



Mitteilungen

aus der Biologischen Bundesanstalt
für Land- und Forstwirtschaft Berlin-Dahlem

Second European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe - SPISE 2 -

Straelen, Germany, April 10-12, 2007

Edited by
Heinz Ganzelmeier
Hans-Joachim Wehmann

412

2007

Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA)

Die Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA) ist eine selbständige Bundesoberbehörde und Bundesforschungsanstalt im Geschäftsbereich des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz (BMELV). Sie blickt auf eine lange Tradition zurück und ist aus der 1898 gegründeten Biologischen Abteilung am Kaiserlichen Gesundheitsamt in Berlin hervorgegangen. Heute gehören zur BBA 13 Institute, eine Abteilung, eine Fachgruppe und gemeinschaftliche Einrichtungen an sieben Standorten in Deutschland. Gesundheit und Leistungsfähigkeit der Pflanzen stehen im Mittelpunkt der Arbeiten der Biologischen Bundesanstalt. Gesunde Nahrungs- und Nutzpflanzen tragen zur Lebensqualität der Menschen bei. Gleichmaßen ist die BBA mit ihrer Forschung daran beteiligt, die uns umgebenden Kulturlandschaften nachhaltig zu sichern. Die Aufgaben der BBA, die auch im Pflanzenschutz- und im Gentechnikgesetz sowie durch die Europäischen Union festgelegt sind, umfassen u. a.:

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- Erarbeitung umweltschonender Verfahren und nachhaltiger Lösungen für den Schutz von Pflanzen und Produkten
- Prüfung von Kulturpflanzen auf ihre Widerstandsfähigkeit gegen Schadorganismen
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The Federal Biological Research Centre for Agriculture and Forestry (BBA) is both a federal authority in its own right, and a federal research centre under the jurisdiction of the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV). Research in the vast field of plant protection and health has a long tradition at the BBA, which has its roots in the "Biological Division at the Imperial Health Office" founded in Berlin in 1898. With its research the BBA helps to maintain our cultivated landscape and contributes to the people's quality of living. Its tasks are defined primarily by the Plant Protection Act as well as the Gene Technology Act, and include among others:

- research on fundamental questions in the whole field of plant diseases
- working on sustainable methods and innovative technical solutions to protect plants and stored products
- examination and authorization of plant protection products,
- registration and examination of plant protection equipment,
- participation in authorizing genetically modified organisms deliberately released and issued, including investigations on biosafety.
- developing methods to test crop plant varieties for their potential of resistance towards diseases and general testing of plant varieties.
- regulatory activities concerning plant inspection and plant quarantine within the European Union (EU)

The research work of the BBA provides the basis for political decision making in the fields of nutrition, agriculture and forestry, and consumer protection. There are more than 600 staff, including about 170 scientists, are presently employed at the BBA.



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Preface

Plant protection equipment must dose and distribute products exactly and function faultlessly. In order to achieve this, plant protection equipment should be inspected regularly to be able to identify and eliminate any technical defects.

However, there are three main arguments for the inspection:

- good control of the pest with the minimum possible input of crop protection product
- less potential risk of environmental contamination by crop protection products
- safety hazards for the operator

The inspection of plant protection equipment is becoming more and more interesting for the Member States (MS).

The 1st European Workshop, SPISE, took place in April 2004 prompted by the publication of European Standard 13790; the 2nd European Workshop aims to support the MS in introducing inspections for plant protection equipment. This Workshop represents a platform on which to discuss further regulations for introducing, putting into practice and monitoring the inspections in the MS and for co-ordinating them. This can be in the form of lectures, working groups or excursions. In some MS such as Belgium, Germany and the Netherlands, equipment inspections have been developed and established over the past few years, and although they are organised in different ways (state-run, private sector), they have all resulted in high-quality technical inspections, ensuring reliable and efficient plant protection equipment.

Within this Workshop, the legal/statutory regulations and technical standards for successful plant protection equipment inspections already in force in the countries stated above have been presented as examples and described in detail. The excursions to the three MS have shown their practical implementation which could be analysed and taken as a basis for implementation in one's own MS.

The corresponding regulations in the three Member States mentioned will be made available in their entirety as an information package which is also intended as an aid for introducing plant protection equipment inspections. Since the Commission is working on regulations for equipment inspections in the context of the thematic strategy, the 2nd European Workshop will also be an opportunity for reporting on the current situation.

The Workshop, with about 100 participants from 27 European countries, was opened by Dr. Schorn, head of Unit 517 for plant protection at the Federal Ministry of Food, Agriculture and Consumer Protection, emphasising the significance of the BBA's initiative concerning the European inspection of plant protection equipment. Prof. Dr. Böhmer from the plant protection office in Bonn/Münster, welcomed the guests in his role as the host and created particularly favourable conditions for a successful conference in making the conference centre in Straelen available to us.

The Workshop was initiated with four position papers

- on the Thematic Strategy for the sustainable use of plant protection products
- on the EurepGAP quality assurance system for agriculture
- on the position of the CEMA - European Committee of associations of manufacturers of Agricultural Machinery
- on a survey of plant protection equipment inspections in the Member States

A further 18 contributions and 20 posters were shown by the conference participants in seven sessions.

Finally, the participants passed a resolution with recommendations which were to be considered in further consultations for introducing an obligatory inspection to Europe.



Group portrait of the SPISE 2- participants

Table of Contents

Ganzelmeier, H. Preface	3
Summary	9
Böhmer, B. Welcoming address	10
Schorn, K. Welcoming address	11
Ganzelmeier, H. Introduction to the Workshop	13
Keynotes	
Ganzelmeier, H. Thematic strategy on the sustainable use of pesticides: an action plan to improve good plant protection practices throughout Europe	15
Moeller, K.; Coetzer, E. Implementation of SPISE features in the EUREPGAP standard	19
Oldenkamp, P. The need for harmonised European inspection of sprayers from manufacturer's view	21
Wehmann, H.-J. Actual survey about inspection of sprayers in the European countries	22
Session 1 – Presentation and explanation of the information packages	
Ganzelmeier, H. Rules of approval, rules of inspection, quality management of inspection in Germany	29
Kole, J.C. Inspection of sprayers in the Netherlands	34
Schmit, J.F.; Braekman, P.; Declercq, J.; Huyghebaert, B. The inspection of sprayers in Belgium	36
Results of Session 1 - Presentation and explanation of the information packages	
Discussion	42

Session 2.1 – Mandatory inspections – what is to be taken into account

Holownicki, R.; Doruchowski, G.; Godyn, A.; Swiechowski, W.

Recommendations of SPISE 2004 and obligatory inspection of sprayers in Poland 43

Harasta, P.

Mandatory inspection of sprayers in the Czech Republic for the past 10 years 48

Bjugstad, N.; Hermansen, P.; Skuterud, M.; Kraggerud, A.G.

Mandatory testing of field sprayers and orchard sprayers in Norway 50

Results of Session 2.1 – Mandatory inspections – what is to be taken into account

Discussion 54

Session 2.2.1 – Calibration of sprayers

Gil, E.; Gracia, F.

Calibration and Inspection of Sprayers: Proposals for a Joint-Venture to Reduce the Use of Plant Protection Products 55

Balsari, P.; Oggero, G.; Marrucco, P.

Proposal of a Guide for Sprayers Calibration 60

Results of Session 2.2.1 – Calibration of sprayers

Discussion 73

Session 2.2.2 – Options for very old sprayers – options for brand new sprayers

Huyghebaert, B.; Mostade, O.; Braekman, P.; Declercq, J.

Belgium's procedure dealing with brand new and very old sprayers 74

Rautmann, D.

German's way to deal with brand-new and very old sprayers in terms of the legal regulation 78

Results of Session 2.2.2 – Options for very old sprayer – Options for brand new sprayers

Discussion 81

Session 2.3 – Inspection of sprayers not mentioned in EN 13790

Balsari, P.; Oggero, G.; Ghigo, D.
Proposal of a methodology for the inspection of sprayers not considered in EN 13790 82

Kole, J.C.
Test methodology for sprayers used in greenhouses in the Netherlands 88

Koch, H.; Knewitz, H.
Experiences with the functional inspection of hand held spray guns 91

Results of Session 2.3 – Inspection of sprayers not mentioned in EN 13790

Discussion 95

Posters

Baldoin, C.; De Zanche, C.; Bondesan, D.; Dalla Pace, A.
Sprayers Inspection in the Venetian Region: past experiences and future perspectives 96

Balsari, P.; Oggero, G.; Ghigo, D.; Liberatori, S.; Limongelli, R.
The ENAMA Working group for the national coordination of inspection activity in Italy 100

Balsari, P.; Gioelli, F.; Tamagnone, M.
A new vertical patternator for the determination of vertical spray pattern 106

Baskys, D.
Optimisation of mandatory sprayers inspection system in Lithuania 111

Braekman, P.; Declercq, J.; Sonck, B.
Equipment used in Belgium to apply PPP's: compliance with inspection standards 115

Đukić, N.; Sedlar, A.; Bugarin, R.
First inspections of mist blowers in Serbia 118

Dimitrievits, Gy.; Gulyás, Z.; Kovács, L.; Bánszki, P.
Periodical inspection of sprayers in Hungary 126

Haller, G.; Loga, J.
GUVERTO – internet based software for sprayer control 129

Huyghebaert, B.
Twining and Taiex, two pre-accession instruments of the EC 133

Ježík, M.; Lavčák, F.
Performance of regular inspections of sprayers 137

Do Carmo Martins, M.; Moreira, J.F.
The First Year of the Sprayer Inspection in Portugal 139

Nagy, E.M.; Vladut, V.; Cota, C.; Bolintineanu, G.; Bungescu, S.; Biris, S. Present and Future in the Control of the Spraying Machines in Romania - Inma'S Concerns in view of Aligning to The Eu-Requirements	140
Osteroth, H.J. Influences of single nozzle adapters on the flowmeasurements results	145
Sandström, M.; Wahlander, J. Voluntary testing of sprayers in Sweden – still voluntary	149
Sedlar, A.; Đukić, N.; Bugarin, R. Establishing sprayer inspection in Serbia	150
Siim, J.; Pähnapuu, O. Results of Inspection of Field Sprayers in Estonia in 2001...2006	157
Bungescu, S.; Stahl, W.; Vladut, V.; Biris, S.; Nagy, E.M.; Iancu, T. Requirements and settlements regarding the pest and disease control equipment verification in Romania in the period of pre adhesion at EU	160
Concluding remarks	167
Excursion for visiting inspection centres	168
List of authors	171
E-Mail addresses	173

Summary

After the first Workshop on the inspection of plant protection equipment in Europe from 27 - 29 April 2004 in Braunschweig, the second SPISE-Workshop took place from 10 - 12 April 2007, to which the Federal Biological Research Centre for Agriculture and Forestry (BBA) / Application Techniques Division invited experts on equipment technology from the whole of Europe to Straelen to the information and training centre for vegetable growing.

The aim of this workshop was to inform the experts from the Member States on the planned introduction by the European Commission of a legal regulation, in the context of the Thematic Strategy for the sustainable use of plant protection products, for plant protection equipment already in use (obligatory inspection) and to discuss further necessary technical, organisational and administrative regulations in the Member States.

An excursion to inspection workshops in Belgium, the Netherlands and Germany, which have been carrying out obligatory inspections for several years now, aimed also at pointing out the specific differences in practice between the countries, the results of which however all assure reliable inspections of high technical quality for the field and air-assisted sprayers in use in the Member States mentioned.

The workshop was initiated with four position papers. Further 18 presentations and 20 posters were shown by the workshop participants in seven sessions. Finally, the participants welcomed the initiative of the SPISE Working Group and expressed their expectations to continue efforts toward harmonising sprayer inspections with a resolution.

Acknowledgement

Special thanks

- to the information and education centre for horticulture of the chamber of agriculture North Rhine-Westphalia at Straelen for the excellent hospitality
- to Mrs. Buerig for support in translation of the Workshop documents

Böhmer, B.

Chamber of Agriculture North Rhine-Westphalia, Plant Protection Service, Bonn/Münster, Germany

Welcoming address

Dear Colleagues,

warmly welcome to you in the name of the agricultural chamber of North Rhine-Westphalia. Here in Straelen you are in the centre of horticulture production in Germany. A lot of nurseries are very near together and the marketing of the products is very well organized by a nearby veiling named Landgard.

It is the job of me and my colleagues to organize the plant protection service in NRW.

Main points are:

- Diagnosis of damaged plants
- Advising farmers and gardeners in all questions of plant protection
- Help in education of young people
- Proofing new pesticides and plant protection methods

Therefore we are 85 person organized in 10 working teams:

- Diagnosis of pests
- Diagnosis of diseases
- Plant quarantine
- Plant protection in agricultural crops
- Plant protection in ornamentals
- Plant protection in vegetables
- Plant protection in fruits
- Plant protection in official and private gardens
- Application techniques
- Controlling

The central office for the Plant protection in NRW is in Bonn, but 60% of our colleges are working outside, cloth to the farmers for education, advising to help them.

Here in Straelen we are in the horticultural experimental station of the agricultural chamber of NRW. In the middle of these intensive horticultural region is the headquarter of the biggest German veiling for fruits, vegetables and ornamentals, the company Landgard. German and The Netherlands growers are suppliers to this market. The gardeners in this region live and work in professional connection with their colleges in Netherlands and Belgium.

It is my opinion that we need more than before harmonisation in pesticide application and also in the discussion of pesticide residues. The development of pesticide application in agriculture was a great success. But the application in horticulture plants is to develop. We need better systems with more efficiency for these very different plants. These topics you will discuss the next days very intensively.

I want to thank Dr. H. Ganzelmeier and Dr. H. Kramer, that this symposium takes place in Straelen.

I wish you a successful symposium and I hope you will see something of this very nice and special area – North Rhine.

Thank You

Schorn, K.

Head of Plant Protection and Plant Health Division, Federal Ministry of Food, Agriculture and Consumer Protection, Rochusstraße 1, 53123 Bonn, Germany

Welcoming address

Ladies and Gentlemen,

On behalf of the Federal Ministry of Food, Agriculture and Consumer Protection, I would like to open the SPISE Workshop 2007 and welcome you all here to Straelen at the Information and Education centre for Horticulture. I am very pleased to welcome so many participants to the 2nd SPISE Workshop. About 100 participants from 27 countries have gathered here and take an interest in the discussion - from EU Member States and from Norway, Serbia and Turkey.

The Workshop organisers have chosen an attractive conference venue that offers an excellent infrastructure. The vicinity to the Netherlands and Belgium will allow us to tour the inspection centres in both neighbouring countries as well. I am convinced that this combination of scientific discussions and technical tours will prove fruitful and give us a good opportunity to exchange experiences and discuss future challenges in this field of work.

Let me take this opportunity to express my warmest thanks to the Chamber of Agriculture of North Rhine-Westphalia and the Plant Protection Service, and also to our host, Mr. Schumacher, for enabling us to spend three days here at the Information and Education centre for Horticulture with our European experts in the Workshop. My cordial thanks also go to the colleagues from the Scientific and Organising Committee for having prepared such an important workshop with an interesting and comprehensive program.

As you all know, equipment technology has always been an important component of plant protection for us in Germany. It has led to the establishment of an effective and competent team of experts in the application techniques division at the Federal Biological Research Centre, the BBA. During your 1st SPISE Workshop in Braunschweig in 2004 you gained an insight into the facilities and the work of the BBA.

The legislation for plant protection equipment and its implementation has been improved in Germany. Allow me to give you a short overview of this "evolution":

- In Germany, we introduced a declaration procedure in 1986, i.e. certification for new plant protection equipment, obliging manufacturers and distributors of equipment to submit a declaration. This is managed and monitored by the division for application techniques in the BBA.
- As early as the end of the 1960's, we embarked on the inspection of plant protection equipment already in use on a voluntary basis and moved to obligatory inspections in 1993 for field sprayers and 2002 for air-assisted sprayers.
- We have also carried out intensive work on drift from applications of plant protection products and on mitigation measures since the beginning of the 1990's and introduced the classification of plant protection equipment with regard to its potential for drift reduction. Subsequently, new plant protection products are now mostly applied with modern drift-reducing techniques. This sophisticated technique poses a challenge in the competition among equipment manufacturers as well.
- Germany has joined the Network for Testing of Agricultural Machinery (ENTAM), in which 19 inspection centres of European countries currently work together with the aim of recognising harmonised testing specifications and standards so as to achieve a mutual recognition of tests and avoid multiple testing.

- We also work closely together within the European and International Organisation for Standardisation in order to standardise test requirements and testing methods as a basis for technical regulations in the European Union.

The situation in plant protection equipment technology in Germany has made great progress in the last few years. The high standards of plant protection have, of course, also contributed to the fact that manufacturers of equipment and nozzles are continuously motivated to develop new techniques and solutions.

Ladies and Gentlemen,

It is a pleasure to have you, the European experts on plant protection equipment, here in Germany during the German EU Presidency. As you all know, proposals on new plant protection legislation are under discussion at EU-level, at present; starting under the Finnish presidency and we are all now working through a demanding agenda:

- the thematic strategy on sustainable use on pesticides;
- a proposal on a regulation of the European Parliament and the Council on the placing on the market of plant protection products;
- a proposal for a Directive of the European Parliament and of the Council establishing a framework for Community action to achieve the sustainable use of pesticides.

With a view to plant protection equipment, the framework directive already under discussion envisages that Member States introduce obligatory inspections at regular intervals for plant protection equipment already in use in the Member States. The outcome of these discussions will be of great importance for the future European Policy on the Authorisation and Use of Plant Protection Products. The European Commission also intends to present a proposal on requirements for the placing on the market of new pesticide application equipment and accessories with a view to the near future. I am therefore delighted that the 2nd SPISE workshop can also contribute towards this aim and that it is taking place here in Straelen, Germany.

High quality of inspection systems for equipment – in use and new equipment - is a prerequisite for risk reduction to prevent a possible adverse impact on human health or on the environment by – for example – malfunctions or incorrect distribution of the plant protection product during spraying. Therefore, Germany welcomes the concept of EU-harmonized requirements for spraying quality and for regular inspection intervals of machinery in use. We gained some good experience with a two-year inspection interval in our national system. Furthermore, a basis for mutual recognition between Member States should be considered in the further discussions - in order to achieve a high-quality equipment inspection which is comparable throughout the Member States of the European Union. It could be also considered whether a reference to the European standard EN 13790 might be beneficial to further harmonisation. This standard has been worked on by experienced technology experts for many years and reflects the current state-of-the-art in this field.

Ladies and Gentlemen,

You are facing a demanding agenda for the next few days. I hope that this SPISE Workshop will bring you together as European experts for the inspection of plant protection equipment and will serve as an excellent platform to exchange experience, gain an insight into different national inspection systems and discuss future challenges in this field. If this workshop contributes to a common understanding of the necessary requirements and suitable systems – it would be a big step forward and of benefit to all of our countries. On this note, I would like to encourage you to hold an in-depth discussion and exchange of views and experiences. But please do make sure to also take some time to get to know the landscape, surrounding area and its people, and enjoy the sight-seeing event as well. And if time is too short, why not extend your stay for a couple of days or come back? It would be worthwhile.

I wish you every success, constructive talks and intensive, fruitful discussions.

Thank you very much for your attention.

Ganzelmeier, H.

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Introduction to the Workshop

With the resolution of the first SPISE Workshop, the SPISE Working Group (SWG) was established which has prepared and organised this 2nd SPISE Workshop.



Figure 1 The SWG comprises experts from Belgium, the Netherlands, Germany, France and Italy

These experts have met several times and have compiled a program which has been unexpectedly well received by experts in plant protection equipment technology in Europe and has prompted around 100 participants from Europe to come to Straelen for this 2nd SPISE Workshop.

Straelen was chosen as the conference location because

- it has a well equipped conference centre in pleasant surroundings,
- the conference location is close to Belgium and the Netherlands which we will visit during the excursion and
- there are reasonably priced hotels in the proximity.

The timing of the workshop straight after Easter is somewhat unfortunate. It was discussed at length in the SWG. Unfortunately, we were unable to find a more suitable date. This is also due to the fact that practical equipment inspections take place mainly in April and May and dates just before and just afterwards were already blocked by other events.

Since our last SPISE Workshop in 2004 a lot has changed.

In particular due to the Thematic Strategy for sustainable plant protection, it is now clear that there will soon be an obligatory inspection in the EU for plant protection equipment which is already in use.

The present version of Article 8 of the framework directive states only a few primary elements for an obligatory inspection; the rest will be left up to the Member States.

We will no doubt learn more about this in the keynote on TS.

