environment to pesticides. To this aim, the following technical requirements are defined in the Directive:

- Controls and monitoring
It must be possible to easily and accurately control, monitor and immediately stop the pesticide application from the operating positions.
- Filling and emptying
The machinery must be designed to facilitate precise filling with the necessary quantity of pesticide and to ensure easy and complete emptying, while preventing spillage of pesticide and avoiding the contamination of the water source during such operations.
- Application of pesticides
The machinery must be fitted with means of easily adjusting the application rate; be designed to ensure that pesticide is deposited on target areas, to minimise losses to other areas and to prevent drift of pesticide to the environment; and be designed to prevent losses/ drips while the pesticide application function is stopped.
- Maintenance
The machinery must be designed to allow easy and thorough cleaning, and to facilitate servicing and changing of worn parts without contamination of the environment.

- Inspections
It must be possible to easily connect the necessary measuring instruments to the machinery to check correct functioning.
- Marking of nozzles, strainers and filters
Nozzles, strainers and filters must be marked so that their type and size can be clearly identified (colour code).
- Indication of pesticide in use
Where appropriate, the machinery must be fitted with a specific mounting on which the operator can place the name of the pesticide in use.
- Instructions (user manual)
The instructions of the application machinery must provide relevant information in order to facilitate correct operation of the equipment and to avoid contamination of the environment, including but not limited to the following:
 - precautions to be taken during mixing, loading, application, emptying, cleaning, servicing and transport operations;
 - detailed conditions of use for the different operating environments envisaged;
 - the range of types and sizes of nozzles, strainers and filters that can be used with the machinery;
 - the frequency of checks and the criteria and method for the replacement of parts subject to wear that affect the correct functioning of the machinery, such as nozzles, strainers and filters;
 - specification of calibration, daily maintenance, winter preparation and other checks necessary to ensure the correct functioning of the machinery;
 - types of pesticides that may cause incorrect functioning of the machinery;
 - an indication that the machinery may be subject to national requirements for regular inspection by designated bodies, as provided for in Directive 2009/128/EC on the sustainable use of pesticides.

Point 7 of the Directive (2009/127/EC) points out the following: "This Directive is limited to the **essential requirements** with which machinery for pesticide application must comply before being placed on the market and/or put into service, while the European standardisation organisations are responsible for drawing up **harmonised standards** providing detailed specifications for the various categories of such machinery in order to enable manufacturers to comply with those requirements."

The harmonized standards support the implementation of the SUD through the definition of the respective functional and technical requirements (6)

Standards

As is common practice in EU technical legislation, accompanying standards have been established by CEN/ISO, compliance with which can be used as one way of showing that the general requirements of the associated directives are met. Standards covering new sprayers ISO 16119 and sprayers in use ISO 16122 have been published specifically for field crop sprayers and orchard sprayers, respectively. These harmonised standards are published in the Official Journal of the EU. Sprayer manufacturers selling sprayers in the EU market are requested to make a risk assessment for their sprayers covering operator and environmental risks, based on applying the harmonized standards. Sprayer manufacturers are responsible for guaranteeing (by means of self certification) that the machinery complies with the relevant requirements, and may then apply the official CE label to the sprayer. So, in principle the CE label can only be applied if the requirements as set out in the machinery directive are fulfilled. Standards are essential because they facilitate the implementation of regulation and contribute to harmonisation between countries. Standards are also a tool which regulation can build on (6).

Article 11 of the Machinery directive states:

"Where a Member State ascertains that machinery covered by this Directive, bearing the CE marking, accompanied by the EC declaration of conformity and used in accordance with its intended purpose or under reasonably foreseeable conditions, is liable to endanger the health or safety of persons or, where appropriate, domestic animals or property or, where applicable, the environment, it shall take all appropriate measures to withdraw such machinery from the market, to prohibit the placing on the market and/or putting into service of such machinery or to restrict the free movement thereof. "

Sprayer inspections concentrate on sprayers which are already in use (ISO 16122), but do not check if new sprayers comply with the harmonized standards. New sprayers are self certified by manufacturers and should show this by means of a CE label (ISO 16119) which is necessary to access the market