Furthermore, the obligatory inspection within the framework directive does not only apply to field sprayers and air-assisted sprayers for bush and tree cultures but also all equipment which is used to apply plant protection products.

This is an extensive approach, which most experts were not reckoning with; up until now, corresponding regulations and experience in inspections in the Member States only exist for field sprayers and air-assisted sprayers for bush and tree cultures.

This is another reason for dealing with the extensive approach of obligatory inspections in the SPISE Workshop.

The SWG believes that the Member States' experiences, in part very extensive, should be made use of so as not to have to start the discussion on introducing obligatory inspections to the Member States from scratch.

For this reason our colleagues from Belgium, the Netherlands and Germany have declared themselves willing to summarise their regulations and experience in an info-package and

- to explain this to us afterwards,
- to offer this on the SPISE website for your information and for downloading and
- to show us its implementation, or how it is put into practice.

On the second day of the workshop there will be an excursion to the Netherlands, Belgium and Germany to visit inspection workshops in order to be able to understand these regulations better and to examine the practical approach and discuss points with the respective experts.

I think this SPISE Workshop with representatives from so many European countries is a suitable platform to expand on giving advice on how an obligatory inspection required by the EU can be organised in the Member States.

It is important to assume when doing so that

- we, the Member States, agree on a uniform technical standard; EN 13790,
- the Member States can enlarge their previous infrastructure correspondingly and ensure a high technical inspection level,
- we, the Member States, aim for comparable technical quality in order to achieve mutual recognition between the Member States and to avoid multiple inspections.

The six sessions of this workshop address the most important topics which need to be discussed and organised when an obligatory inspection is introduced to the Member States. A few general remarks on the sessions:

- Each session will be introduced with 2 or 3 short presentations of approx. 15 minutes.
- The remaining time will be available for discussion.
- The chairmen have prepared a Powerpoint presentation with questions and suggestions for solutions which should be discussed and added to - so that at the end of each session the results of the discussion are recorded in writing.

I would like to take the opportunity now of thanking our colleagues from the Organizing and Scientific Committee who have participated in an extremely constructive way in preparations and who will be in charge of the sessions and be involved in the excursion.

We have 4 initiatory keynotes so that our discussion in the sessions takes into consideration the most important aspects:

- which will illustrate to us the Thematic Strategy and corresponding regulations for technical equipment. But unfortunately neither Mr. Helbig nor Mrs. Cotillon will be able to attend the SPISE workshop due to work commitments to do with meetings of the European parliament. So I will try to do this job,
- which will illustrate the organisation EUREPGAG and the possibilities of gaining farmers' support for or obliging them to participate in equipment inspections. In this respect I would like to introduce Dr. K. Möller,
- which will show us the necessity of harmonised equipment inspections in the EU from the plant protection equipment manufacturer's point of view. For this I would like to welcome the president of CEMA, Mr. Oldenkamp,
- which will show us the current situation of plant protection equipment inspections in the Member States with the help of a recent survey. Mr. Wehmann, a member of my staff, whom you know at least by name from the many emails over the past few weeks and months, will do this.

Keynotes

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Thematic strategy on the sustainable use of pesticides: an action plan to improve good plant protection practices throughout Europe

1. Introduction

Like already mentioned the colleagues from the European Commission are unable to come and presenting the keynote on Thematic Strategy on the sustainable Use of Pesticide.

Because of the great importance of the TS for the inspection of sprayers in Europe, we decided to keep this topic on the agenda.

Now, I will present the power point slides provided by the commission. You will receive a sheet of paper to note your questions. We will gather your sheets and forward these questions to the commission to be answered.

The presentation addresses the following issues:

- Why a Thematic Strategy on the sustainable Use of Pesticide?
- How was the Thematic Strategy built?
- What are the measures proposed by the Commission?
- Where are we in the adoption process?

2. Why a Thematic Strategy on the sustainable Use of Pesticide?

Pesticides are active substances and products that have the inherent potential to kill or control harmful or unwanted organisms- such as pests and weeds. They can be used in agriculture or to control the growth of plants on non-agricultural surfaces. The use of pesticides brings various benefits –mostly economic-in particular for farmers.

However, because of their specific (intrinsic) properties, pesticides can be harmful to non-target organisms and can have unwanted adverse effects on human health and the environments. All pesticides need to be evaluated and authorised before they can be placed on the market according the Directive 91/414/EC. The placing of biocidal products on the market followed the Directive 98/8/EC. Despite the existing regulatory restrictions, the actual consumption and use of pesticides in the EU has not decreased over the last ten years. In addition, certain pesticides are commonly found in the aquatic environment at concentrations well above the regulatory limits.

Furthermore, existing legislation on plant protection products focuses on the placing on the market and on the end of the life-cycle of such products, but hardly addresses the actual use-phase. In order to correct this deficiency and create an overall coherent well consistent policy framework for pesticides, the Strategy focuses on the use-phase.

A number of other pieces of EU legislation also affect the use of pesticide. In particular

- the Water Framework Directive
- the Maximum residue levels of pesticides (Regulation EC 396/2005)
- the Waste-Framework Directive and
- the Directive on hazardous Waste

For the time being, the TS only deals with plant protection products. Biocides will be considered at a later stage.

3. Current legal framework

In adopting the 6th Environmental Action Programme (6th EAP), the European Parliament and the Council recognised that the impact of pesticides on human health and the environment in particular from plant protection products, must be further reduced (Decision No 1600/2002/EC). They underlined the need to achieve a more sustainable use of pesticides as well as a significant overall reduction in risk and of the use of pesticides consistent with the necessary crop protection.

The EP and the Council call for the development of a Thematic Strategy on the sustainable Use of Pesticides.

4. How the Thematic Strategy was built?

The Commission consulted the general public and all stakeholders and institutions on this communication, including the European Parliament, the Council, Overall, there was a lot of support from all, although institutions and some stakeholders did differ on the details, e.g. on whether a measure should be implemented at Community level or Member State level, or whether it should be legally binding or voluntary. The most controversial issues were aerial spraying, quantitative use reduction targets, and taxation. The Commission was then invited to assess the economic, social and environmental impacts of the future Strategy proposal. A study was carried out by an independent consultant, BIPRO outlined several options for potential measures. BIPRO delivered a report which was based on a survey of competent authorities and stakeholders. Numerous conferences were organised. In addition, the Commission launched an open internet consultation from March to May 2005, which gave rise to almost 1800 responses. The Commission used all these contributions to develop the proposal for the Thematic Strategy on sustainable Use of Pesticides. The TS contain measures which are destined to be integrated into existing legislation. Only when this is not possible is it necessary to propose new legislation or other appropriate instruments.

The European Commission adopted the Strategy in July 2006.

- It is accompanied by a proposal for a framework Directive on the sustainable use of pesticides (adopted in July 2006)
- In parallel to the Strategy a regulation revising the Directive 91/414 has been adopted (July 2006)
- In December 2006 the European Commission adopted a proposal for a regulation on the collection of statistics on plant protection products.
- Another new proposal due to be adopted by 2008 will complete the Strategy: It will lay down essential environmental protection requirements for the placing on the market of new pesticide application equipment and accessories, possibly within the Framework of Directive 2006/42/EC.

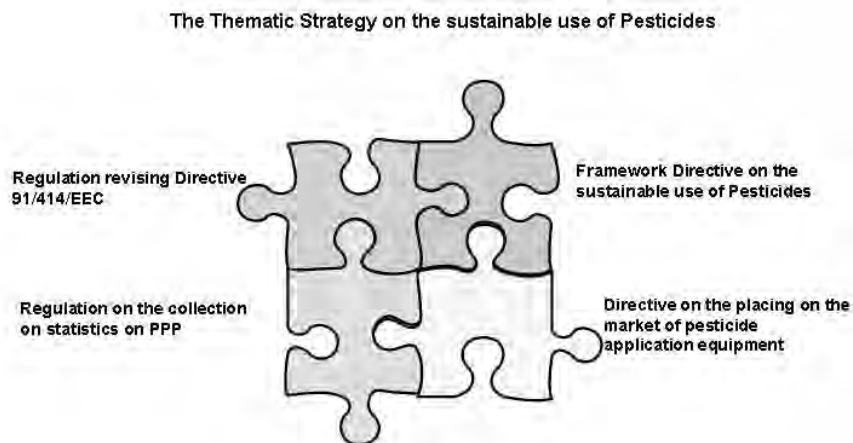


Figure 1 Linkage of European Regulations, Framework Directives and Directives

These regulations, Framework Directive and Directive are linked as the figure 1 shows.

5. What are the measures proposed by the Commission?

Inspection of equipment in use: Well maintained application equipment is essential for reducing the adverse impacts of pesticides on health and the environment, and to guarantee the most efficient and economic use of pesticides. Application equipment must be regulatory inspected and maintained. The organisational aspects (e.g. public or private inspection systems, quality control of inspection bodies, financing, fees to be paid by owners, etc.) will remain at the competence (discretion) of the MS, who will have to report to the Commission. Exchange of best practices should be developed in the framework of the Thematic Strategy Expert Group, made up of representatives of the MS and of stakeholders.

Certification of new application equipment: Pesticide application equipment for professional use has to be placed on the market and put into service only if it does not endanger the health or safety of persons or the environment, when properly installed and maintained and used for its intended purpose. Essential health and safety requirements already set out in Directive 2006/42/EC on Machinery. Essential environmental requirements have to be laid down. New Directive to be proposed by 2008 (possibly through amending Machinery Directive)

Other measures

National Action Plans: The Strategy contains a proposal for a Framework Directive which will be obligate Member States to set up National Action Plans (NAPs) to reduce hazards, risks and dependence on pesticides. In several countries, such national plans have been very successful.

Training: Users must be fully aware (in particular professional users) of the risk linked to the use of pesticides. MS should therefore ensure that professional users, distributors and advisers have access to the minimum training required. Requirements regarding the training and official recognition of training (certifications or licensing) should be established. The general public should be better informed, information passed on through retailers and distributors, and other appropriate measures.

Aerial spraying: Aerial spraying can cause significant damage to health and the environment, in particular from spray drift. It should therefore be strictly regulated and used only where it represents clear environmental advantages compared to other spraying methods or where there are no viable alternatives. The draft Directive therefore requires MS to ban aerial spraying. It allows derogations for crops and areas where aerial spraying can have advantages or bring environmental or health benefits, or where there are no viable alternatives. MS will have to report these derogations, which will be discussed in the Thematic Strategy Expert Group in order to define guidelines and criteria.

Protection of the aquatic environment: Specific measures to protect surface water and ground water are required to reduce the impact of pesticides on the aquatic environment. The draft Directive will require MS to establish pollution reduction programmes which must include measures such as buffer strips (buffer zones) or the use of particular technical equipment to reduce spray drift.

Prohibition or restriction of plant protection products use in sensitive areas: Member States will have to strongly reduce or ban the use of pesticides in the specific safeguard zones.

Storage and handing of plant protection products: Unused, past-expiry or banned pesticides and empty packaging have to be collected in a controlled way. Obsolete pesticides have to be treated in accordance with the rules for hazardous waste. Cleaned packaging which has been rinsed three times is considered non-hazardous in most MS. It should be treated for possible re-use and ultimately destroyed in a controlled way. When spraying equipment is cleaned, the residue must be disposed of in an environmentally-sound way.

Promotion of low pesticide input farming: Pesticides should be used only when there are no other ways or controlling and limiting the damage caused by pests. More encouragement should be given to pest control techniques that allow little or no use of pesticides. Support is already provided to farmers who convert to certified Integrated Control, Organic Farming or other schemes with the objective of reducing pesticide application. The Draft Directive requires MS to promote implementation of IPM principles.

Risk indicators: Common and harmonized indicators are important for measuring risk reduction trends within and among the MS. Up to now, there has been no agreement on indicators. The OECD is developing harmonized risk indicators for water and soil. This project ends in spring 2007.

Where are we in the adoption process?

The Thematic Strategy, and in particular the draft Framework Directive, is now going through the EU decision making process. Presently the decisions on the proposal for the Framework Directive on the sustainable use of pesticides taking place in the Agriculture Council (AGRI). The discussion on the Thematic Strategy and the legislative proposal is still continuing in the Environment (ENVI) and Agriculture (AGRI) Committees of the Parliament. The first reading agreement is not yet known.

References

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Moeller, K.; Coetzer, E.

EUREPGAP c/o FoodPLUS GmbH, Spichernstr. 55, 50672 Cologne, Germany

Implementation of SPISE features in the EUREPGAP standard

EUREPGAP, the global partnership for Safe and Sustainable Agriculture, introduced the all-encompassing, updated Integrated Farm Assurance (IFA) in March 2007. The IFA standard is a pre-farm gate standard that covers the certification of crops, livestock and aquaculture against Good Agriculture Practices. EUREPGAP has started with the standard for Fruit and Vegetables in 1997 and EUREPGAP certified Fruit and Vegetables are available in more than 80 countries.

EUREPGAP membership is voluntary and independent from certification (for producers) or approval as a EUREPGAP approved certifier. Members show additional commitment to shape and improve EUREPGAP as active partners and interested parties can apply for Retailer, Producer or Associate membership. The EurepGAP Board and all elected committees are made up of retailer and producer members.

The updated IFA standard version resulted from 10 years of auditing (2 previous versions), more than 100,000 conducted audits and 2 years of extensive stakeholder discussions. More than 500 experts such as producers, traders, retailers, and governmental and non-governmental representatives from 56 countries were involved in the standard-setting process.

For its IFA standard, EUREPGAP has developed Control Points and Compliance Criteria that producers must comply with to receive certification. EUREPGAP advocates the safe use and handling of plant protection products and it is one of the sections covered within the standard. Calibration and maintenance of plant protection product application equipment is not only important for worker health and safety and environmental protection but also for economical reasons; therefore reinforcing “safe and sustainable” Good Agricultural Practices.

The IFA standard comprises the ALL FARMS BASE module, CROPS BASE, LIVESTOCK BASE and AQUACULTURE BASE modules (see Fig. 1). CROPS BASE is the basis for all crop certifications.

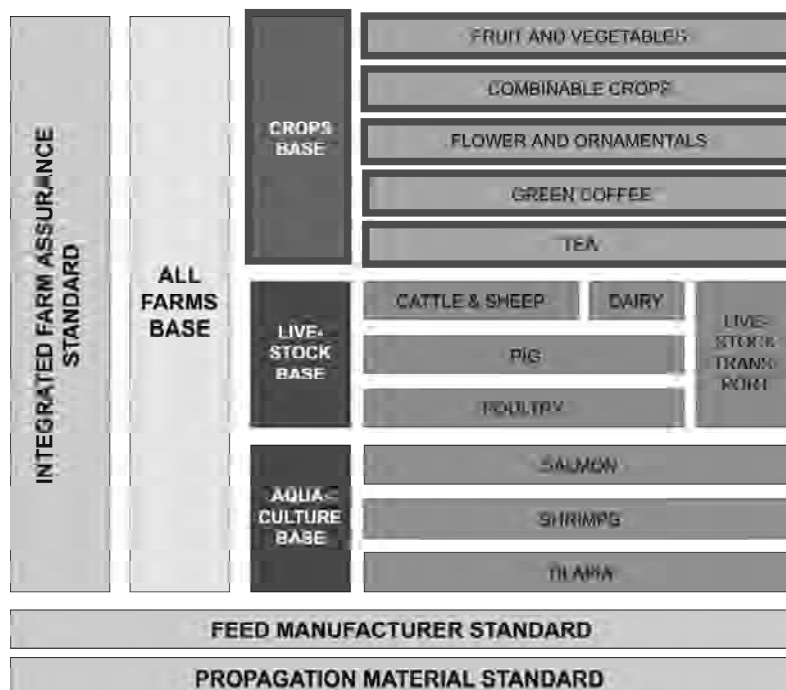


Figure 1 Structure of the new IFA standard

The SPISE features are elements of the CROPS BASE. They must therefore be implemented of all producers, which are certified for Fruit and Vegetables, Combinable Crops, Flower and Ornamentals, Green Coffee and Tea. The following box (see figure 2) quotes the SPISE control point and guideline.

Crops Base Control Point 8.4 Application Equipment

Control Point:

Is PPP application machinery kept in good condition and verified annually to ensure accurate application?

Compliance Criteria:

The PPP application machinery is kept in a good state of repair with documented evidence of up to date maintenance sheets for repairs. See Guideline (Annex CB.3) for compliance with visual inspection and functional tests of application machinery.

Annex CB.3 Guideline for visual inspection and functional tests of application machinery.

1. There shall be no leakages from the pump, spray liquid tank (when the cover is closed), pipes, hoses and filters.
2. All devices for measuring, switching on and off, adjusting pressure and/or flowrate shall work reliably and there shall be no leakages.
3. The nozzle equipment shall be suitable for appropriate application of the PPP. All nozzles shall be identical..., form a uniform spray jet... and there shall be no dripping after switching off the nozzles.
4. All the different parts of the equipment (sprayer), e.g. nozzle holder/ carrier, filters, blower, etc. shall be in good condition and work reliably.

Source document: DIN EN 13790-1:2004

Figure 2 SPISE control point and guideline

By introducing the SPISE features based on the European standard for the inspection of plant protection application equipment (EN 13790), which defines the minimum requirements, EUREPGAP supplies easy-to-implement guidance to producers to ensure safe and calibrated equipment. The SPISE features are applicable to knapsack sprayers, field sprayers and equipment used in greenhouses. EUREPGAP certification inspections are performed by independent Certification Bodies annually, and these features will ensure that the equipment is inspected properly.

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The need for harmonised European inspection of sprayers from manufacturer's view

The European sprayer industry represented by CEMA is very interested in harmonised procedures for the inspection of sprayers in use. The reasons are obvious:

- Crop protection shall be carried on a high level to avoid environmental damages and to ensure food safety. Therefore, the industry places products on the market fulfilling all legal and customer demands and supports the development of reasonable regulations, e.g. on European or International level. The sprayer inspection supports these activities by contributing to the proper sprayer function and condition.
- The sprayer industry sells their products all over Europe and also worldwide. The different requirements applied to sprayers in use in individual Member States may affect the design of new sprayers and can cause obstacles to the free trade in Europe.
- The inspection of sprayers all over in Europe improves the application of pesticides and by this also the image of crop protection in the public.

But otherwise the industry is also interested in avoiding unnecessary costs and bureaucracy for its own but also the customer's benefit. This means that new European regulations shall focus on the essential elements.

The strategy of the EC Commissions seems to support this request. To include environment related aspects of sprayers into the Machinery Directive would cover new machines completely in an appropriate way and the inspection itself could focus on the machines in service. For both – new sprayers and sprayers in use – appropriate European standards are available and represent the common expertise of all interested in crop protection.

As chairman of the CEMA sprayer group and as sprayer manufacturer I hope that these standards will be used to define the state of art in Europe and will shorten the process to get an agreement on the inspection of sprayers.

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Actual survey about inspection of sprayers in the European countries

Summary

During the last months of the year 2006 a survey in most of the European countries was carried out. The aim of this survey was to compile information concerning the actual situation of sprayer's inspection. To get this information the responsible colleagues of all countries - where a contact person is known - got a short questionnaire.

1. Introduction

On the occasion of the first SPISE workshop in the year 2004 a similar survey was carried out by the colleagues from Italy. With that information it was pointed out that the situation regarding sprayer inspections in the Member States and other European countries was marked by great differences between the Member States and other European countries. At that time, sprayer's inspections were mandatory by law only in some European countries.

With this present survey the colleagues were asked for data (separate for field sprayers and air-assisted sprayers) regarding

1. the number of sprayers in use,
2. the kind of inspection (mandatory, voluntary, experimental state or no inspection),
3. the number of inspections carried out in the years 2004, 2005 and 2006.

Furthermore there are some questions regarding special characteristics

4. the inspection interval,
5. the average inspection costs,
6. the procedure for brand new sprayers,
7. the indication by stickers,
8. what to do with sprayers where a defect is stated?

27 of 30 asked countries returned during the last months their filled questionnaires. Exactly these countries sent their delegates to attend this workshop. And therefore I would like to take the opportunity to thank all these colleagues for the fruitful cooperation and for their important contribution. I can imagine that especially the determination of the number of sprayers in use and the number of yearly carried out inspections was combined with some problems.

The tables 1 and 2 summarize most of the collected data separated for field sprayers and air-assisted sprayers for bush and tree crops.

Table 1 Inspection of field sprayers in the European Countries

Current status of the inspections	Number of sprayers in use	Inspections mandatory from	Will be mandatory from	Voluntary from	Number of sprayers inspected (average 2004-2006)	After how many years the inspection must be repeated?	Average inspection cost (Euro) from...to...	Brand new sprayers have to be inspected?	May serious defects lead to a prohibition of use?
Austria	38.000			1983	9.800	3	50-160	No	No
Belgium	19.031	1995	-	1989	6.344	3	12 - 142	yes	yes
Bulgaria	4.480				0				
Czech Republic	3.500	1997		1980	1.150	2	100-350	No	Yes
Denmark	30.000	1993	-	-	151	-		No	No
Estonia	?	2000			218	3	32...+transp	No	Yes

Current status of the inspections	Number of sprayers in use	Inspections mandatory from	Will be mandatory from	Voluntary from	Number of sprayers inspected (average 2004-2006)	After how many years the inspection must be repeated?	Average inspection cost (Euro) from...to...	Brand new sprayers have to be inspected?	May serious defects lead to a prohibition of use?
France	200.000	-	2009	1990	0	-	100-250	-	-
Germany	130.100	1993	-	1976	72.809	2	55 - 341	Yes	Yes
Greece	45.089	-	-	-	0	-	-	-	-
Hungary	30.000	-	2007	-	0	2	110-130	No	Yes
Ireland	12.000	-	in future	-	0	-	-	-	-
Italy	200.000	1999 - 2001	-	1988 - 2006	2.300	1 to 5	0 to 206	Yes	Yes
Latvia	2.300	-	in future	-	0	-	-	-	-
Lithuania	15.000	2001	-	-	281	3	28-86	Yes	Yes
Norway	16.800	2006	-	1991	1.950	5	180-300	Yes	Yes
Poland	299.399	1999	-	-	60.500	3	33-42	Yes	Yes
Portugal	56.000	-	-	2.007	0	-	-	No	No
Romania	14.832	-	-	-	0	-	-	-	-
Serbia	18.800	-	2007	-	0	2	?	Yes	?
Slovakia	3.700	2003	-	-	605	2	205 - 230	No	Yes
Slovenija	20.000	1995	-	-	7.172	2	33,00	No	Yes
Spain	70.000	-	2010?	1990	300	4	25-100	No	No
Sweden	19.000	-	-	1987	1.700	2	1740,00	No	No
Switzerland	25.238	1993	-	-	2.980	4	-	-	-
The Netherlands	13.000	1997	-	1976	5.751	3	120-200	Yes/No	Yes
Turkey	-	-	-	-	-	-	-	-	-
United Kingdom	44.000*)	-	-	1997	8.790	1	100 - 650	Yes	Yes

Table 2 Inspection of air-assisted sprayers in the European Countries

Current status of the inspections	Number of sprayers in use	Inspections mandatory from	Will be mandatory from	Voluntary from	Number of sprayers inspected (average 2004-2006)	After how many years the inspection must be repeated?	Average inspection cost (Euro) from...to...	Brand new sprayers have to be inspected?	May serious defects lead to a prohibition of use?
Austria	20.600	-	-	1983	6.500	3	20-140	No	No
Belgium	2.187	1995	-	1989	729	3	12,5 – 62,5	yes	yes
Bulgaria	304	-	2010	-	0	-	-	-	-
Czech Republic	2.500	1997	-	1980	600	2	100-250	No	Yes
Denmark	?	1993	-	-	0	-	-	No	No
Estonia	?	2000	-	-	?	3	32...+transp	No	Yes
France	150.000	-	2009	1990	0	-	100-250	-	-
Germany	50.900	2002	-	1983	22.405	2	25 - 139	Yes	Yes
Greece	107.005	-	-	-	0	-	-	-	-
Hungary	10.000	-	2007	-	0	2	90	No	Yes
Ireland	100	-	in future	-	0	-	-	-	-
Italy	350.000	1997 – 2001	-	1988 - 2006	5.967	1 to 5	0 to 206	Yes	Yes
Latvia	20	-	in future	-	0	-	-	-	-
Lithuania	150	2001	-	-	8	3	28-58	Yes	Yes

Current status of the inspections	Number of sprayers in use	Inspections mandatory from	Will be mandatory from	Voluntary from	Number of sprayers inspected (average 2004-2006)	After how many years the inspection must be repeated?	Average inspection cost (Euro) from...to...	Brand new sprayers have to be inspected?	May serious defects lead to a prohibition of use?
Norway	1.000	2006		1995	58	5	180-300	Yes	Yes
Poland	23.702	1999	-	-	4.155	3	33	Yes	Yes
Portugal	38.000	-	-	2.006	220	1	30-60	No	No
Romania	5.640	-	-	-	0	-	-	-	-
Serbia	2.000	-	2007	-	2	2	130	Yes	?
Slovakia	750	2003	-	-	80	2	215	No	Yes
Slovenija	8.000	1995	-	-	2881	2	33	No	Yes
Spain	140.000	-	2010?	1990	1133	4	25-100	No	No
Sweden	500	-	-	1995	50	2	1800	No	No
Switzerland	3.000	-	-	-	550	-	-	-	-
The Netherlands	2.000	2002	-	1995	828	3	120-180	Yes/No	Yes
Turkey	-	-	-	-	-	-	-	-	-
United Kingdom	2.000*)	-	-	1997	366	1	100 - 650	Yes	Yes

2. Special information

Some special information given by the colleagues responsible in their countries shall be given in the following part:

AUSTRIA: Since many years Austria performs the voluntary inspection of sprayers using an interval of 3 years. The result here is remarkable.

BELGIUM: Belgium has also much experience with the inspection of sprayers. The inspection interval is also 3 years.

BULGARIA: Bulgaria has at present no inspection but plans a mandatory procedure with start in the year 2010.

CZECH REPUBLIC: The Czech Republic introduced the mandatory inspection in the year 1997 and in the meantime there is inspected a considerable part of sprayers in use. The inspection follows in total the requirements given in the EN 13790.

DENMARK: Introduced the inspection of sprayers long time ago. There were inspected only some sprayers per year.

FRANCE: France will change from the voluntary inspection system to a mandatory in future. Unfortunately there are at the moment no recent data concerning the yearly performed inspections available.

GERMANY: Since 1993 for field sprayers and 2002 for air-assisted sprayers the mandatory system is prescribed here. The governments of the Federal Countries are responsible for the inspections. Due to the fact that a valid sticker is relevant also in the frame of the Cross Compliance Regulation there are very good results regarding the participation of the farmers. In the year 2005 in this connection there were carried out 10 700 checks like that and this led only to 35 complaints, that means there were found only 35 sprayers without any inspection sticker. Of course for these certain farmers this leads to cut backs of the subsidies.

GREECE: In Greece at present there exists an inspection system only for brand new knapsack sprayers in the frame of representative samples.

HUNGARY: Hungary introduced a mandatory inspection this spring. All sprayers with a nominal volume with more than 100 litres shall be subject to a periodic system. The EN standard 13790 will be the basis of the organisation. The Plant and Soil protection service will be authorized as supervisor.

IRELAND: The contact point with Ireland is still new and Ireland attends the first time this year. In Ireland at present the state agriculture research, advisory and training institution provides a sprayer operator training course, and in this course the students learn how to inspect and calibrate their own sprayers.

ITALY: The country with the highest sprayer frequency is Italy. Here 1,83 sprayers per square kilometre (whole area of Italy) are to be found. The reason for this is high percentage of air-assisted sprayers for bush and tree crops – 350 000 of such sprayers are used here. In Italy there are different regions with different governments. And these governments didn't introduce the inspection systems at the same time and furthermore different intervals were laid down. Therefore some information are given as range.

LATVIA: Latvia gave the information that at this moment there isn't any sprayer inspections on any legal basis carried out. At present there exists a voluntary sprayer test carried out from some retailers. But in the future, in accordance to the Thematic strategy, there will be introduced a system of mandatory system.

LITHUANIA: Also in Lithuania there is a mandatory inspection system introduced. The interval is three years. The inspection is carried out by seven accredited private inspection centres.

NORWAY: Additional to the information you can see, the delegates from Norway informed us that since the first SPISE workshop, the Norwegian requirements have been harmonised due to the EN 13790-1/2. Furthermore they have included some earlier additional requirements in order to increase the technical level of recently new sprayers, especially due to environmental aspects and more user friendly equipment.

POLAND: Most European field sprayers are used in Poland. Nearly 300.000. All together, that means field sprayers and air-assisted sprayers, we find here more than 1 sprayer per square kilometre of the whole country area. Since 1999 here we have a mandatory inspection of sprayers.

PORTUGAL: The next country in our order today is Portugal. Portugal is also attending the SPISE workshop the first time. Here the inspection service began at 2006. Some inspections in different regions of the countries are carried out in the meantime – some bad results can be explained by wear and tear of the used sprayers – so the information of our colleague there.

ROMANIA: Romania up to now hasn't any regulation for sprayer inspection. But of course there exists concrete considerations concerning the adoption of the EN Standard 13790.

SERBIA: Introduced the mandatory inspection in this year following the requirements given in EN 13790. This is the reason that there aren't any data concerning the performed inspections are available at present.

SLOVAKIA: Slovakia introduced the mandatory inspection of sprayers in 2003 and carried out a certain number of inspections. Nearly 0.1 sprayers per square kilometre can be seen here.

SLOVENIA: Slovenia also has much experience with sprayers. Since 1995 mandatory inspections are existent here. The inspection interval amounts to 2 years. A remarkable part of sprayers is inspected during the last three years.

SPAIN: The situation in Spain is characterised by the planned introduction of a mandatory system in the year 2010. Up to now there are different systems for each local government and only a few inspections can be carried out.

SWEDEN: At the time of the SPISE conference in 2004 the Swedish participants thought that a mandatory testing programme of sprayers was going to be introduced in Sweden. This did not happen due to concerns for the farmers in sparsely populated areas. So we see that in Sweden the voluntary inspection is still seen as suitable.

SWITZERLAND: In Switzerland a mandatory inspection is to be performed every fourth year, related to the obtainment of cross-compliance in the frame of farm subsidies, which concerns 97% of all Swiss farms.

THE NETHERLANDS: Remarkable here is the result of the number of inspections carried out yearly. This can be declared by the fact that last year the Netherlands increased the inspection interval from 2 years to three years.

TURKEY: The colleagues from Turkey certainly returned their questionnaire, but at that time they only could give the information that no inspection is carried out.

UNITED KINGDOM: The United Kingdom, since 1997, carries out inspections of sprayers by a voluntary initiative - named the NSTS -. The NSTS is a voluntary test which is intended as annual test. Unfortunately the numbers of sprayers was not split by field or air-assisted sprayers so the percentage of both is estimated.

3. Conclusions

To sum up the collected data some final graphs are added.

Looking on the figure 1 it can be stated that the involved 25 countries reported an existence of more than 2 Millions of sprayers. In Italy, France, Poland and Spain are located about 75% of these sprayers.

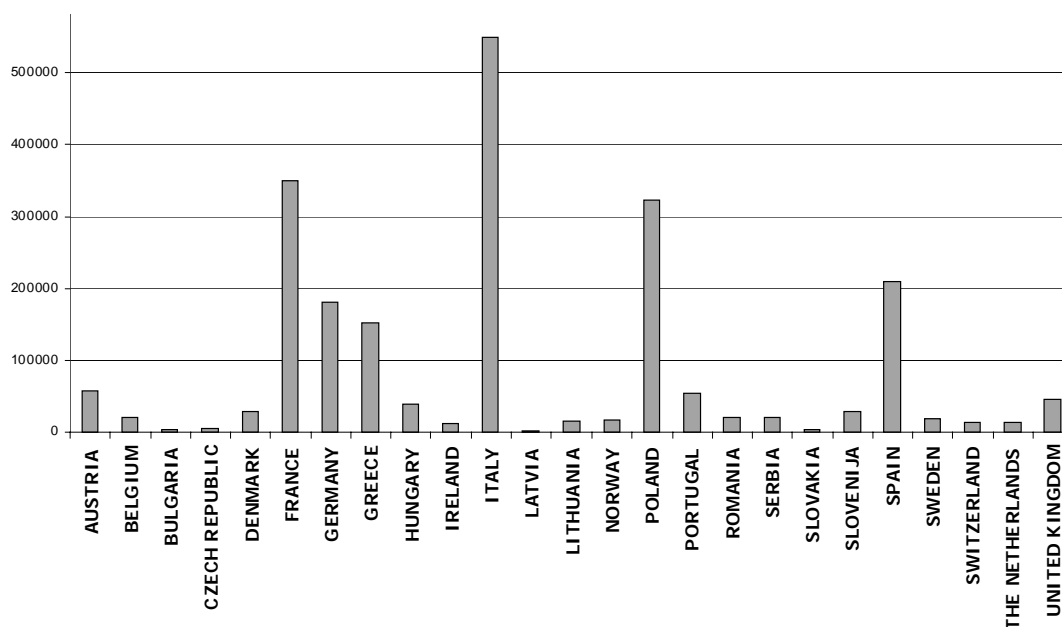


Figure 1 Number of field sprayers and air-assisted sprayers in use

To have an overview in which extent the farmers take part in the offered inspections figure 2 is added. To be able to show results from all countries where the data material was sufficient we had chosen the net graph.

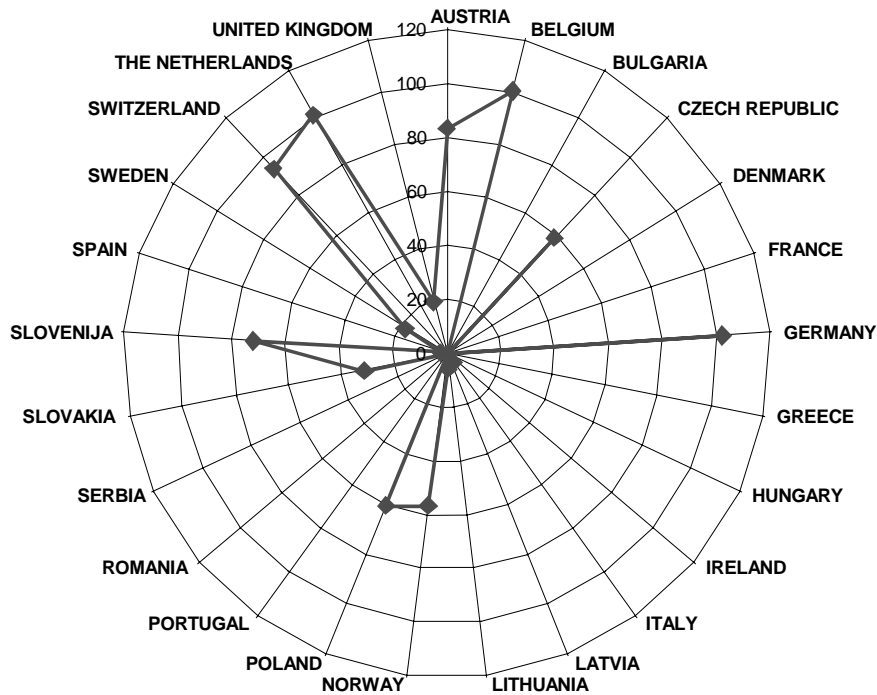


Figure 2 Inspections carried out yearly (average 2004 – 2006) as percentage of the prescribed or recommended inspections.

The calculation of these values is the following: Yearly prescribed or recommended inspections means: Number of sprayers in existence divided by the inspection interval. From this value the percentage of real performed inspections can be found out.

For example Belgium has 21.000 sprayers and an interval of 3 years so there are 7000 inspections yearly possible. There are carried out 7000 inspection and therefore the value reported is 100%.

Belgium, Germany and the Netherlands here are number one with about 100 %.

Finally I would like to show these developments which can be stated since the last SPISE workshop 3 years ago:



Figure 3 Development since SPISE 1 workshop

The number of attending countries shows the growing importance of our common intention!

The second value shows that the reservations against such survey and probably against the inspection of sprayers in general decreased during the last years.

Still two countries carry out no inspection – but today that are not the same countries as 3 years ago!

There are unchanged some countries in which a voluntary system is preferred.

Remarkable is the increasing number of countries where a mandatory sprayer inspection was introduced or will be introduced within the next time and furthermore the increasing number of yearly carried out inspections in the European countries.

Session 1 – Presentation and explanation of the information packages

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Rules of approval, rules of inspection, quality management of inspection in Germany

1. Introductory information

All in the following named documents can be reached via the BBA website (www.bba.bund.de / Plant Protection Equipment – SPISE – Information packages – Germany).

In the past few years inspections have been introduced for sprayers already in use in various Member States and candidate countries. This development has been encouraged by public concern about possible risks, and efforts to reduce the use of plant protection products. The three most important reasons for these inspections are

- reducing the risk of environmental pollution through the use of plant protection products
- optimum plant protection using the least possible amount of plant protection products and
- the safety of inspection personnel.

In order to assure the safe use of plant protection products in European agriculture, it is necessary to introduce inspections of sprayers throughout Europe and to determine requirements and inspection methods for sprayers already in use. The requirements and methods for inspecting sprayers in use are determined by European standard EN 13790, which was published in 2004. Compliance with the requirements stated shall be checked by inspection, function tests and measurements. A total of some 45 different requirements are stated which are checked during the inspection and whose results are recorded in an inspection report. This is a logical step following the standardisation of environmentally relevant requirements for new equipment.

EN 13790 also states that sprayers can be inspected either on a voluntary or a compulsory basis. In both cases, further legal and non-legislative regulations are needed, for example concerning the enforcement of inspections, the certification of centres for carrying out the inspections, intervals between inspections, administrative regulations, technical prerequisites and a quality assurance system.

It can be assumed that the thematic strategy for the sustainable use of plant protection products in the European Union will create the prerequisites / regulations which are at present missing for obligatory inspections of sprayers in use. These prerequisites / regulations are essential for assuring technical inspections of high quality and for comparability between the Member States.

The European Commission supports the introduction of sprayers' inspections in the Member States and candidate countries by TAIEX or twinning programs which finance the stay of experts in other countries.

As already mentioned, numerous Member States see the sprayers as an important element for sustainable plant protection and have therefore already introduced sprayers inspections or are planning these.

The survey presented on the occasion of the first European Workshop on sprayers inspections (SPISE) in 2004 does not of course represent entirely the current situation, but still gives an impression on the many activities in the Member States.

An updated survey on sprayers' inspections in the Member States will be presented during the second European SPISE workshop in Straelen in April 2007.

2. The current situation regarding sprayers inspections in Germany

The inspection of used sprayers has a long history in Germany. The first inspections for field crop sprayers were at the end of the 60's, for air-assisted sprayers in fruit and hop growing and viticulture in the mid 80's, initially only as voluntary inspections. The unsatisfactory participation of farmers was the decisive factor for making the inspections compulsory, which was in 1993 for field crop sprayers and 2002 for air-assisted sprayers. The owners of field sprayers and air-assisted sprayers for viticulture and fruit and hop growing are now obliged to have their equipment tested at intervals of 2 years by official inspection workshops (agricultural machinery workshops). Brand new sprayers must be inspected 6 months following initial use. But the range of such inspections is reduced to the pump, the hoses and lines and the nozzles, Annex 8. The cornerstones of the sprayers inspections are stipulated in the Plant Protection Product Ordinance. The BBA is authorised to determine the inspection procedure and the technical requirements for sprayers and inspection facilities.

The Federal States are responsible themselves for carrying out sprayers inspections in accordance with legal regulations and BBA guidelines.

The Federal States have built up a wide network of officially recognised inspection workshops; there are more than 1000 inspection centres throughout the country which carry out inspections in over 2000 locations. About 70 000 field sprayers and 25 000 air-assisted sprayers are inspected annually. It can be seen by consulting the list of sprayers that about 50 % of all the sprayers inspected was faulty and had to be repaired.

As a rule, the official inspection centres have an agricultural machinery workshop at their disposal so that obvious faults can be repaired immediately and the sprayer can leave the inspection workshop in perfect technical condition. Sprayers which are in perfect technical working order are awarded an inspection sticker when they have passed the inspection.

3. Future EU regulations regarding the inspection of sprayers

With its Thematic Strategy the EU Commission is preparing binding regulations for the sustainable use of plant protection products.

The Thematic Strategy includes numerous measures. Among these are:

- a) further education
- b) certification of new sprayers
- c) inspection of sprayers already in use
- d) aerial spraying
- e) specific measures to protect the aquatic environment
- f) reducing the use of pesticides in sensitive areas
- g) handling and storage of pesticides and their packaging and residues
- h) integrated plant protection

For sprayers, both regulations b) and c) mentioned above are relevant. Both regulations envisage a certification system for new sprayers and an obligatory inspection for sprayers already in use. The present state of both sprayer regulations is illustrated on the Commission's web pages, where current versions can be read or downloaded.