New sprayers therefore can enter the market without prior sprayer inspection. Manufacturers represented in CEMA offer a sprayer inspection as an option following ISO 16122 (7). In Germany the first sprayer inspection is required 6 months after purchase, in Austria the first sprayer inspection is required 5 years after purchase. This can have negative consequences for the farmer because after 5 years guarantees from manufacturers are no longer valid if standards are not met. This means that manufactures may not be liable for non compliance with the standard. This also means that the standard for sprayers in use ISO 16122 applies, which only inspects technical features present on the sprayer (8). Yet, new sprayers being placed on the market since 2011 should comply with the harmonized standard ISO 16119. Unfortunately, this is not always the case today. Reports from sprayer inspectors (8) mention examples of cases where new sprayers enter the EU market which do not comply with harmonized standard ISO 16119 (this is particularly the case for sprayers at the cheaper end of the market).

In general, the enforcement level of the machinery directive would benefit from strengthening in most EU member states, and this needs to be addressed urgently.

Although standards exist for field crop sprayers, bush and tree crop sprayers and some fixed, semi mobile sprayers, there is also a lot of specialised application equipment on the market to which no standards apply, and this needs to be addressed as well.

Harmonization of inspection procedures in countries are needed.

It is only the first step to establish EU directives with the overall target to improve PAE and PPP application, which is fully supported. Stronger guidance and support on how more effective implementation could be achieved would be helpful. Inspection procedures in EU member states are variable and do not always deliver comparable results (9). Therefore, testing results can be partly questioned. In this regard, we give credit to the efforts of the SPISE working groups which try to help develop and implement harmonized procedures for sprayer inspection. These efforts need to be better supported to increase their chance for success. Harmonized inspection procedures are also important for increasing their acceptance by farmers and their associations. The cost for the sprayer inspection varies by state and by region, which may also influence the acceptance of sprayer inspections by farmers at local level. A low level of acceptance may also indicate a lacking explanation of the benefits of sprayer inspections by authorities (10). Harmonized inspections are in the interest of the crop protection industry as sprayers are part of the efforts for overall risk reduction, which should support the compliance with regulatory requirements of the PPP.

Crop protection needs to be understood as a process where each step offers opportunities to realize improvements.

The legal requirements, as reflected by the relevant EU Directives, are based on a process view for crop protection, which includes the people involved (e.g. operator), the application technique, and also suitable infrastructure and the PPP. Each element in the process can contribute to the objectives as set

out in the SUD and contribute to sustainable crop protection. Based on experiences from the TOPPS projects (16) we realized that the areas of sprayer configuration and sprayer calibration/adjustment/maintenance represent mostly untapped resources for improving the overall process of crop protection. It is clear from a TOPPS stakeholder/advisor survey 2016 (Fig1) that there is insufficient advice or training for farmers concerning the adjustment and operation of sprayers (11). Currently, relatively few application specialists are active in EU member states and we believe we need to find innovative solutions to expand advice capacity for teaching farmers the correct adjustment of sprayers and on the significance of further application parameters which are relevant for risk reduction.

Can we develop the sprayer inspection schemes further to also provide advice on technical matters and the adjustment of sprayers?

In most countries sprayer inspection is organized through local workshops, where technicians are trained and supervised by an authority (which may be private or state run). In general, the workshops just perform the technical inspection as required in an inspection protocol. Advice to farmers on correct sprayer use and adjustments in practice are usually not provided. These workshops could offer an opportunity, if technicians are correctly trained, to increase the advice capacity concerning the correct use and adjustment of sprayers. Especially the quality of the sprayer adjustment for bush and tree crop sprayers has great potential to improve the overall efficacy and environmental performance of crop protection practices. This often does not require costly technical upgrades of the sprayer. Practical tests in Italy, for instance, showed that just by adjusting orchard sprayers to the correct tree height via selection of the number of nozzles used and their spray direction, that spray drift was reduced by 65 to 70% (12).