Member States and candidate countries considering regulations for sprayers should therefore now take these Thematic Strategy requirements into account.

4. Technical requirements regarding the inspection of sprayers - European standard EN 13790

European standard EN 13790 stipulates technical requirements regarding the inspection of sprayers. It also defines measuring methods and test facilities for the inspection of pumps, manometers, and the distribution quality of spray booms.

By means of the many illustrations shown in these PowerPoint presentations, the technical approach of inspections can be demonstrated very clearly and comprehensively.

This standard also states that the definition of many further technical, organisational and legal facts is required, for example whether private or national organisation, inspection intervals etc.

EN 13790, Parts 1 and 2, has been implemented into the BBA inspection regulations / features via the BBA guideline on the Inspection of Plant Protection Products and Sprayers, Part VII 1 – 3.2.1.

This prescribes how to handle new sprayers and to define minor technical deficiencies. Since EN 13790 Parts 1 and 2 only apply to field sprayers and sprayers for tall growing crops and the Commission, in its Thematic Strategy, also considers the inspection of other types of sprayers, this guideline also presents features on other types of equipment such as aircraft, hose sprayers with pistols, etc.

5. Implementation of sprayers' inspections in Germany – legal and non-legislative regulations

In order to ensure that farmers have their sprayers inspected at the intended intervals and that the appropriate possibilities/prerequisites have been established on the part of the government, and that in the case of non-compliance with the inspection obligation, necessary measures are taken, legal and non-legislative regulations are required in addition to EN 13790 in the Member States.

Germany has already introduced an obligatory inspection for field sprayers (1993) and sprayers for tall growing crops (2002) and has established the corresponding regulations. It is agreed that this is a successful example for the introduction of obligatory inspections in other Member States.

With the introduction of an obligatory inspection, the technical, organisational and administrative regulations/processes in the Federal States have to be discussed and adapted continuously in order to ensure a high-quality inspection which is comparable throughout the Federal States. The existing legal and non-legislative regulations in Germany and their use together with European rules are presented in a diagram.

Comments: When introducing sprayers inspections, the Member States must take into consideration the rules at European level, EN (e.g. Thematic Strategy) and CEN (European committee for standardisation).

Germany has taken these European rules into consideration. For example, the BBA features correspond with European standard EN 13790 Parts 1 and 2. Furthermore, the Plant Protection Product Ordinance states that sprayer which is inspected in other Member States according to EN 13790 Parts 1 and 2 is accepted in Germany if the inspection is no longer than 2 years ago.

As for regulations at national level: § 30 (1) German Plant Protection Act – the BMELV (Federal Ministry of Food, Agriculture and Consumer Protection) is authorised to establish an obligatory inspection with the required regulations and to regulate this procedure through an ordinance.

The Ministry has made use of its authority and stipulated the remaining cornerstones in § 7, 7a and 7b of the Plant Protection Product Ordinance, for example the obligation to have sprayers inspected, the types of equipment to be inspected, the intervals between inspections (2 years) and the consequences of not complying with the obligatory inspections.

§ 30 (2) of the German Plant Protection Act also states that the governments of the Federal States may delegate the inspection of sprayers to approved inspection workshops and that the Federal States have to regulate the approval procedure and the implementation of inspections.

The BMELV and the Federal States have agreed to establish a working group WG-BBA/PPS organised by the BBA, which is to co-ordinate between Federal Government and the Federal States. As a result of this working group, a workshop approval decree has been compiled for inspection workshops which stipulates the procedure for approval, and also the rights and obligations of inspection workshops.

An inspection decree has also been compiled which regulates how inspections are to be carried out, the inspection report, inspection stickers, fees and the contents of training for inspection personnel.

The proposals/recommendations made by the working group were adopted by the Federal States in their regulations and administrative provisions. Consequently, the inspection workshops are obliged to use comparable and harmonised procedures for inspecting sprayers.

In the meantime, the working group WG-BBA/PPS has become a fixed establishment and represents the discussion forum for subject matter requiring debate or co-ordination between the Federal States. In accordance with the inspection decree, the approved inspection workshops are obliged to report on the inspections carried out to the responsible plant protection service, which is the approval authority in the Federal State, and to provide the approval authority with a copy of the inspection report for each inspected sprayer. The BBA compiles a collective report with the report results from the Federal States and reports to the BMELV annually in April/May on the inspection results from the past year.

The chosen structure of the legal regulations and others is characterised by the fact that in the Plant Protection Act and in the Plant Protection Product Ordinance, fundamental matters have been defined and the technical matters, which need to be updated and developed continuously due to technical progress, remain the responsibility of the Federal States/BBA, i.e. they can be discussed and determined in the working group. This means greater flexibility as far as technical matters are concerned.

6. Quality assurance/quality management

The test benches, as they are used for pump and manometer testing and distribution measurement, must be inspected from time to time and re-adjusted if necessary. It is the job of the approval authority in every Federal State to monitor the accuracy of the test benches used. Since the plant protection service is organised differently as an approval authority in the different Federal States, and has differing resources at its disposal, the Federal States have introduced different solutions for quality assurance as far as the inspection facilities are concerned. For example, Lower Saxony has acquired mobile centres and inspects/calibrates inspection facilities at the individual inspection workshops on these premises. In North Rhine-Westphalia the inspection workshops have to show their inspection facilities to the approval authority responsible in Münster. In Bavaria, the competent authority of the plant protection service allocates this task to the DEULA (Vocational training centre for agricultural technology and know-how transfer), which carries out inspections and calibration on the premises of the respective inspection workshop.

7. Monitoring of plant protection equipment in use - plant protection monitoring program

In the Federal Republic of Germany the authorities in the Federal States monitor compliance with regulations which apply to the placing on the market and the application of plant protection products.

Monitoring is carried out in accordance with the plant protection monitoring program which provides for a national harmonised procedure for carrying out and reporting on monitoring.

The Federal States determine the subject of monitoring and the selection of farm businesses. Additionally, the focus for nationwide annual monitoring is determined.

According to the plant protection products ordinance, plant protection equipment which has not been inspected obligatorily (technical inspection) is not to be used. Therefore, monitoring checks are for seeing whether a valid inspection sticker exists. Alternatively, the operator can prove the timely inspection of his equipment by showing the inspection protocol. Furthermore, a visual inspection of the exterior condition of the equipment shows whether it has any obvious deficiencies which would inhibit the correct application of a plant protection product, e.g. leaking tanks, pipes and hoses, defective pressure gauges, dripping nozzles, defective spray booms.

In 2005, 4600 pieces of plant protection equipment were inspected. Around 2.6 % were declared as defective. Fines of up to 800 € were imposed.

In addition to the plant protection monitoring program, agricultural farms are monitored by the integrated administration and control system introduced by Regulation (EC) N°1782/2003 (InVeKoS) in accordance with cross compliance law. The farms selected are checked for compliance with good agricultural practice. As far as plant protection legislation is concerned, the certificate of expert knowledge of plant protection product use and the use of inspected plant protection equipment is checked. In 2005 the InVeKoS checked 10 738 pieces of plant protection equipment, of which 35 (0,3%) had no valid inspection sticker.

In 2005, a total of 15 388 pieces of plant protection equipment already in use were checked for a valid inspection sticker. Only 153 did not meet requirements, a rate of only 1 %.

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Inspection of sprayers in the Netherlands

1. Introduction – History of testing sprayers in the Netherlands

In the middle of the seventies and the beginning of the eighties several initiatives were exposed for testing field crop sprayers in the Netherlands. In 1988 the Foundation for Quality Control of Agricultural Machinery (SKL) was founded with the objective to develop one uniform standard for testing the spraying equipment in the Netherlands. In that year the first official testing stations were founded and the first test operators were certified. In this period the inspections were voluntary and stimulated by buyers of agricultural products. From 1997 the inspections for field crops sprayers are obligatory on basis of regulations of the Commodity Boards for Agriculture and Horticulture. In 2002 the testing of air-assisted sprayers for bush and tree crops became obligatory. The number of testing stations for testing field crop sprayers has grown to 135 and the number of stations for testing air assisted sprayers for bush and tree crops is now 16. All owners of spraying equipment now have a testing station within a reasonable distance. In 2004 SKL has started also to build up a network of testing stations for other spraying equipment, like the equipment what is in use in greenhouses.

The information package contains all documents what are involved in the organisation and execution of the sprayer tests. This documents can be reached via the SKL (www.skлкеuring.com) website.

2. Organisation

The general structure is that private owned, by SKL approved workshops do the inspections of the sprayers. SKL is the organisation what is responsible for correct and uniform sprayer tests.

The basis for the obligation for testing the sprayers is the regulations from the Commodity Boards for Agriculture and Horticulture. The regulations of these Boards are binding for all farmers, contractors, vegetable, fruit and tree growers. In the regulations is a definition of the spraying equipment that is forced to the inspections, the validity of the inspection is set, the sanctions for the farmers are explained and the requirements the sprayers have to fore fill are written. These testing standards are in line with EN-13790 with some minor differences. In the regulation of the Commodity Boards, the SKL is pointed at as a certified body what has to undertake the executing of the inspections.

From the start the system is chosen that approved testing stations carry out the inspections under supervision of SKL. SKL sets the requirements for and does the approval of the testing stations. In order to be approved, the testing stations has to have testing equipment what is in line with the requirements of SKL, a certified test operator and an adequate testing site. The requirements for the testing equipment are in line with EN-13790. A specialized trainings institute under supervision of SKL does the training of the test operators. The basic training takes two days and is finalised by an examination of both the theoretical and the practical skills of the test operators. To keep the skills of the test operators high, a two-yearly refreshing course of the test operators is obliged.

The inspections of the sprayers are done by the approved workshops following the SKL testing standards. A sprayer can only be approved if all defects are solved, there is no classification in major and minor defects. Before the test starts the sprayer has to be clean and safe.

On an approved sprayer an approval sticker is placed. On this sticker is a unique number that corresponds with number on the testing form. On the sticker is also the date for the next inspection. The colour of the sticker is every year different and follows the colour codes of spray nozzles according to ISO-10625. The results of the inspection are filled in on a testing form. This can be on paper of on-line via the SKL website. In the future all testing forms have to be filled in electronically. The advantage is

that all testing forms are filled in uniformly, the chance on mistakes is minimised and the administration for both the testing station and SKL will become more efficient.

3. Quality Assurance

Uniformity and quality are the keywords in a good working sprayer-testing scheme. The quality assurance system of SKL therefore is certified according to ISO9001:2000. This system contains the following elements:

1. Uniform testing standards with a uniform interpretation file for the elements what are not quiet clear (like standard heights for testing the cross-distribution and the standard pressure to test the cross-distribution, nozzle flow-rate and agitation capacity)
2. A yearly control on the condition and accuracy of the testing equipment. Pressure gauges, flow meters and electronic and mechanical measuring devices are calibrated yearly by SKL.
3. Unexpected at random samples on the performed tests.
4. A yearly meeting with all testing stations.
5. Administrative control on the filled in testing forms.
6. Refreshing courses for the test operators.

If the testing equipment or the testing site are not according to the regulations or the results of the at random samples of the performed test are bad, a system of sanctions is working. This sanctions vary from an extra inspection on account of the testing station to a withdrawal of the approval for testing.

4. Future developments.

To keep the testing standards in line with the technical evolution of the spraying equipment a constant attention is needed to keep the standards and the interpretation of these standards up to date. This means a uniform explanation of these standards to the testing stations and keeping the skills of test operators high by keeping the refreshing courses.

To streamline the communication between SKL and the testing stations, all communication will be via the SKL website. For stations that will not have an Internet connection on the testing site, an off-line version of the electronic testing form is made.

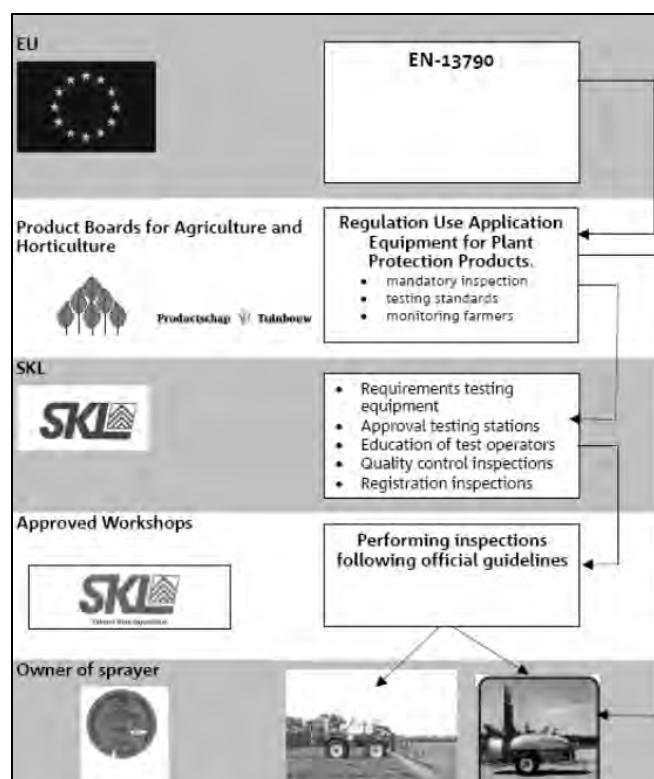


Figure 1 Flowchart of the organisation of the sprayer inspections in the Netherlands

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The inspection of sprayers in Belgium

Summary

In order to avoid the presence of excessive amounts of pesticide residues on crops as well as to protect the environment, pesticides should be used as accurately as possible. One of the prerequisites to achieve that goal is that the spraying equipment must be in perfect working order.

Since 1995, all sprayers – with the exception of some specific types – used in Belgium to apply liquid pesticides for use in agriculture must be submitted to a technical inspection every 3 years. The provisions regarding this inspection have been laid down in two Decrees. The Belgian Food Agency is in charge of this inspection, but has delegated this power to two inspection bodies: the Agricultural Engineering Department of the Walloon Agricultural Research Centre in Gembloux (CRA-W) and the Technology and Food – Agricultural Engineering Unit of the Institute for Agricultural and Fisheries Research in Gent (ILVO). Both inspection bodies are hence responsible for the administrative and practical organisation of the inspection, for raising funds, issuing inspection reports, recruiting and managing staff members and for purchasing and managing inspection equipment.

The inspection criteria have been laid down by law. When the inspection result is positive, a sticker is affixed to the sprayer and a certificate is given to the owner. When the result is negative, the owner is asked to carry out the adjustments or repairs required and to submit the sprayer for a new inspection some time later. It will be forbidden to use the sprayer any longer if no positive inspection result has been obtained within four months.

A Steering Committee, composed of representatives of the Federal and the Regional Administrations as well as representatives of agricultural organisations, supervises the compliance of inspection operations. This Steering Committee is assisted by a Technical Committee, which shall make recommendations in order to improve inspection procedures and techniques.

1. Introduction

All in the following named documents can be reached via the BBA website (www.bba.bund.de / Plant Protection Equipment – SPISE – Information packages – Belgium).

The use of plant protection products is part of our modern agriculture. In this context, a sprayer in perfect working order is a prerequisite to guarantee a satisfactory pest control, to avoid the presence of excessive amounts of pesticide residues on crops, to avoid harmful effects on the environment and to protect users. Moreover, the correct application of plant protection products can save money.

The Federal Ministry of Agriculture requested in 1993 the implementation of a compulsory inspection for crop sprayers and atomisers (orchard sprayers) already in use in Belgium (Huyghebaert et al, 1996).

Consequently, a Federal working group was set up in October 1993 and commissioned to study the practical organisation of a mandatory sprayer inspection. This working group was composed of representatives of all stakeholders: federal and regional governments, farmers' associations/unions, manufacturers, universities and research centres. Two years later, a draft bill was submitted and on 4 September 1995 the Belgian Ministry of Agriculture implemented the mandatory inspection of crop sprayers already in use in Belgium.

2. Description of the Sprayer Inspection in Belgium

2.1 Legal Basis

The mandatory sprayer inspection in Belgium is organised by the Government and is regulated by two federal rules:

- the Royal Decree of 10 August 2004 on conducting the mandatory inspections of sprayers and the fees related thereto, published in the Belgian Official Journal of 30 August 2004, and
- the Ministerial Decree of 25 August 2004 on the mandatory inspection of sprayers, published in the Belgian Official Journal of 14 September 2004.

The subjects treated by these two decrees are different. The Royal Decree aims at defining the general framework of the sprayer inspection (responsibility, fees, ...) while the Ministerial Decree focuses on the day-to-day management of the sprayer inspection (scope of the inspection, inspection protocol, tolerances, description of all official documents, ...).

The inspections are organised in cycles of three years. The two decrees are revised every cycle, so the regulations about sprayer inspection have been in constant evolution since 1995. The fourth cycle of inspection, which started on September 2004, is still going on now.

2.2 Administrative Organisation of the Inspection

The Belgian Food Agency is the competent authority for the inspection of sprayers in Belgium. This federal authority, which is placed under the supervision of the Ministry of Public Health, does not conduct actual sprayer inspections in the field but is in charge of the co-ordination of the inspections through the central secretariat. Its main tasks are the updating of legislation, the administrative follow-up and the management of the litigious cases.

If a sprayer is not submitted for mandatory inspection, the Central Secretariat gets in touch with the owner to find out the reason of his absence at the inspection (retirement, sprayer sold, ...). Whenever necessary, the inspection services of the Belgian Food Agency will carry out inspections at the owner's premises in order to clarify questionable cases.

The Food Agency has delegated the practical inspections of sprayers to two inspection bodies by means of an agreement. These two inspection bodies which depend of the Regions conduct the inspections, i.e. the "Agricultural Engineering Department" of the "Walloon Agricultural Research Centre (CRA-W)" in Gembloux which conducts the inspections of sprayers used in the Walloon region and the « Agricultural Engineering » section of the « Institute for Agricultural and Fisheries Research, (ILVO, T&V - AT)" which conducts the inspections of sprayers used in Flanders.

These two bodies are responsible for the administrative and practical organisation of inspections (planning, sending letters inviting to attend inspection, technical inspection), issuing inspection reports, fund raising, recruiting and managing staff members, purchasing and managing inspection equipment and reporting to the central secretariat.

Inspections are supervised by a Steering Committee composed of representatives of the Belgian food Agency, the inspection bodies, the regional Administrations and the professional associations (of farmers, contractors and importers). The Steering Committee may request the assistance of a Technical Committee composed of experts which may make recommendations for the improvement of inspection procedures and techniques.

When a user contests the decision of the inspection body (rejection of a device), he can make a complaint to the Appeals Committee. This Committee includes representatives of the Belgian Food Agency. Figure 1 represents the administrative organisation of the mandatory inspection of sprayers in Belgium.

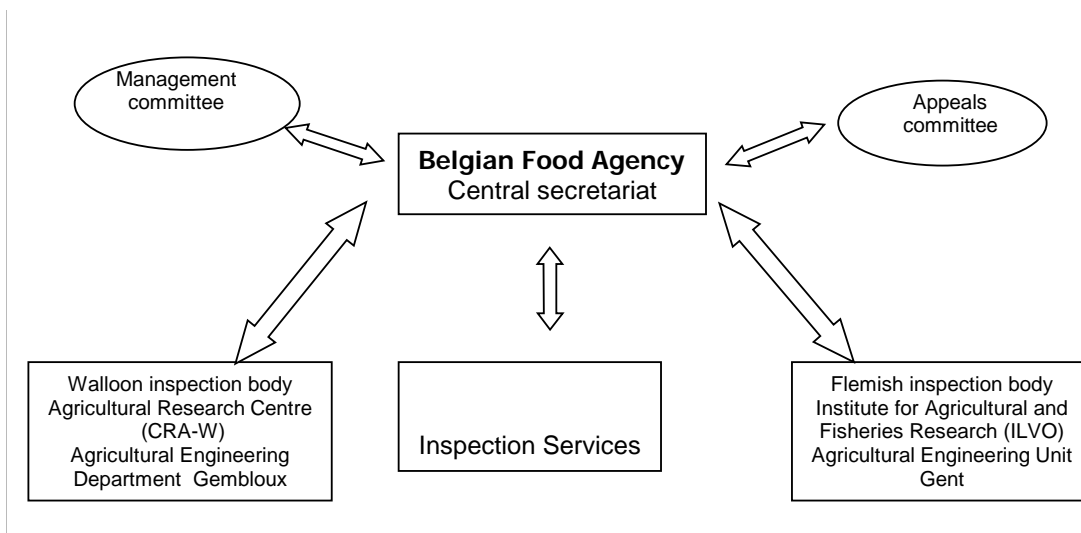


Figure 1 Administrative organisation of the mandatory inspection of sprayers in Belgium

2.3. Scope of the Inspection

Any device intended to apply plant protection products in a liquid form and used on the Belgian territory shall be submitted for inspection every three years. Some sprayers are excluded from this scope: hand or gas pressurised sprayers, knapsack sprayers and lance sprayers.

It should be noted that farmers having their official address in another Member State of the European Union (this means for Belgium: the Netherlands, Germany, Luxemburg and France), are allowed to use their sprayers that have not been tested by the Belgian authorities on Belgian territory provided that these sprayers have been tested by the competent authority of this Member State and that a valid certificate has been issued for it.

2.4 Inspection Procedures and Methodology

Inspections are carried out by mobile test teams (figure 2), which go to different sites of inspections located near the user's premises. Owners of spraying equipment are officially invited to present their spraying equipment at one of the test sites at a given date and time. The notice is sent to them at least 3 weeks in advance. In this way, the user can prepare his sprayer for the actual official inspection. The notice gives vital information to the user: where and with which sprayer he should present himself, the conditions of admission, the 13 possible reasons that may lead to rejection of the sprayer, the inspection fees and the terms for requesting a postponement of the inspection. The inspections are planned geographically and according to a preset time schedule. The test periods for each region are arranged according to the number, type and size of sprayers in that region. To minimize time loss for the farmers and to optimize the time management of inspection teams, farmers are invited to attend inspection at a specific day and time.



Figure 2 Van used by mobile test team for the inspections

Inspections of sprayers are conducted in accordance with the inspection method described in annex 1 of the Ministerial decree specifying the method for inspecting crop sprayers, orchard sprayers and all types of other sprayers working according to the same principle.

Several checks are done when the sprayer is not operating, most of them being visual like the state of maintenance of the sprayer, the protection of moving parts, the presence of filters, the readability of the manometer, the presence of obstacles in the spraying nozzles (pipe), the presence of leaks. Then, when the machine is spraying, several measurements are carried out in order to check the functioning, e.g. the pressure stability of the manometer, the flow rate of the nozzles ...

The different items, which are checked, the tolerable deviations and the correct interpretation of the test result, are described in the Ministerial Decree (table 1).

Table 1 Items to check, tolerable deviation and interpretation of the test results are described in the Ministerial Decree

Code	Parameter checked	Test : <u>Visual</u> <u>Measurement</u>	Item inspected by observation or measurement	Limit values	Interpretation of test (1)
<u>General Order</u>					
A1	State of maintenance of sprayer	V	Absence/Presence of pieces of rope, iron wire, rust,	Obvious signs of poor maintenance	FF
A2	State of the fan	V	Check the state of the fan blades and the deflectors	Fan blades and/or deflectors clearly damaged	FMR
<u>Tank Contents</u>					
<u>Gauge</u>					
B1	Absence/Presence	V	Absence or presence of tank contents gauge	Absence of a tank contents gauge	FF
B2	Readability	V	The mark of the fluid level is read from the driver's seat	Fluid level in tank cannot be read by means of filling scale	FF
<u>Filters</u>					
C1	Absence/Presence of a basket filter/suction filter	V	Absence or presence of basket filter/suction filter	Absence of basket filter/suction filter	FF
C2	State of basket filter/suction filter*	V	Inspection of the state of sieve and/or extent of obstruction	Sieve damaged and/or obstructed	FMNC

Code	Parameter checked	Test : <u>Visual</u> <u>Measurement</u>	Item inspected by observation or measurement	Limit values	Interpretation of test (1)
C3	Absence/Presence of suction filter	V	Absence or presence of filter on pump suction	Absence of suction filter	FF
C4	State of suction filter*	V	Inspection of the state of the sieve and/or extent of obstruction	Sieve damaged and/or obstructed	FMNC
C5	Absence/Presence of pressure filter	V	Absence or presence of pressure filter	Absence of pressure filter	FF
C6	State of pressure filter*	V	Inspection of the state of the sieve and/or extent of obstruction	Sieve damaged and/or obstructed	FMNC
C7	Absence/Presence of section filter(s)	V	Absence or presence of section filter(s)	Absence of section filter(s)	FF
C8	State of section filter(s)*	V	Inspection of state of sieve and/or extent of obstruction	Sieve damaged and/or obstructed	FMNC
	* only in case of a hydraulic problem				
	<u>Spraying Arc</u>				
D1	Symmetry and deformation	M	Inspection of the symmetry of the spray boom with regard to the hitch points on the frame or the tank and deformation thereof	No left-right symmetry and deformation of spraying arc > 5 cm	FMR
D2	Fixation of arc	V	Inspection of the solidity of the fixation of the arc to the tank	No solid fixation	FMNC
D3	Symmetrical spacing of nozzle holders	M	Checking (by measurement) if the distance between nozzle holders left and right is symmetrical	Different spacing (no left-right symmetry) > 3 cm	FMNC
D4	Symmetrical position of nozzle holders	M	Checking (by measurement) if angle of slope of nozzle holders left and right is symmetrical	Different spacing (no left-right symmetry) > 10°	FMNC

2.5. Reporting results

When the sprayer passes the inspection, it may be used in a normal way during the validity time of 3 years and a sticker is affixed on it. When it fails the inspection, the sprayer must be repaired and presented again for inspection after no more than 4 months. The owner receives a report mentioning the results and the conclusions of the tests.

Defects are classified in 3 categories of severity: 1) defects that should be repaired immediately - sprayer rejected, 2) defects that should be repaired within 3 years - sprayer is approved, 3) minor remarks to improve the use of the sprayer. Besides the identification of the defect, also an objective advice on how to solve the problem is mentioned on the report.

2.6 Inspection Fees

The inspection fees which are due by the owner are fixed in the Royal Decree. They are fixed on such a level that the inspection services, which are self-sufficient, can finance their tasks while limiting the cost for farmers to an absolute minimum.

For crop sprayers, the inspection fees rate from 70 € to 142 € depending on the boom length. For orchard sprayers the fees are fixed at 70 € Second passage fees rate from 12,5 € to 62,5 € depending on the severity or the type of the failure.

2.7 Other Features

In order to update the database of sprayers that must be submitted to inspection, it is important for the inspection body to know the movement of sprayers. If a sprayer (new and/or second hand) is sold, this sale shall be notified by the seller to the inspection body by means of a form, which appears in the annex of the Ministerial Decree. Similarly, when a sprayer is taken out of use, the owner shall inform the inspection body and disassemble the spray boom or spray arc.

3. Conclusions and Perspective

Inspections of sprayers in Belgium became mandatory in 1995 and take place every three years. They are now well established.

- Inspections are organised by the Government and conducted by two Regional control bodies. A Steering Committee supervises the inspections so as to guarantee the objectivity and the transparency of inspections.
- Inspections of sprayers are conducted in accordance with the inspection method and tolerances described in annex 1 of the Ministerial decree so as to guarantee the uniformity of inspections
- Inspections are carried out by mobile test teams on sites located near the user's premises
- Inspection bodies issue an inspection certificate to the owner with all the results and the Conclusions so that users are well informed
- Inspection bodies are self-sufficient and the fees are fixed at such a level that they can finance their tasks while limiting the cost for farmers to an absolute minimum.

The fourth cycle of inspections will end in September 2007. At this occasion, legislation will be amended. The protocols for the inspection of crop and orchard sprayers fixed in the Ministerial Decree have been compared to the CEN specifications (EN 13790 part 1 and 2). Some relevant parameters in the Belgian protocol have been adjusted to be in line with these specifications.

Two new protocols will also be added to annex 1 of the Ministerial decree, one concerning the inspection of sprayers for soil disinfections and the other concerning sprayers in (ornamental) horticulture. Finally, the inspection fees will be increased to make sure that inspection bodies can remain self-sufficient.

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Results of Session 1 - Presentation and explanation of the information packages

Discussion

1. There were 14 questions addressed to the experts who presented situation on inspection activities in Germany, Netherlands and Belgium
2. Main questions were about simplified procedures for new sprayers in the period of first seasons after purchase, about the possibilities of mutual recognition of approved sprayers between neighbouring countries, about the standardisation of length of intervals between inspections and about the improvement of quality assurance management results and systems

Results and Conclusions

The level of introduction EN 13790 in the national rules for sprayers' inspection is high in countries with long tradition of testing sprayers, but still not 100% in none of the countries.

More precise instructions – guidelines on the following topics are needed:

1. Additional specific and clear enough criteria (types of faults) for rejecting the sprayers are needed.
2. Clear guidelines for system of training of inspection personal (testing operators), SPISE shall define the frequency and methods of regular education for testing operators, proposals for common European training system shall be prepared.
3. Some modifications in basic rules for authorisation (recognising) procedures for workshops shall be proposed by SPISE (exact proposals for information transfer between the authorities and the workshops, agreement samples, rules for withdrawal of licences, ...).
4. Additional guidelines for the inspection (monitoring) of workshops (random visits of workshops, visual observation of work carried out by operators and additional checks of accuracy of measurements performed by operators, ...) are necessary.
5. New proposals for unified quality assurance systems should be prepared by SPISE.
6. The procedures for performance of quality assurance activities shall follow the scheme of ISO standards valid for similar authorised organisations for technical inspection.
7. The development of procedures for mutual recognition of sprayer inspections is necessary to enable farmers and contractors to use the equipment in neighbouring countries without need to perform the test twice.
8. In order to insure the additional high quality of sprayer testing some recommendations should be prepared to define the optimum number of tested sprayers per year per testing team.
9. In the future (a few year time scale) some amendments of EN 13790 will be needed to improve above mentioned topics and to suite to the needs of many new types of equipment for application of PPP.

Session 2.1 – Mandatory inspections – what is to be taken into account

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Recommendations of SPISE 2004 and obligatory inspection of sprayers in Poland

Summary

The aim of the 1st SPISE Workshop was to stimulate the implementation of the EN 13790 standard in Member States and to harmonize the inspection of sprayers that would enable mutual recognition of the inspections between the countries. The comparison of the EN standard with the current Polish sprayer inspection system justifies the statement that the most of procedures are similar, including those proposed as long-term actions. The obligatory inspection of both tractor driven and self-propelled sprayers for field crops and fruit growing was introduced in Poland in 1999. The procedure was based on the proposal of EN 13790 standard. The same procedure applies both to new sprayers and the sprayers in use. However, no knapsack sprayers and greenhouse equipment is subject to the inspection. The system has been organized and supervised by the Plant Health and Seed Inspection Service. It includes 360 officially approved commercial test stations. The personnel of the test station has to follow the 5-day training course and pass the official examination. The Polish system allows the minor repairs of the sprayers during the inspection. The calibration of sprayers is not included in the inspection procedure. The control system of sprayer test stations was established in 2006 in order to guarantee high quality and uniformity of sprayer inspections. Among Polish farmers an increased interest in sprayer inspection is observed for it is an important requirement of Good Agriculture Practice and therefore is a must in the certified production systems such as Integrated Production or EurepGAP. A harmonization of inspection procedures and mutual recognition of inspections between Member States is needed in the situation of increasing import of new and second-hand sprayers.

Key words: obligatory inspection, sprayers, testing

1. Introduction

The aim of the 1st SPISE Workshop was to stimulate the implementation of the EN 13790 standard in Member States and to harmonize the inspection of sprayers that would enable mutual recognition of the inspections between the countries (Ganzelmeier, 2004). The workshop was not only the place of information exchange but also brought a very valuable conclusions and recommendations regarding the organization, procedures and criteria of testing of sprayers in use as well as the training for the personnel of testing units. It also showed the main directions for the future, European harmonized system. The participants had a unique opportunity to compare the situation in their countries and to specify recommendations in order to improve their national sprayer testing systems.

The conclusions and recommendations of the 1st SPISE Workshop were carefully analyzed in Poland. The results of these analysis are included in the presented paper. The analysis was carried out according to the structure of the Workshop sessions, where the future recommended actions (short/long-term) were described.

2. Actual inspection on the MS and their comparison with EN 13790

The comparison of the EN standard with the current Polish sprayer inspection system justifies the statement that most of procedures are similar, including those proposed as long-term actions (Table 1). The obligatory inspection of both tractor driven and self-propelled sprayers for field crops and fruit growing was introduced in Poland in 1999. The procedure was based on the proposal of EN 13790 standard. The same procedure applies both to new sprayers and to the sprayers in use. In order to increase

the importance of the sprayer inspections they were implemented into the certified production systems (Integrated Production, EurepGAP).

Table 1 Results of Session 1 “Actual inspection in the MS and their comparison with EN 13790”

a) objective to improve situation	In Poland
1. Establish a uniform level of sprayer inspection throughout the EU by application of EN 13790	
- standard procedure for training the personnel involved in the inspection	YES
- standardise the period an inspection certificate is valid	YES
- standardise the type of supervision of the inspection centre	YES
2. Establish European guidelines also concerning:	
- type of adjustment of the sprayers	YES ¹
- how to use the sprayer in a proper way	YES ¹
b) need for further action	
2. EN 13790 inclusion into the national regulation in all MS	YES
- the inspection of application equipment in use in all MS and CC	YES
- to harmonize different national (MS & CC) regulations on sprayer inspection by complying progressively with EN 13790	YES
- to include the sprayer inspection into the production specifications (EurepGAP, labels, traders, specifications ...)	YES
- to develop an European standard also for the inspection of other types of sprayers (greenhouse ...)	YES ¹
- to improve sprayer adjustment as a part of inspection	NO

¹) general opinion in Poland

Knapsack sprayers and greenhouse equipment are not included in the mandatory inspection in Poland. The official bodies and the farmer unions are waiting for the proposal of testing procedure specified at least as a draft of EN standard. That would enable mutual recognition of the inspections between countries.

Including the sprayer calibration in the inspection should be a subject to the extended discussion. As calibration of sprayer should be made for a specific application and take into account specific circumstances of the treatment (crop, plant protection product, whether) setting the parameters of application once every two or three years, at the occasion of inspection makes no sense. On the other hand this kind of service offered by testing stations may be a chance to educate the operators with low skills how to calibrate the sprayer.

3. Administrative regulations required for establishing an inspection

Based on the Act on Plant Protection of 1995, the State Plant Health and Seed Inspection Service (PIORiN) was established to coordinate all the phytosanitary activities including inspection of sprayers (Table 2) (Holownicki et al., 2004). The requirements for the sprayers as well as general principles and procedure of the mandatory sprayer inspection were elaborated by the group of experts appointed by PIORiN. They were introduced by the Decrees of the Minister of Agriculture and Rural Development and came in force in 1999. The EN 13790 standard for inspection of sprayers in use, at that time being still a proposal under discussion, was used as the guideline for the Polish system in order to adapt it easily to the European model when it becomes a directive. After the last amendments of Act on Plant Protection in 2004 also new sprayers have to be tested according to the same procedure.

Despite of our suggestion, the term “minor defaults” was not added to the inspection procedure. It means that all the components of the sprayers have to pass positively inspection procedure and each defect found has to be repaired and checked again.

Table 2 Results of Session 2 “Administrative regulations required for established an inspection”

	In Poland
a) objective to improve situation	
1. To establish administrative regulations which guarantee a high quality level of sprayer inspection	YES
2. To establish an European training scheme for inspectors	YES ¹
b) need for further action	
1. Establishing legal regulations for sprayer inspections on the basis of EN 13790 in all MS.	
- the commitment to either voluntary or mandatory inspection	YES
- the organization of inspection	YES
- the procedures for sprayers in use and brand new sprayers	YES
- the procedure of approval of test stations	YES
- the definition of minor defaults	NO
- the consequences of failure	YES

¹) general opinion in Poland

In Poland sprayers are tested every 3 years in 359 approved Sprayer Test Stations – SKO, established on commercial basis, equipped with diagnostic equipment of specified parameters and employing the staff trained in the approved Centres of Education on Plant Protection Technique – CSTOR (15 hours of lectures and 20 hours of practical training).

4. Technical prerequisites required for conducting inspections

The EN 13790 standard sets the rules of inspection of sprayers. The weak part of this standard is evaluation of nozzles. Implementing both flow rate and transverse spray distribution methods for evaluation of nozzles on field crop sprayers caused some confusion because the results of evaluations made according to those methods cannot be compared. In order to avoid this confusion only one methods specified in the EN 13790 should be implemented in a given country.

The nozzles on orchard sprayers are evaluated by the flow rate method which is relatively simple, cheap easy to understand by growers. The vertical spray distribution seem to be difficult to interpret by the personnel of the testing stations, because it is influenced not only be nozzle quality but also by nozzle setting and air-jet distribution. Besides, the optimal vertical spray patterns for different spices and training system of trees are not yet specified.

Table 3 Results of Session 3 “Technical prerequisites required for conducting inspections”

	In Poland
a) objective to improve situation	
- Observance of (new) administrative regulations	YES
b) need for further action	
1. Establish a list of technical prerequisites for implementing the inspection. Establish a sort of “step by step receipt” and focus on the key points of the success.	YES
2. Define inspection procedures for brand new sprayers	YES
3. Define how to manage sprayers with minor defaults	NO
4. Follow the definitions of EN 13790 concerning vertical distribution measurements for air-assisted sprayers	NO
5. Ensure the repeatability and the reproducibility of the measurements by agreed protocols	YES
6. Specify the procedure of approving the measuring instrumentation	YES

5. Quality management for the inspection

The inspection procedures as well as diagnostic equipment should meet the requirements specified in regulations in order to ensure the uniform terms of the inspections in all testing stations. In 2006 the control system of testing stations was established in Poland to guarantee high quality and uniformity of sprayer inspections. The inspection procedure was accepted by the State Plant Health and Seed

Inspection Service. The performance of inspections is controlled by the approved laboratory of the Industrial Institute of Agriculture Engineering in Poznań (member of ENTAM) and the officer representing the regional office of the State Plant Health and Seed Inspection Service.

Table 4 Results of Session 4 “Quality management for the inspection”

	In Poland
a) objective to improve situation	
1. Uniform comprehensive guidelines for quality management	YES
2. Regular training courses for staff of inspection stations	YES
3. Testing equipment needs regular check of its measurements	YES/NO
b) need for further action	
1. Development of quality management system on inspection. Specifying minimum requirements on qualifications of inspection personnel and training courses	YES
2. Exchange information how a better quality management can be introduced taking into account the specific national conditions	YES ¹

¹ general opinion in Poland

In 2006 over 50 testing stations were controlled and another 50 inspections are planned in 2007. During the control action the diagnostic equipment is checked for compliance with the requirements and for accuracy. The measuring devices are calibrated.

The inspectors of testing stations need to follow the 5 day training course and pass the exam before they are approved for the inspections. According to the existing regulations this approval is of unlimited duration. These regulations may need revision to ensure the updating of the inspectors' knowledge during the 2-3 days seminars organized every 3 years.

6. Harmonization of inspection for mutual recognition between Member States

The Polish system of sprayer inspection is based on EN 13790 standard and it follows most of the SPISE recommendations. It means that it is well prepared for mutual recognition between Member States. However, the ministerial decree is needed to avoid double inspections of imported new or second hand machines. The establishing of the European Steering Committee may help to improve the quality of inspection and solve the problem of mutual recognition between MS.

Even the best organized inspection of sprayers, based on the most restrictive regulations and supported by a very competent control system will not improve environment, personal and food safety if operators' awareness is not increased. Therefore obligatory inspection of sprayers should be complemented by the education activities such as training courses for the operators. In 1999 such trainings were introduced in Poland as a mandatory routine. The operators have to attend a 2 day training course in one of 235 certified education units where the officially approved program is followed. The training includes 10 hours of lectures on basic rules of plant protection and safe use of PPP followed by 4 hours of practical training on application technique and calibration of sprayers.

7. Conclusions

Polish system of inspection of sprayers meets most of the SPISE recommendations. In particular:

- Most of the inspection procedures follow EN 13790 standard on testing sprayers in use.
- Inspection of knapsack sprayers and greenhouse equipment in MS should be proceed by the EN standard.
- Calibration of sprayers only once every second or third year during inspection seems to be controversial. Procedure of calibration should be a vital part of training courses for operators.
- The inspection of new sprayers based on EN 13790 standard was introduced in Poland in 2001.
- The Polish system of inspection of sprayers in use is organized and supervised by official body (Plant Health and Seed Inspection Service).

- Only one method of evaluation of nozzles in field crop sprayers should be used in a given country.
- The performance of inspections is controlled by the approved laboratory since 2006.
- The inspectors of testing stations follow the 5 day course and have to pass the official examination.
- Training courses for operators should focused mainly on the safe use of ppp and on calibration of sprayers.