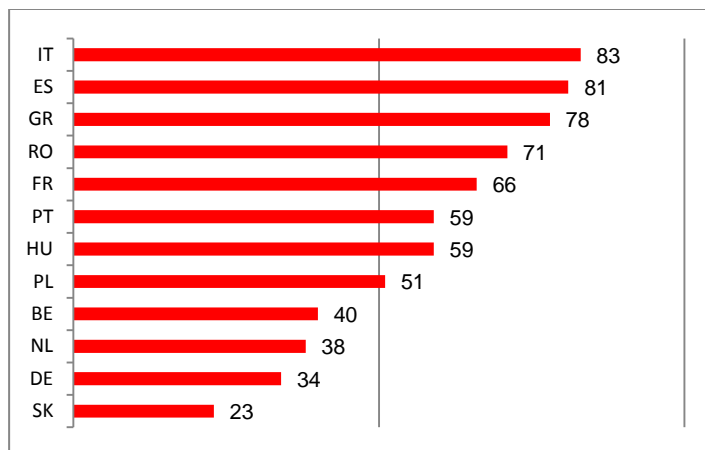


Fig 1.: TOPPS - Stakeholder / Advisor survey 2016; n= 1161

Do you think farmers get sufficient advice to correctly adjusting and using their sprayer ?

(Answer "No" in % of respondents)

Sprayer inspectors can see immediately when they inspect a sprayer how it is adjusted and maintained and therefore are in an ideal position to make a judgment on the needs for advice for the operator of the sprayer. Such an approach would require a dedicated training program for the persons who are running the sprayer inspection to broaden their competencies for providing advice on sprayer adjustment and correct use to farmers. This additional advice or service would also help increase the acceptance of sprayer inspection schemes by farmers, as they would directly experience the benefits for their crop protection practices.

However, such an extension of advice activities by the sprayer inspection organizations might meet some resistance, as it would require additional training and effort. Such an approach could possibly be tested in an EU project involving various partners and countries to identify the main hurdles and also the success criteria. If we are able to combine sprayer inspection and advice on the correct use of the

sprayer we would reach most farmers operating a sprayer and would have a better chance of reaching the objectives set out in the SUD.

A further aspect where sprayer inspectors could give advice is to check as far as possible if the sprayers comply with the harmonized standards. Farmers should be made aware of machines which are non-compliant with current ISO/CEN standards. Sprayers which have entered the market after 2011 and which clearly do not comply with the harmonized standards should not get a label to certify inspection.

STEP-water a joint effort between sprayer manufacturers (CEMA) and crop protection industry (ECPA) to provide information to users on sprayer standards

As a result of the ECPA - TOPPS water protection projects it became clear that a reduction of PPP losses to water needs to consider spray machinery conditions and options to realize further risk reduction (13,14,,) and also that there is scope for possible future improvement in this area. This has stimulated further developments such as the continuous internal sprayer cleaning concept, which is now implemented on some new sprayers and is also applicable via upgrading kits to retrofit older sprayers. In Switzerland, the continuous internal sprayer cleaning is incentivised and there are intentions to make this obligatory in future.

Additional activities focus on providing information tools (websites) for farmers, and evaluating technologies with respect to their risk reduction potentials for improved water protection. Based on an intensive cooperation between CEMA and ECPA, the STEP-water webtool will be launched this year as an information and learning platform for farmers on technologies relevant for sprayer filling, internal and external cleaning, reduction of spray losses, and remnant management. It highlights technologies which are partly covered by harmonized standards and those which can be strongly recommended and which might be established as a standard in future. Such web information tools can help to spread information about standards and technologies to farmers, sprayer dealers, advisers, as well as to technicians performing the sprayer inspections (15).

The current module concentrates on water protection, but it could be extended to also cover e.g. operator safety aspects.

Outlook

Sprayer inspection is needed and should be further developed and supported.

The Crop Protection industry supports the implementation of sprayer inspection as a well-designed and functioning sprayer / PAE is an essential element to achieve sustainable crop protection in practice. The whole process of PPP application should be seen as providing potential contributions to risk reduction and thus to achieving the objectives of the various EU directives which include e.g. to optimize the application to reach best efficacy with lowest losses of PPP, improve operator safety, and reduce the risk of environmental contaminations with PPP.

Some unintended effects of PPP applications (e.g. PPP losses to water or non target areas by spray drift) can be significantly reduced by utilizing the risk reduction potential which is offered by improved spray equipment (16). Risk reduction measures (e.g. technologies) will increasingly be linked more closely with the regulatory process for PPPs, as we can see already with spray buffer distance regulations being related to drift reducing technologies. This will require harmonized sprayer inspection schemes, which ensures that the results can be used across countries. Sprayer inspection may become a subject of certification schemes (already in place in some countries, and with market organizations), which would mean that the inspection procedures must be transparent and auditable.