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Mandatory inspection of sprayers in the Czech Republic for the past 10 years

Summary

The quality of plant protection products (PPP) application is one of the most important aspect in the crop protection. The present economical and environmental situation needs to improve application equipment and application technology for a reduction of a potential danger of environmental contamination.

Key words: mandatory inspection, plant protection equipment

1. Introduction

Throughout the world, official authorities are trying to improve the use of pesticides in an agriculture. The inspection of plant protection equipment (PPE) in use is one of the steps to avoid a proper plant protection and to improve an equal level of human health and the environment. Different schemes are established in order to testing a functional capability of sprayers in many countries.

1.1 Registration of new PPE types

New PPE which is used for PPP application must comply with technical and technological requirements in the Czech Republic.

1.2 Inspection of PPE already in use

Inspection of PPE in use was established in 1997 in the Czech Republic. The inspection cover field sprayers, orchard sprayers, seed treaters and aerial application equipment.

2. Standards and requirements

The Czech scheme of the new sprayers registration and the inspection of sprayers in use is working in light of European standards.

2.1. Requirement for the new type PPE registration

Requirement for PPE in a connection with environmental protection are demanded at new PPE. Standard EN 12761 Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors – Environmental protection – Part 1, 2, 3 was introduced to the Czech system (CSN).

2.2 Requirements for the inspection of PPE in use

Requirements and methods for the inspection are stated according to EN 13790 Agricultural machinery – Sprayers – Inspection of sprayers in use – Part 1,2. Requirements for seed treaters and aerial application equipment are stated on national level. These requirements and methods are set in the Act No. 326/2004 on phytosanitary care. Procedures for carrying out inspection requirements for testing facilities and their accuracy were based on ISO 5682-2. Requirements for establishing of stations and technical and technological requirements for inspection are stated by the Order of the Ministry of Agriculture No. 334/2004 about mechanisation means for plant protection.

3. Responsibilities

The State Phytosanitary Administration (SPA), Application Technique Department is responsible for registration procedure of new PPE and for introduction and realization of the inspection of PPE in use as well as their approval procedure. The SPA carried out supervision over the mandatory inspection and for the supervision over proper PPP application.

4. Activities

Thematic strategy – Framework Directive about sustainable use of pesticides. Participation in EU Life project TOPPS - East cluster together with Poland and Slovakia. Establish a new information system – online on internet www.srs.cz . Cooperation with foreign countries – close contacts with BBA.

5. Conclusions

The inspection of PPE in use is a functional system in the Czech Republic. About 6 000 sprayers are in use (3500 field sprayers and 2500 orchard sprayers) in the Czech Republic. 55 testing stations have been approved in the Czech Republic. 65 % of PPE in use has been inspected during four two-years period.

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Mandatory testing of field sprayers and orchard sprayers in Norway

Summary

Testing of field sprayers and orchard sprayers started up voluntarily in 1991 and 1995 respectively. In 2000, the Norwegian parliament made the test mandatory. Due to practical reasons, all the sprayers had to be tested within the year 2005. Since the first SPISE workshop, the Norwegian requirements have been harmonised due to the EN 13790-1/2. However, we have included some earlier additional requirements in order to increase the technical level of recently new sprayers, especially due to environmental aspects and more user friendly equipment.

The topography and infrastructure in Norway are difficult. Therefore, the testing system is implemented in approx. 70 mobile trailers located across the country. In addition, the user of the sprayer has to participate in the test. Thus, only 1-6 sprayers are normally tested at the same location. In average less than 50 sprayers are tested per testing unit on an annual basis. This means that Norway uses rather cheap testing equipment which can be quickly mounted / dismounted and quickly put to use, in order to lower the costs of the tests. The sprayers must be tested every 5 years. From the year 2004, testing of sprayers has become a part of the educational programme for pesticide applicators. During the test, the user learns to calibrate the sprayer every year. A prepared check list is made for this purpose. The test normally takes 2 hours, and the sprayers are mostly repaired and updated during the test. In spring 2007 we are planning to start a testing programme for spraying equipment in greenhouses, to ensure the use of correct dose. Testing in other crops and productions are also continuously evaluated.

Key words: mandatory inspection, plant protection equipment

1. Introduction

A correct use of sprayers as well as a high standard on the spraying equipment is an important factor to ensure an environmental and precise spraying application. Therefore, a testing programme of the sprayers in Norway started up voluntary for crop sprayers in 1990. Later on a voluntary testing programme for tractor mounted orchard mist sprayers was initiated in 1995. Within 2006-01-01 all crop sprayers and orchard sprayers had to be tested in accordance to the mandatory testing programme. The testing frequency is every five years.

2. Objectives

The objectives of the function test in Norway are:

- Control of the sprayer
- Repair of the sprayer
- Information and demonstration to farmer / user about the test results and how to calibrate the sprayer by the use of clean water to ensure a correct and even dose
- Motivate the farmer to get a better understanding and perform a proper sprayer application

After our point of view, all these parameters have to be taken into account when evaluating the quality of a function test.

After the SPISE I in 2004, the testing requirements in Norway are strongly harmonized due to the EN-standards. This work will also continue in the future. However, some adaptations and additional requirements are supplied, mainly to meet our specific conditions and increase the sprayer quality regarding environmental aspects as well as other technical issues. In this paper these deviations are better described and the reasons for these implementations are explained.

3. Testing equipment

Because of our topographic and geographic special conditions, and because one requirement is that the farmer himself shall join the test, more than 70 testing trailers may offer the test in Norway, see figure 1. The trailer contains all necessary facilities to complete a test, such as tachometer, flowmeter to measure pump capacity, three reference manometers (1-10 bars and class 1.0), patternator (Lurmark, UK) to measure the boom distribution, jugs for measuring the nozzle capacity (Hardi and Spraying Systems jugs), filter samples for determination of filter mesh sizes, washing facilities for the test operator, safety package for demonstration, testing protocols, check lists and spare parts (nozzles, filters, hoses, pipe lines, pumps etc).



Figure 1 Testing trailer equipped with necessary testing equipment and spare parts.

This gives the following advantages:

- the transport costs and time consume are low from the farmer/ grower's point of view
- the tractor normally used for the spraying operations will be tested (travel speed)
- easier to ensure that the farmer/ grower joins the test
- measurements may be done in some extent in the field/ orchard
- only 1-5 tests per localisation. There is no need to collect the water used for the test (the sprayer has to be proper cleaned before the test can start)

4. Test procedure

When the farmer contacts the test operator for the first time, basic information about type of sprayer, main function and standard of the sprayer is exchanged. The farmer has to clean the sprayer properly and test the sprayer with clean water to determine leakages and/ or operating failures. This shall be reported back to the test operator in forehand. Thus the test operator can calculate roughly time needed and what kind of extra spare parts that is necessary. The farmer is asked to fill the tank at least half with clean water and arrive by the tractor he normally uses when spraying. If possible 3-5 farmers should meet at the same testing place, but in many cases the test is carried out at every farm. Then he does not have to travel long distances by tractor. The farmer has to join the test. Therefore the farmer is more relaxed, learns more from the test and gets more motivated to take care by the further spraying application with pesticides.

A test includes control of functionality and control of leaking of the sprayer. The pump capacity, the manometer exactness, the sprayer and boom construction and the stability and not at least the control of the nozzles on the boom are measured. The nozzles are measured by distribution as well as by flow rate of every nozzle. Failures are repaired mostly during the test. The test takes in average 2 hours. The farmer, grower or user has to join the test to be skilled in correct use and calibration of the sprayer. Before every season he is asked to do a test alone by using a check list adapted for this purpose. The function test shall be carried out at least every 5 years, but the instructed self calibration is recommended to be done every year. The function test as well as the check list includes a control of the driving speed. This is very much appreciated by the farmer. Frequently, failures in driving speed may occur and have to be avoided.

5. Documentation

The farmer gets a copy of the test protocol as well as a check list with correct values for the first year. In addition a "Function test" sticker is attached the sprayer as well as a "Registration" label to state that the sprayer is approved. The protocol may also be filled out digitally. In this way necessary calculations are done automatically.

6. Requirements

The requirements have always been further adapted according to the progress in the sprayer development. To increase the quality of the new sprayers in Norway, the requirements were made stricter for sprayers bought new after the 2001-01-01. This was especially due to components that would be more expensive to install on older sprayers, but easier to mount into new sprayers, when produced. Such requirements were made firstly due to better environmental solutions, but also for an increased spraying quality. Examples of such requirements are flush tank and flush nozzle (from tank size 600 litres) and safe and simple handling of filters and emptying of the tank. Also a safe and simple regulation of boom height (from 8 meters and above) was required. In this way recently new sprayers have got an improved standard without any high costs and all the farmers will therefore still become motivated. The farmers are of course free to install even more sophisticated solution as remote control, pesticide filling devices etc.

A further harmonization of the requirements according to the EN-standards was implemented for new sprayers bought after 2006-01-01. We do still use the Lurmark patternator. From our point of view this equipment for crop sprayers of our size gives important and visual information. Effect of wrong nozzle height may simply be demonstrated. Additionally, every nozzle output in litres per min is measured. Therefore nozzle test carried out in Norway fulfil the EN-standard. Other examples on requirements for sprayers bought new after 2006-01-01 are;

- - the manometer shall have a diameter of at least 100 mm.
- - the sprayer shall be equipped with a calibration valve or similar for constant dose control
- - Trapez or similar equipment shall be mounted for booms from 10 m width and above.
- - All sprayers shall be equipped with flush tank and flush nozzle of sufficient quality. At the moment a flush tank of only 7.5% of the main tank is required. This will probably be increased in the future in order to ensure a proper flushing quality.

7. Quality of testing equipment

The exactness of the testing equipment is mainly in accordance to the requirements in the EN-standards, expect for the patternator (Lumark). However, the control of the nozzle capacity is, as earlier mentioned, in accordance to the standard.

8. Control of testing equipment

Until now, mainly the reference manometers are controlled annually. The testing equipment has to be controlled more frequently in the future in accordance to the EN-standard.

9. The frequency of testing

The sprayers in practical use have to be tested every five years. However, a check list is carried out, where the farmer/grower by his own can calibrate the sprayer properly before every season. A demonstration of such a checklist is included in the function test of the sprayer. In this way, the farmer / grower learn to work quickly and exactly and fills in the need values. This list also includes the test of the driving speed.

New sprayers have to fulfil even more requirements, as earlier explained. Of practical reasons, it is difficult to make a test of a new sprayer in such a way that the farmer/ grower may join the test. However, a sticker has to be fixed on the sprayer, to underline that the sprayer fulfils the requirements and has proved a distribution test. The new sprayers may be tested in the country where they are produced, at the main dealer in Norway, at the local sprayer shop or at the farm. The last case happens very rarely. The forthcoming grower/ farmer has to get the sprayer tested by a skilled testing personal within five years due to the requirements according to the EN-standard and the added Norwegian requirements for new sprayers, as earlier described.

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Results of Session 2.1 – Mandatory inspections – what is to be taken into account

Discussion

1. Which sprayers will be inspected?
 - Other sprayers than boom sprayers and orchard sprayers?
 - Only sprayers for professional or commercial use? Limit to tank size?
2. What will be inspected on the sprayer?
 - How to inspect band sprayers?
 - How to handle minor defects?
3. Who will do the inspection?
 - Objectivity of the inspections necessary.
 - Inspection and need to repair sprayers
 - What about inspection by trained and authorised persons, not employed in mechanic workshops
4. When the inspection will be done?
 - Recently the time interval in Europe is 1 to 5 years. Problems with mutual recognition in border regions. Should the frequency be harmonised?
 - Differences between contractors and others?
5. Where the inspection will be done?
 - Central location, local workshop or farm site?

Results and Conclusions

According to the discussion points above:

1. It should be clarified what is meant by “all sprayers” in the draft European guideline. For instance, inspection of knapsack sprayers should be avoided. It is necessary to consider the amount of chemicals that is applied with and the risk caused by several kinds of sprayers.
2. EN 13790 gives good information on subjects to be inspected.
 - For field sprayers still cross distribution or flow rate measurement possible.
 - Method for band sprayers not yet clear.
3. When inspection system is introduced inspection by public institutions may be appropriate but not necessary. Private workshops with trained personnel and authorisation are useful to ensure an appropriate density of inspection points. Inspection by other trained and authorised persons may be useful for sprayers with specific inspection requirements (e.g. spray booms in glass houses, equipment with hand held lances, helicopter spraying equipment). Objectivity of the inspection must be provided. Inspectors must be trained and authorised.
4. A quality management system is useful.
5. Time interval between inspections should be uniform across EU.
6. Location for inspection should fulfil basic technical requirements (see EN 13790). Environmental aspects should be considered.

Further actions

1. To establish a system of processing, administration and reporting of data concerning inspection considering the privacy of data for each member state.
2. To define a uniform inspection interval for all member states.
3. To establish guidelines for evaluation of observation of the requirements of EN 13790 in order to obtain uniformity, quality and objectivity of inspections.

Session 2.2.1 – Calibration of sprayers

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Calibration and Inspection of Sprayers: Proposals for a Joint-Venture to Reduce the Use of Plant Protection Products

Summary

Calibration procedure of sprayers is one of the more influence factors affecting the final success on spraying application. In general, inspection of sprayers in use has widely defended as an interesting tool to improve the pesticide application process via a good maintenance of sprayers. But, from the user's point of view, in many cases the official inspection procedure has been received as an administrative procedure, much more official than practical, including the mandatory taxes, being the benefits hidden by the procedure itself. The organization of activities focusing on the maintenance and calibration process, together with the inspection of sprayers in use, can be a profitable way to improve the success of the spraying operation, both from the technical and the economical point of view. A well maintained sprayer, operated correctly, is the key to a successful spray application.

One of the mandatory measures proposed in the recently proposed directive of the European Parliament about the use of pesticides is directly related with mandatory training procedures involving all professional users. Proposals about how to relate those two mandatory aspects (training and inspection) are presented in this paper. The main objective is to improve not only the sprayer itself, but also the pesticide application. In this sense, seems absolutely important to arrange actions in order to encourage and to motivate users, showing them the further benefits of attending such activities, in addition to financial incentives.

Key words: sprayers, inspections, training, application, calibration

1. Introduction

The future of agriculture in the new EU-27, in which includes not only agricultural and fish activities, but also the agro food industry, seems one of the most important aspects for all the European citizens. An important structural transformation process lies ahead for agriculture and fisheries in the EU as a consequence of the recent incorporation of new members, the latest changes in agricultural policies, the development and incorporation of new technologies, the increasing demand for sustainability and the new aspects on food safety. All these aspects are derived because of pressure from governments and institutions waiting to establish and control all parameters related to plant protection products (PPP) use. Information, as well as knowledge, not only about PPP to apply, but also about the most suitable conditions for its distribution, total amount to apply and the sprayer characteristics, are key factors for the final success of any pesticide application

In general, inspection of sprayers in use has widely defended as an interesting tool to improve the pesticide application process via a good maintenance of sprayers (Gil, 2007). But, from the user's point of view, in many cases the official inspection procedure has been received as an administrative procedure, much more official than practical, including the mandatory taxes, being the benefits hidden by the procedure itself. Regular checks of pesticide application equipment should be promoted in a way that all participants see a clear advantage for themselves (Friedrich, 2001). The organization of activities focusing on the maintenance and calibration process, together with the inspection of sprayers in use, can be a profitable way to improve the success of the spraying operation, both from the technical and the

economical point of view. A well maintained sprayer, operated correctly, is the key to a successful spray application. In fact, not only the engineering characteristics and operating conditions of the sprayer have an influence, but also the maintenance process and the management conditions are, frequently, a decisive factor affecting the final quality of application (Gil and Gràcia, 2004). The sprayer should be regarded as part of a spraying system rather than just a machine (Landers, 2000). Farmers need to review the spraying to ensure that maximum benefit is made from the use of the latest agricultural chemicals.

2. Legal Framework and Institutional Actions

The present legislative framework mainly concentrates on the start and end-of-life stages of pesticides. As a consequence there is a need to complement the existing legislative framework by targeting the use-phase of plant protection products.

The recently published proposal of Directive of European Parliament and Council establishing a framework for Community action to achieve a sustainable use of pesticides states “This Directive establishes a framework for achieving a more sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment in a way that is consistent with the necessary crop protection” (COM, 2006). Moreover, in article 5, part 1 establishes: “Member States shall ensure that all professional users, distributors and advisers have access to appropriate training. The training shall be designed so as to ensure that sufficient knowledge on the subjects listed in Annex I is acquired”. In this previous mentioned Annex I appears a clear link between inspection of sprayers in use and training of users when Commission proposes that training programmes shall be designed so as to ensure that sufficient knowledge of the technical check of sprayers in use and ways to improve spray quality is acquired.

The main objective is to improve not only the sprayer itself, but also the whole PPP application process. In this sense, seems absolutely important to arrange actions in order to encourage and to motivate users, showing them the further benefits of attending such activities, in addition to financial incentives.

It is also important to underline here the extreme difficulty confronted by any regulatory initiative in Europe where twenty-five different governments exist, each of which is characterized by internal differences among local governments, and engages in a wide and variable range of production. This reality, together with a patent dearth of information available to farmers about the benefits of inspections, makes it extremely difficult to establish any coordinated action.

3. Inspection and Training: Key for Success

In principle, keeping spraying equipment in good condition is to be encouraged, and the inspection of spraying equipment is an adequate way to improve the safety and efficiency of pesticide use. But any proposed action must be rationally and responsibly presented if it is going to achieve its objective to benefit in a practical way the member states involved. Regulation must be characterized by effectual dissemination of information and by useful training initiatives prior to and concurrent with inspections, so that farmers will be encouraged to participate in the process and to see it as a demonstrable enhancement of their operations and not as an unwelcome intrusion into their private affairs.

According Bals (2004) inspection of sprayers in use could easily be introduced as a technical check, to ensure that sprayers are in a good/safe condition. The same author also proposes that inspection should be allied with operator training schemes including calibration and ongoing maintenance procedures. In the same opinion Braekman and Sonck (2005) argue that the mandatory inspection of spraying equipment should not be repressive but educative and beneficial for the user. It is also interesting to mention one of the proposed measures from the EU stakeholder’s conference in 2002 (Anon., 2002) on which inspections of sprayers in use should be use as a platform to increase users' awareness.

The establishment of a coordinated program of inspections and training, as proposed by the European Commission, has been widely suggested in previous works (Koch, 1996; Bjugstad, 1998; Ozkan, 1999; Balsari, 2000; Biocca and Vanucci, 2000; Gil, 2006). A proper regimen of sprayer-maintenance, together with adequate training in calibration procedures and selection criteria for operative parameters, will allow

the reduction of up to 25% of pesticide use, without reduction of efficacy of plant protection (Bjugstad, 1998). Gil and Gràcia (2004) concluded that the most consequential discovery made in the course of a voluntary inspection of sprayers in use in a Spanish vineyard region was with improper equipment settings selected by growers during applications, as a consequence of their lack of familiarity with the calibration process.

But still some difficulties have been observed from the legal and administrative point of view when training aspects have been included in the pure inspection procedure. The most important comes from the differences between a pure administrative and quantified inspection procedure and the most subjective and “uncountable” training process. Also it is important to remark the fact that not all the active inspectors should be able to follow training schemes.

4. Proposed actions

Information is a key factor in the general objective of improving PPP phase-use. Farmers are more willing to "accept" information when given personally and adjusted to site specific conditions than when received through general letters and pamphlets (Kreuger and Nilsson, 2001). Also is interesting to mention that incentives are preferred to penalties, which are difficult to accept for farmers. They prefer voluntary approaches. Hence skill development and knowledge/technology transfer are important elements to be developed in the thematic strategy.

Following those previous situation, some actions have been proposed in order to improve, together with the actual European situation (figure 1), the binomial inspections-training always with the main objective to achieve the safest use of PPP.