The current standards also need to be further developed to reflect progress made in application technology. Parallel to this we need to extend the sprayer inspection into areas which are important but which are not inspected today e.g. like measuring the cleaning efficiency or the agitation quality of sprayers. It is also important to develop inspection regimes which cover the air profile and adjustment

of Bush and Tree crop sprayers (18). Additionally, standards should be developed for those types of Pesticide Application Equipment (PAE) to which standards do not apply today. SPISE working groups intend to close this gap through the publication of SPISE advice (e.g. 18). These activities are useful to address the issue, but will not have the same obligation for implementation as an established technical standard. Therefore, developing such standards should be a next step to help achieve the SUD goals of improved operator safety and environmental protection in the EU. It would be very helpful if such developments could be financially supported under an appropriate EU project.

References

- (1) Rademacher B., 1949: Krankheiten und Schädlinge im Acker- und Feldgemüsebau. Ulmer Verlag Stuttgart.
- (2) https://de.wikipedia.org/wiki/Pflug#Geschichte_des_Pfluges
- (3) Balsari P., P. Marucco, 2011: The new EU Directive requirements and the innovation in pesticide application techniques. Journal ASTN Int, Vol.8.2
- (4) DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. Official Journal EU, L309/71-85
- (5) DIRECTIVE 2009/127/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 amending Directive 2006/42/EC with regard to machinery for pesticide application, Official Journal EU, L310/29-33
- (6) Bals, T. : CEN and ISO Standards on equipment for plant/crop protection. <https://pdfs.semanticscholar.org/presentation/2ad9/a09c65834755e39417e229e3e1a879772c56.pdf>
- (7) Schulze Stentrop C., P. Holben 2016: Industry proposal on the inspection of sprayers in use (preliminary inspection). 6th European workshop on Standardised Procedure for the Inspection of Sprayers in Europe-Spise 6. 37-39. Barcelona
- (8) Herbst K, E. Herbst 2016: Inspection of new sprayers defects following EN-ISO 16119/16122. 6th European workshop on Standardised Procedure for the Inspection of Sprayers in Europe-Spise 6. 41-43. Barcelona.
- (9) Kole J, P. Harasta 2016: "Certification" of the Workshop activity (quality assurance) included the certification of devices/ instruments used for the inspections. 6th European workshop on Standardised Procedure for the Inspection of Sprayers in Europe-Spise 6. 125-129. Barcelona.
- (10) Gonzales C. 2016: The point of view of a farmer. 6th European workshop on Standardised Procedure for the Inspection of Sprayers in Europe-Spise 6. 31-34. Barcelona
- (11) Roettele, M., M Gallart, E Gil, 2017: Perception on how to reduce the risk of Plant Protection Products (PPP) losses to surface water in fruit production. Results from the European TOPPS stakeholder survey 2016. Abstract 14 th Workshop on Spray Application Techniques in Fruit Growing, 10-12 May 2017 Hasselt, BE
- (12) Balsari P., 2017: Personal communication
- (13) Roettele M, Balsari P, Doruchowski G, Petersen PH (2010). Sprayer development needs more focus on mitigation of environmental risks arising from point source water pollution. Inter. Advances in Pesticide Application, Aspect of Applied Biology 99,, 357-368
- (14) Roettele M., P. Balsari, G. Doruchowski, H.J. Wehmann 2012: Environmentally Optimized Sprayer (EOS). Evaluation of spray equipment to mitigate point and diffuse source losses of Plant Protection Products (PPP) to water. Int. Advances in Pesticide Application. Aspects of Applied Biology 114, 143-150.
- (15) Roettele, M., S Rutherford, P Balsari, I Hostens, T Bals, J-C Rousseau, P Hloben, 2018: STEP-water - New online advice and information tool on sprayer technologies enabling the reduction of Plant Protection Products (PPP) losses to water. Inter. Advances in Pesticide Application, Aspect of Applied Biology 137, 59-64.
- (16) www.TOPPS-life.org
- (17) Triloff, P. 2016: Results and conclusions from five years measuring and adjusting air distribution of brand new sprayers for 3D crops. 6th European workshop on Standardised Procedure for the Inspection of Sprayers in Europe-Spise 6. 179-185. Barcelona

(18) Spise Advice 2/2016: Advice for functional inspection of special spraying trains and other vehicles for chemical weed control on railways and public roads. SPISE website- <https://spise.julius-kuehn.de/>