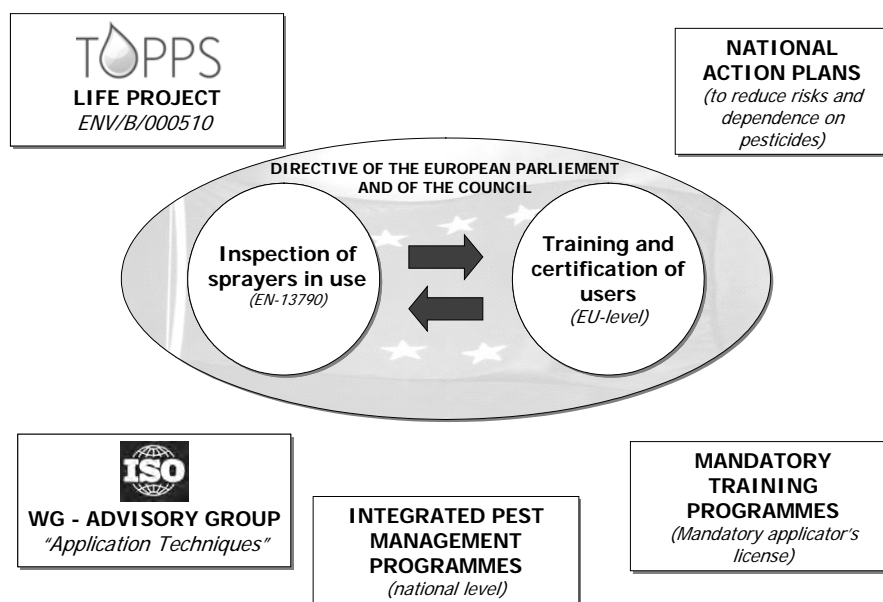


Figure 1 Different official actions have been arranged at EU level in order to improve the phase-use of PPP

4.1 Promote Measures to Demonstrate the Benefit of Inspections

Those actions should encourage the farmers to inspect the sprayer via recognition of interesting advantages as a more efficiency application process (good calibrated sprayers allow increasing uniformity and reducing losses and drift), less time consuming (inspected and calibrated sprayers allow reducing the applied volume) or less economic impact and reduction of PPP used (lower volume rate, together with high efficiency allow reducing the total amount of PPP).

4.2 Field Demonstrations about Inspections

A well known process will be in general more accepted: show how the process work, how is the measurement process, how is the evaluation. Include the possibility to change minor implements: opinion changes if those minor changes (nozzles, manometers... occurs during the inspection.

4.3 Creation of an Informative Website about Inspections

The idea is to create an interactive website where user could find answer to FAQ as: what is the procedure of the inspections? Where can I inspect my sprayer? How much it cost? Who must pay the inspection procedure? How must I carry my sprayer (clean, full, clean water...)?

This website could include a tool to promote a "virtual inspection": According the official criteria, what is my sprayer's situation? What is the "optimal" situation of each component?

Users could also update the established criteria for the different elements: Should I modify my manometer before attend the inspection? What is the correct way to protect the PTO?

4.4 Publication of Informative Elements about Inspections

Leaflets, DVD, multimedia presentations: establish a correct dissemination way to achieve all the involved stakeholders. Guarantee the involvement of technicians, advisors, private companies...

4.5 Practical Information about the Cost of the Inspection

Keep under rational level the fees for the inspection procedure. As a promotional tool we suggest to arrange the first mandatory inspection free of charge for farmers. Incentive elements (tax reduction, increasing recovery from EU policies...) seem more effective than penalties for non assistance. It is absolutely necessary to avoid the idea that inspection is another type of tax for farmers.

4.6 Effective Relation between Mandatory Inspection Procedure and Compulsory Training Activities in the EU

In the inspection procedure adds practical information about calibration process: How to select nozzles, how to determine the applied volume, how to measure nozzle flow rate, how to use nozzle charts...). Also in the opposite way, add exhaustive information about objectives, procedure and benefit of the inspections in the official training programs.

5. Conclusions

Training and information, both for users and technicians are key elements in the final success of the complex process of PPP safety use.

Inspection itself allows to obtain interesting information about the real situation of sprayers in use, but benefits for the user and society in general are limited if this action is not complimented with recommendations and training about calibration procedure and sprayer's management.

Inspection of sprayers in use, via a voluntary or mandatory scheme, promises to be a reliable tool in the overall process of improvement of the use of PPP. But some additional legal and administrative efforts must be made before inspections could be presented as an attractive and beneficial step for PPP users.

Organizing activities focusing on the maintenance and calibration processes and the inspection of sprayers in use can become profitable ways to improve the success of the spraying operation, both from the technical and the economical point of view. A well-maintained sprayer, operated correctly, is the key to successful PPP use-phase.

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Proposal of a Guide for Sprayers Calibration

Summary

The use of an inspected sprayer is not, alone, a sufficient guarantee for a correct pesticide application. Sprayer calibration, that is the adjustment of spray distribution to the specific crop situation, is an operation that should always follow the sprayer inspections, as it has considerable effects both in pesticide application efficacy and in environmental control. Sprayer calibration should be carried out for every single crop situation in the farm, at least for the most important. Due to the high number of operative situations that could be present and should be considered (type of crop, training system, crop layout, etc.) is not possible to define a specific test methodology, so general guidelines have been developed.

The present paper provides a summary of the guidelines agreed by the ENAMA working group about the methodology and the equipment to use for adjusting both field sprayers and orchard sprayers in use.

Key words: calibration, guidelines, methodology.

1. Introduction

Along with pesticide formulation, type of equipment, and timeliness of operation, sprayer calibration is generally considered as an essential factor in determining the effectiveness of spray application in agriculture. Proper calibration should provide a constant deposit of the active ingredient per unit target area (Pergher, 2003). Often, in spite of the employment of well functioning sprayers and of the adoption of the PPP doses recommended in the labels, spray application result poorly effective because the spray distribution is not calibrated according to the stage of vegetation development (Furness et. al, 1998).

In details, sprayer calibration means the adaptation of the sprayer use to the special crop conditions present in the farm. This operation has to be carried out preferably during or at the end of the sprayer inspection procedure, anyway never on sprayers that have any functional failure, and it shall be made for each single crop present in the farm context, at least for the most spread ones.

Actually there is not any European standard that can be used as reference for the correct calibration of sprayers. Just in recent International standards and standard proposals (ISO/DIS 22522 Field measurement of spray distribution in tree and bush crops, ISO/TC 23/SC 12 Spray deposit tests of field crop sprayers) some methods to assess the sprayers performances in the field are described.

Recently, in the ambit of the ENAMA working group dealing with the co-ordination of sprayers inspections in Italy, two documents have been produced. These texts aim to provide some guidelines for sprayers calibration: one is targeted to field crop sprayers, the second one is addressed to air-assisted sprayers for arboreal crops. Thresholds value that are mentioned in these documents only provide indications on the whole and can be modified according to the specific crop situation in which the sprayer has to operate.

2. The proposed methodology for field crop sprayers

The document prepared starts from the analysis of the sprayer operating parameters that can be adjusted during the calibration procedure:

- Volume application rate
- Nozzle type
- Nozzle flow rate

- Operating pressure
- Spray height
- Forward speed

2.1 Choice of the volume application rate

The boom sprayer has to be calibrated in order to apply volumes suitable for the target crop, for the type of application (e.g. pre-emergency weed control or post-emergency weed control, banding weed control, insecticide or fungicide application, etc.) and for the crop growth stage. If no indications about the spray volumes are mentioned in the PPP label, in Table 1 maximum volume rates that should be applied for the main crops are reported. Higher spray volumes do not increase the efficacy of treatment, but imply increments of the environmental contamination and of the production costs.

Table 1 Maximum and recommended application rates that shall be adopted for main field crops

Crop type	Application rate for weed control (l/ha)*		Application rate for pest control (l/ha)*	
	maximum**	recommended	maximum**	recommended
Winter cereals	400	150-250	500	300
Mais, sunflower, sorghum	500	Pre=150-250 Post=300-400	600	400-500
Rice	400	150-300	600	250-300
Tomato, potato	500	300	1000	600-700
Sugar beet	400	Pre=150 Post=300	700	300-400

*application rate in accordance with maximum vegetative development

**it is necessary to respect always maximum active ingredient dose indicated in label

Concerning banding spray under the rows in vineyards and orchards, the suggestion is to measure the flow rate of the nozzles mounted on the boom sprayer, then to refer to table 2 where, for the nozzle flow rates more frequently used it is reported the corresponding volume application rate referred to the sprayed surface, assuming to operate with one single nozzle and a width of the band sprayed equal to 1 m. Volume application rates suggested range between 200 and 400 l/ha.

Table 2 Application rates (l/ha) for banding spray under the rows of vineyard and orchard using different types of nozzles and forward speed

Nozzle (ISO code)	Pressure (bar)	Flow rate (l/min)	Forward speed (Km/h)			
			3	4	5	6
11002	2	0.65	260	195	-	-
	2.5	0.72	288	216	-	-
	3	0.79	316	237	189	158
	3.5	0.85	340	255	204	170
	4	0.91	364	274	218	182
11003	2	0.96	384	288	230	192
	2.5	1.08	432	324	259	216
	3	1.18	472	354	283	232
	3.5	1.27	508	381	305	258
	4	1.36	544	408	326	272
11004	2	1.29	-	387	309	258
	2.5	1.46	-	438	302	292
	3	1.58	-	474	379	316
	3.5	1.73	-	519	415	346
	4	1.82	-	546	436	365
11005	2	1.61	-	-	386	322
	2.5	1.80	-	-	432	360
	3	1.97	-	-	473	394
	3.5	2.27	-	-	545	454
	4	2.54	-	-	609	508

When spraying bands of different width or employing a spray boom equipped with multiple nozzles it is possible to apply the following formula:

$$V_r(l/ha) = \frac{q_e \times 600}{v \times f}$$

Where:

V_r = volume (l/ha) effectively sprayed

q_e = total nozzles flow rate (l/min)

v = forward speed (km/h)

f = width of the band sprayed by all nozzles (m)

2.2 Forward speed

Values suggested for the Italian situation range between 4 and 8 km/h. Slower forward speeds, if not justified by the morphology of the treated area (e.g. slopes) or by the shape of the field (e.g. small fields with irregular borders), are not suitable and would cause increments of the volumes applied even over the thresholds allowed as well as excessively long working times. Faster forward speeds, that may cause a poorer evenness of spray distribution and may increase drift risks, can be accepted - when operating in conditions of calm wind - only for the boom sprayers equipped with automatic hydraulic suspensions, independent pneumatic suspensions, electronic systems for stability boom control, etc. except for the air-assisted boom sprayers.

Forward speed measurements have to be carried out employing the tractor normally used to make pesticide application, fitted with an efficient revolution counter, if possible directly in one of the fields where treatments are executed.

More tests using different gears and engine revolution speeds will be performed in order to find the suitable forward speed to apply the intended volume rate; the following formula can be used:

$$v(km/h) = \frac{d}{(t_1 + t_2)/2} \times 3,6$$

Where:

d = distance covered by the tractor (m)

t_1 = time to travel the measured distance replication 1 (s)

t_2 = time to travel the measured distance replication 2 (s)

2.3 Nozzle type

The nozzle choice shall especially take into account the type of spray application (broadcast, localised, band spraying), the type of target (bare soil, water, vegetation) and the indications reported on the PPP label. Hollow cone nozzles do not allow to obtain very even spray distribution patterns. Considering that they usually spray fine droplets, their use should be addressed to post-emergency applications made with contact products, working at pressure within 5 bar in order to limit drift.

Flat fan nozzles provide more uniform spray patterns and can be used for all types of application, regulating conveniently the operating pressure: values should range between 4 and 5 bar to obtain fine droplets (VMD < 200 μ m) and between 1,5 and 2,5 bar to obtain medium droplets (VMD 200÷400 μ m).

Deflector-type nozzles are suitable for spraying on bare or waterlogged (e.g. paddy fields) soil and allow to operate at low pressures (1-2 bar), reducing drift risks. Thanks to the delivery of a wide spray jet trapezium shaped, these nozzles may be mounted on the boom at 100 cm spacing, and they enable to apply reduced volumes – without facing clogging of the nozzle orifices – and to reach a good evenness of transverse distribution.

In order to reduce spray drift when wind speed exceeds 1,5 m/s, the use of air induction nozzles is recommended, as they produce larger droplets. For the correct functioning of air induction nozzles it is normally required to adopt higher operating pressure with respect to the conventional nozzles of equal size. Nevertheless, as air induction nozzles generate larger droplets, their use with contact products, which needs a high target coverage, has to be well evaluated. Drift reduction can be achieved also using end boom nozzles featured by asymmetric spray jets, especially when the border of the treated field is closed to a sensitive area.

Concerning the nozzle choice, it is also important to consider the wear resistance of the materials of nozzles orifices, as these nozzle parts are exposed to abrasion and corrosion. Nozzles orifices made of ceramic are the most durable with respect to corrosion and abrasion (Table 3).

Table 3 Main features of the materials used for nozzle orifices

Ceramic	Stainless steel	Polymer (plastic)	Brass
Extremely long duration; high resistance to corrosive and abrasive chemicals	Long duration; excellent resistance to chemicals	Medium-long duration; good resistance to chemicals; risks to damage the orifice during cleaning procedures	Short duration; sensitive to corrosive chemicals.

For pneumatic sprayers there are two parameters acting on droplets size: the air velocity and the liquid flow rate in the pneumatic nozzles. Increasing the air velocity - for instance employing diffusors featured by narrower outlet sections or increasing the rotation speed of the fan – finer droplets are obtained. On the other hand, increasing the liquid flow rate in the pneumatic nozzles – for instance employing larger calibrated orifice plates – coarser droplets are produced.

2.4 Nozzle flow rate

After the determination of the intended volume application rate and of the intended forward speed it is possible to calculate the flow rate (q) for each single nozzle:

$$q(l/min) = \frac{V \times v \times d}{600}$$

Where:

V = volume application rate (l/ha) selected according to the indications reported in paragraph 2.1

v = forward speed (km/h) calculated according to the instructions reported in paragraph 2.2

d = nozzles spacing on the boom (m)

As an alternative, knowing the boom working width it is possible to calculate the total flow rate of the boom sprayer (Q)

$$Q(l/min) = \frac{V \times v \times l}{600}$$

Where:

V = volume application rate (l/ha) selected according to the indications reported in paragraph 2.1

v = forward speed (km/h) calculated according to the instructions reported in paragraph 2.2

l = boom working width (m)

Dividing Q by the number of nozzles mounted on the boom, the single nozzle flow rate (q) will be obtained.

2.5 Operating pressure

When the nozzle flow rate has been determined, it is possible to select the operating pressure to employ, using the tables flow rate/pressure that are available for most of nozzles on the market and classified according to ISO colour coding (Table 4).

Table 4 Example of flow rate (l/min) - pressure (bar) table for nozzles classified according to ISO standard

ISO code	Pressure (bar)							
	2	3	4	5	6	8	10	12
- 0067 -	0.22	0.27	0.31	0.35	0.38	0.44	0.49	0.54
- 01 -	0.33	0.40	0.46	0.51	0.56	0.65	0.73	0.80
- 015 -	0.48	0.59	0.68	0.76	0.83	0.96	1.08	1.18
- 02 -	0.65	0.80	0.92	1.03	1.13	1.30	1.45	1.59
- 025 -	0.81	0.99	1.14	1.28	1.40	1.62	1.81	1.98
- 03 -	0.96	1.18	1.36	1.52	1.67	1.92	2.15	2.36
- 04 -	1.29	1.58	1.82	2.03	2.23	2.57	2.88	3.15
- 05 -	1.61	1.97	2.28	2.55	2.79	3.22	3.60	3.95
- 06 -	1.94	2.37	2.74	3.06	3.36	3.87	4.33	4.75
- 08 -	2.57	3.15	3.64	4.07	4.46	5.15	5.76	6.30

The table is built on the basis of the relationship existing between flow rate and operating pressure: for each nozzle type, knowing the pressure (p_1) that enables to obtain a certain known flow rate (q_1), it is possible to calculate the pressure p_x needed to obtain an intended flow rate (q_x) applying the following formula:

$$p_x (\text{bar}) = \frac{q_x^2}{q_1^2} \times p_1$$

The increasing of the operating pressure implies not only an increment of the nozzle flow rate but also finer droplets; consequences are that a higher number of droplets is generated, aiding to obtain a better target coverage, but also that more fine droplets may be drifted away from the treated area by wind.

Moreover, fine droplets evaporate faster and this can have negative effects on the efficacy of the spray application; for these reasons, according to the type of nozzle used, if no special indications are given by the nozzle manufacturers, it is recommended to keep the operating pressures in the ranges listed in Table 5.

Table 5 Recommended operating pressure in accordance to nozzle type

Nozzle type	Pressure range
Flat fan	2-4 bar
Twin flat fan	2-4 bar
Air induction flat fan	3-8 bar
Drift guard flat fan	2-5 bar
Deflector	1-2 bar
Hollow cone	3-5 bar
Air induction hollow cone	3-9 bar

2.6 Boom height

To achieve a sufficient evenness of transverse distribution, it is necessary to operate the correct boom height. Its selection shall take into account nozzles spacing on the boom and the nozzles spray angle. In general terms, nozzles featured by wide spray angles are preferable, as they enable to operate low boom heights and therefore to reduce drift risks. To prevent that boom endings could hit the soil, minimum boom height recommended is 0.50 m (table 6).

To verify if the selected boom height allows to achieve a sufficient uniformity of spray distribution, a test bench featured according to EN 13790-1 indications can be used: the CV value obtained shall result below 10% (employing a scanner type patternator).

In case special nozzles for banding spray are used, the boom height should be selected according to the recommendation reported in Table 7, aimed at ensuring a correct spray distribution on the target band and at minimising drift.

Table 6 Boom heights enabling to achieve the correct spray overlapping according to the nozzle type and to the nozzle spray angle

Nozzles spacing (m)	Hollow cone nozzle		Flat fan nozzle		
	$\alpha = 60^\circ$	$\alpha = 80^\circ$	$\alpha = 80^\circ$	$\alpha = 90^\circ$	$\alpha = 110^\circ$
0,33	0,50	0,50	-	-	-
0,50	0,55	0,50	0,60	0,50	0,50
0,65	-	-	0,75	0,65	0,50
0,75	-	-	0,90	0,75	0,55

Table 7 Recommended boom height for banding spray application.

Spacing between nozzles (m)	Nozzle height (m)		
	Spray angle 80°	Spray angle 95°	Spray angle 110°
0,50	0,20	0,30	0,40
0,75	0,30	0,40	0,55

2.7 Evaluation of the actual application rate

After the selection of nozzle type, nozzle flow rate, operating pressure and forward speed that enable to apply the intended volume rate, it is necessary to verify that these choices, implemented on the sprayer we are calibrating, provide the expected results. This verification has to be made assessing the average nozzles flow rate (q_e) according to the following formula:

$$V_e (l/ha) = \frac{q_e \times 600}{v \times d}$$

Where:

V_e = volume (l/ha) actually sprayed

q_e = average nozzles flow rate measured on the sprayer (l/min)

v = forward speed (km/h)

d = nozzles spacing on the boom (m)

When localised application are made, as for banding spray on row crops, two different types of volume rates could be verified:

- Volume rate expressed in l/ha of crop field (V_e);
- Volume rate actually applied only on the sprayed bands (V_r).

In the first case, the above formula is still valid. In the second case, the following formula will be employed:

$$V_r (l/ha) = \frac{q_e \times 600}{v \times d} \times \frac{f}{d}$$

Where:

V_r = volume (l/ha) actually sprayed

q_e = average nozzles flow rate measured on the sprayer (l/min)

v = forward speed (km/h)

d = nozzles spacing on the boom (m)

f = width of the band sprayed by one nozzle (m)

The volume actually sprayed could result higher or lower with respect to the intended one. When it is necessary to have a precise correspondence between actual volume and intended volume, the operating pressure has to be modified until $q_e = q_v$:

$$p_v (bar) = p_e \left(\frac{q_v}{q_e} \right)^2$$

Where:

p_e = operating pressure corresponding to the actual flow rate (q_e)

p_v = operating pressure corresponding to the intended flow rate (q_v).

If it is not possible to obtain the intended flow rate without exceeding the recommended pressure ranges, it is necessary to change nozzles size.

3. The proposed methodology for tree crop sprayers.

Adjustable sprayer operating parameters during the calibration procedure are:

- Volume application rate
- Forward speed
- Nozzle type
- Sprayer flow rate
- Operating pressure
- Spray profile
- Fan flow rate

The calibration procedure should follow the order reported in figure 1.

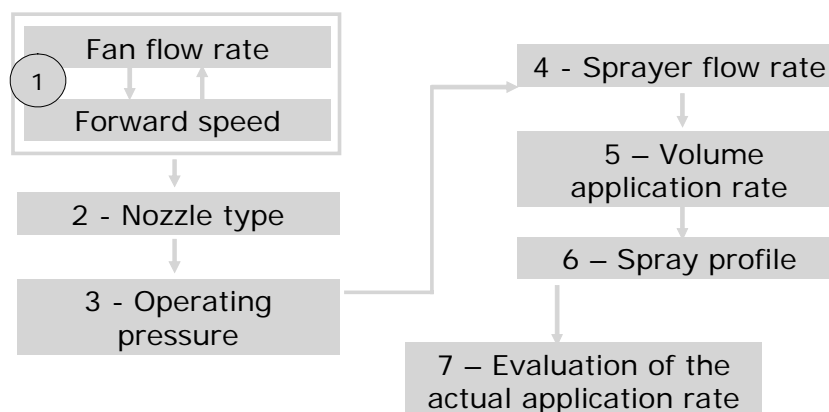


Figure. 1 Order scheme for adjustments on the sprayer during the calibration procedure.

3.1 Choice of the fan flow rate

It is adjustable without modifying other parameters only for air-assisted sprayers featured by hydraulic pulverisation. Air flow rates shall be selected according to the sprayer forward speed and especially according to the shape and size of the vegetation target.

When spraying very dense and expanded canopies (e.g. orchards at full vegetation development growth stage) it is necessary to employ a high air flow rate and a low forward speed in order to achieve a sufficient penetration of spray droplets inside vegetation. On the other hand, at early growth stages, when canopies are smaller, it is recommended to reduce the air flow rate and higher forward speeds can be adopted.

As general indications, when spraying vineyards featured by poor vegetation development (early growth stages), the air flow rate should range between 3000 and 6000 m³/h, while operating in vineyards with the vegetation full developed the air flow rate could be increased up to 7000-12000 m³/h. Concerning orchards featured by a leaf surface up to 4000 m²/ha, fan flow rate should not exceed 20000 m³/h, while in orchards with higher leaf surfaces this value can reach 25-30000 m³/h. In all cases, it is fundamental to correctly address the air flow in order to match the canopy profile, adjusting the position of air deflectors.

The theoretical air volume to use can be calculated according to the following formula:

$$A(m^3/h) = \frac{1000 \times v \times i \times h}{K}$$

Where:

v = forward speed (km/h)

i = inter-row width (m)

h = tree height (m)

K is a coefficient ranging between 3.0 and 3.5 when vegetation is poor, ranging between 2.5 and 3.0 when the vegetation is dense and fully developed.

To change the fan flow rate it is possible to adjust the following parameters (Table 8):

1. fan gear (if a gear-box is present on the fan)
2. blades inclination (only for axial fans)
3. PTO revolution speed

It is important to notice that changing the PTO speed in sprayers mechanically driven, means to change also the forward speed if the same tractor gear is kept.

Table 8 Example of air flow variation for axial fans according to fan gear and to blades inclination.

Blades inclination	diameter = 750 mm		Blades inclination	diameter = 600 mm	
	1° gear	2° gear		1° gear	2° gear
35°	16000 m ³ /h	22000 m ³ /h	25°	15000 m ³ /h	19000 m ³ /h
40°	25000 m ³ /h	33000 m ³ /h	30°	18000 m ³ /h	25000 m ³ /h
45°	35000 m ³ /h	45000 m ³ /h	35°	20000 m ³ /h	27000 m ³ /h

3.2 Choice of the volume application rate

It has to be selected according to the type of crop (vine, pome fruits and stone fruits, citrus trees, olive trees, poplars) and according to the training system, the height of the vegetation band to be sprayed, the growth stage, etc.

As in Italy there are very different situations from region to region, it is very difficult to provide reference values valid for the whole country.

3.3 Forward speed

Recommended range is between 3 and 8 km/h. Higher forward speeds can be adopted at early growth stages when the vegetation development is still poor, while when canopies are more developed or plants are very high it is suggested to use lower forward speeds. In any case the forward speed adopted shall guarantee sufficient safety and comfort to the operator.

3.4 Nozzle type

In hydraulic sprayers that are not equipped with a fan, the lack of the air flow implies a very limited spray penetration into canopies; this type of sprayer can therefore be used only for application in vineyards and orchards featured by dwarf trees, narrow inter-row widths and poor vegetation density. Early application during the season can be made using flat fan nozzles, that are able to provide homogeneous droplets sizes (the fraction of very fine droplets is limited), while new hollow cone nozzles are recommended for spraying more developed and dense canopies as these nozzles enable to achieve a better spray penetration into the target.

When using air-assisted sprayers, the air flow conveys droplets to the target and enables the penetration of droplets into the canopy. Nozzle choice should be oriented towards the nozzle types able to provide a homogeneous droplet size spectrum, as flat fan or new hollow cone nozzles.

For the other aspects, the same indications provided for boom sprayers are valid.

3.5 Operating pressure

For hydraulic sprayers without fan (still very spread especially in Italian vineyards) recommended operating pressures are between 10 and 12 bar for early spray application and between 15 and 20 bar when spraying fully developed canopies.

When employing air-assisted sprayers the variation of the operating pressure shall not be used as an instrument to improve spray penetration inside the vegetation as this latter aspect is mainly influenced by the air flow rate. It is recommended to adopt operating pressures in the range 5÷15 bar; higher values mean excessive spray pulverisation, with increased drift and evaporation risks and higher wear for nozzles and sprayer circuit components.

For pneumatic sprayers, operating pressure has mainly the function to convey the liquid from the main tank to the nozzles, therefore it should range between 1 and 2 bar.

3.6 Sprayer output

When the volume application rate and the forward speed have been stated, it is possible to calculate the total sprayer flow rate (Q):

$$Q(l/min) = \frac{V \times v \times l}{600}$$

Where:

V = volume application rate (l/ha)

v = forward speed (km/h)

l = inter-row width (m)

If the nozzle mounted on the sprayer have all the same size, dividing Q by the number of active nozzles, the single nozzle flow rate (q) will be obtained.

3.7 Evaluation of the vertical spray profile

The adjustment of the nozzles positions, of the air deflectors and the choice of the number of active nozzles aims at allowing the spray jets to match as much as possible the target profile. During this calibration phase it is necessary to take into account the maximum plants height at fully development growth stage, as one of the main goals is to avoid overspraying beyond trees, therefore reducing environmental impact and spray losses (Figure 2).

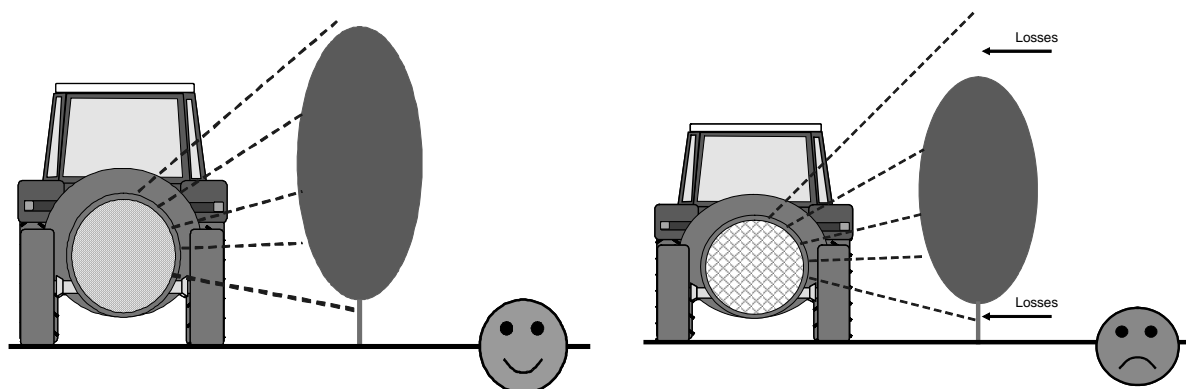


Figure 2 Adjustment of the spray profile according to the canopy profile.

Moreover, it is important to adequate spray volumes to the amount of target vegetation (leaf surface and density). Most of tree training systems present variations in the amount of vegetation at different heights especially at fully development growth stages, so it is important to consider “more dense” and “less dense” parts of the canopy to design the correct spray profile.

If the plants are trained in a way to present an even “wall” of vegetation, the vertical spray profile should be as even as possible along its whole height (Figure 3).

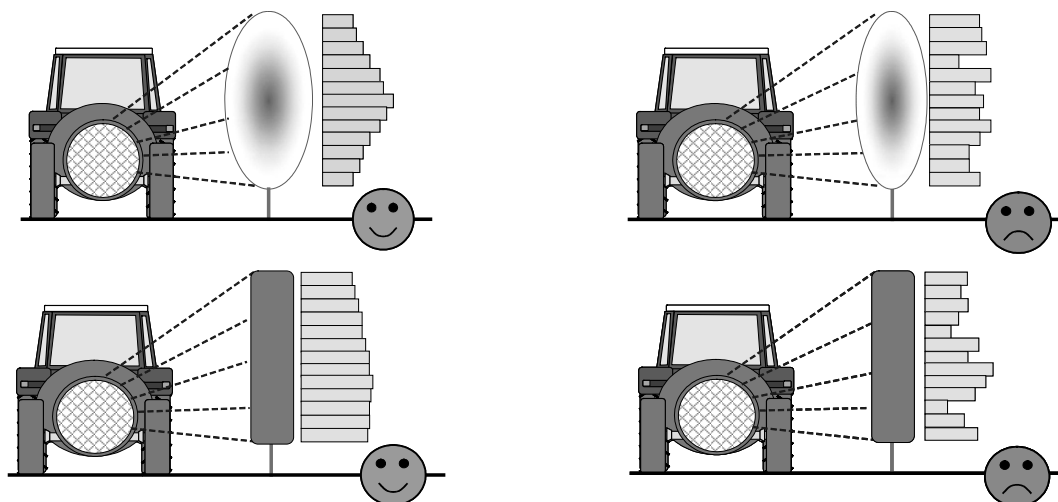


Figure 3 Examples of adjustment of the vertical spray profile according to the training system and to the vegetation thickness.

The adjustment of nozzles positions on air-assisted sprayers can also allow, in some situations, to solve the asymmetry of spray distribution between left and right side, due to the asymmetric air flow rate generated by axial fans (Figure 4).

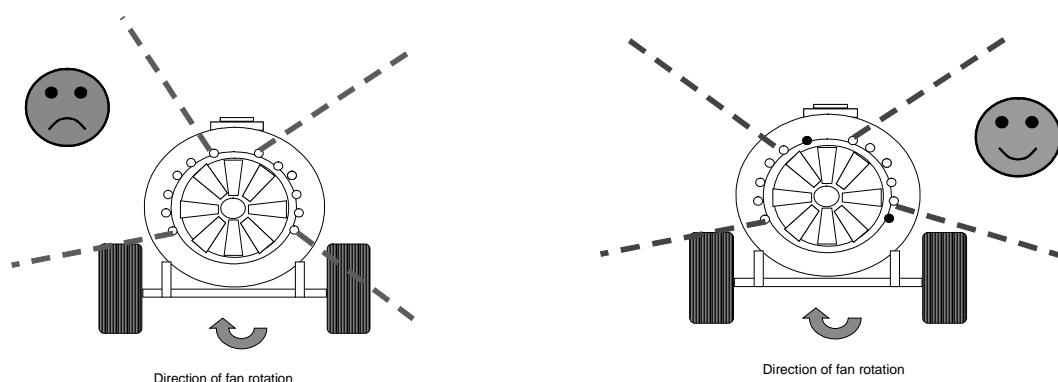


Figure 4 On axial fan sprayers it is often possible to obtain symmetric spray profiles between left and right sprayer side just closing the upper left hand and the lower right hand nozzles.

For pneumatic sprayers it is possible to modify the vertical spray profile acting on the diffusers inclination and, in case of adjustable air outlets, on the number and size of open outlets.

To assess the vertical spray profile, a test bench with the following characteristics should be used:

- Liquid collector size: $\geq 180 \times 220$ mm (only for discontinuous vertical walls)
- Distance within liquid collectors ≤ 300 mm
- Measurements repeatability: $CV \leq 10\%$
- Graded tubes capacity: ≥ 50 ml
- Graded scales: $\geq 1\%$ of capacity

3.8 Evaluation of the actual application rate

When the sprayer output, the operating pressure and the forward speed have been selected in order to apply the intended volume rate and the spray vertical profile has been checked using a patternator, it is necessary to verify the actual application rate.

This verification has to be carried out determining the total sprayer flow out (Q_e) as sum of all single nozzle flow rates and then applying the following formula:

$$V_e(l/ha) = \frac{Q_e \times 600}{v \times i \times n}$$

Where:

V_e = actual volume application rate (l/ha)

Q_e = total sprayer flow rate (l/min)

v = forward speed (km/h)

i = inter-row width (m)

n = number of rows sprayed in one pass

The volume actually sprayed could result higher or lower with respect to the intended one. When it is necessary to have a precise correspondence between actual volume and intended volume, the operating pressure has to be modified until $q_e = q_v$:

$$p_v(bar) = p_e \left(\frac{q_v}{q_e} \right)^2$$

Where:

p_e = operating pressure corresponding to the actual flow rate (q_e)

p_v = operating pressure corresponding to the intended flow rate (q_v).

If it is not possible to obtain the intended flow rate without exceeding the recommended pressure ranges, it is necessary to change nozzles size.

4. Documents delivered to the farmer

At the end of the calibration procedure, an official document will be delivered to the farmer. In this document, identificative data of the calibration centre will be reported as well as indications about the correct spraying parameters to be adopted in function of the type of crop and of the type of application carried out in the farm (see example for boom sprayer in annex 1).

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Report of Boom Sprayer Calibration

Sprayer manufacturer (if present)

Sprayer model (if present)

Serial number (if present)

More elements to identify the sprayer

Tractor (manufacturer and model)

Technical data of tyres

Sprayer owner [] Sprayer utilizer []

Owner (or utilizer) name (*)

Farm name

Farm address

Crop and type of application	Boom length (m)	Nozzle number	Spray height (m)	Gear and rpm	Forward speed (km/h)	Nozzle type	Average flow rate (l/min)	Operating pressure (bar)	Application Rate (l/ha)
1. sugar beer – pre emergence	12	24	0.65	1° gear - 2000	6	Flat fan 1100...	1.0	2,5	200
2. sugar beet – post emergence	12	24	0.70	1° gear - 2000	6	Flat fan 11003	1.5	5,0	300
3. mais – post emergence	12	24	0.60	1° gear - 2000	6	Flat fan 11003	1.2	3,0	250
4.									
5.									

(date)

(technician's signature)

Results of Session 2.2.1 – Calibration of sprayers

Discussion

Main point of discussion was the question whether the calibration should be a (voluntary) part of the inspection or not. This is not only a problem of organisation but also of legal authorisation, training of personnel and costs:

1. Different guidelines for calibration of field crop sprayers and orchard sprayers?
2. Is it useful to calibrate the sprayer without operator training or at least recommendations on dose and volume rate adjustment, nozzles (flow rate, droplet size, drift potential) or drift reducing measures?
3. Where should the calibration be done: At test station or on farm?
4. Should the calibration be done by inspectors or by other staff? How can inspectors be trained?
5. Should farmers pay for calibration or can it be financed by other sources like environmental support (Cross Compliance advising) or national support?

Results and Conclusions

1. Calibration of sprayers as task of the advisory service is necessary separately from and prior to the inspection.
2. Uniform (European) guidelines are necessary for calibration. Farmers should be trained in using the right set-up of the sprayer for different growing situations.
3. Farmers should record sprayer set-up for each treatment.
4. Sprayer manufacturers should help to increase the technical knowledge of operators by appropriate manuals.

Further actions

1. To establish a working group within SPISE/ CEN to develop guidelines with minimum requirements for calibration.
2. To work on national levels/EU-level for mandatory operator training, with regular refresher courses.
3. To work on national levels/EU-level for systems with voluntary operator training and calibration.

Session 2.2.2 – Options for very old sprayers – options for brand new sprayers

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Belgium's procedure dealing with brand new and very old sprayers

Summary

Belgian inspection of sprayer is mandatory since 1995. During the implementation of this inspection, two questions have been raised: Do the brand new sprayer need inspection ? What to do with the very old sprayers ?

Exemption of inspection of brand new sprayer is possible if they comply with the requirements of a type approval for new sprayers and if this is checked just before they are put on the market. At that time, the first requirement ensures that the manufacturer has well designed the concerning sprayer's type and the other requirement verifies the quality of the manufacturing.

Between 1990 and 1998, the Belgian Ministry of Agriculture developed a National Law concerning a type approval for brand new sprayers and nozzles (Belgisch Type-reglement, 1998). This project has been notified to the EC and has been rejected. The rejection was based on 2 main arguments: the Belgian project would introduce an obstacle to the free circulation of goods in Europe and these Belgian dispositions were believed to be opposite to the Machine Directive and the prEN 12 761.

On the other hand, the Belgian Ministry of Agriculture has been questioned by private stakeholders about the validity of the inspections of brand new sprayers performed by manufacturers/dealers just before they are put on the market in Belgium. The Ministry has decided not to authorize such inspections arguing that only the 2 official inspection bodies certified in Belgium can carry out the inspections. Taking into account the previous facts, brand new sprayers are considered in Belgium as sprayer already in use and they are inspected as such.

Concerning the very old sprayer, the Ministerial Decree about the mandatory inspection of sprayers provides a procedure to take out of service non-repairable or very old sprayers. At this time, the boom (or the spraying arc for orchards sprayers) must be dismantled but the sprayer can still be used as a vessel. A sprayer, which is rejected twice consecutively, cannot be used. It can either be put out of service or either be used only after reparation and re-inspection.

Key words: mandatory inspection, brand new sprayer, old sprayer, agreement, out of service.

1. Introduction

European and national authorities, producers of plant protection products (PPP's), non-governmental organisations (NGO)... launched many actions to secure the use of PPP's. Reinforcement and strengthening of the PPP registration, withdrawal of old active ingredient, monitoring of residues, reduction programmes, integrated pest management, code of good practices... are few examples among others taken in order to improve the use of PPP. Those measures are however not sufficient, as the attention is not directed towards the spraying techniques. It has been proved that PPP can only perform well if they are applied at the right time and in good conditions but also with the right spraying technique.

Due to the major role played by the spraying technique in plant protection, its improvement is essential. Early in the nineties, Belgian government became aware of this fact and launched several working groups aiming at the development of a New Sprayer Registration and an Inspection of Sprayer already in use.

2. Brand New Sprayer Registration

In 1990, under the umbrella of the former Federal Ministry of Agriculture, a Belgian Working Group has been set up to develop the New Sprayer Registration, the so-called "Type Approval". This WG was composed of the main stakeholders: representatives of the Ministry of Agriculture, of the machine's importers and the main Belgian manufacturers of sprayers, researchers (Universities and Research Centres).

The scope of this "Type Approval" was brand new sprayers for plant protection (knapsack and hand-held sprayers being excluded) and spare parts as new nozzle, pump, regulation system... The objectives were to develop requirements and measurement protocols to verify these requirements. The requirements were aimed at the verification of the safety, the correct functioning and the environment-kindness of the new types/prototypes of sprayers.

After 8 years of meetings and discussions, the Belgian Working Group finalised the "Type Approval for Brand New Sprayers and Nozzles". The new regulation has been presented and accepted by the sector. Before to translate it into Ministerial Decree, it had to be notified to the European Commission in 1998.

The Belgian project has been rejected by the EC. This rejection was based on the detailed opinions from France, Germany and Italy arguing that the Belgian project constitutes:

- a new obstacle to the free circulation of goods in Europe,
- an obstacle to the Machine Directive 89/392/CEE and the harmonised Standard EN 907 dealing with security aspects,
- an obstacle to the future European Standards prEN 12 761 - 1/2/3 dealing with environment protection.

Finally, European authorities asked for an extension of the time limit of the status quo and invited Belgium to retry this project to the profit of the existing harmonised European Regulation about the security of the Machines and of the harmonised Regulation about environmental protection which could quickly be established on the technical basis described in the prEN 12 761.

Following the EC decision, the Belgian Authorities aborted the project of a national Brand New Sprayer Registration, waiting for a hypothetic harmonization at the European level.

In the meantime, the so-called Machine Directive dealing with security has been revised in 1998 (European Dir. 98/37/CE) and the harmonized Standard EN 907 is still in revision. The approach of the Machine Directive is still the same : the compliance with security requirements is declared by the manufacturer under an auto-certification without any homologation/registration procedure.

The standard EN 12 761 – 1/2/3 has been published in 2001. Those standards aren't harmonized and integrated in any European Directive about environmental protection. However the New Thematic Strategy on sustainable use of Pesticides is on the go and should integrate/harmonise more or less the issue of a Brand New Sprayers Registration.

In conclusion, in Belgium, the Registration of Brand New Sprayers and spare parts is still open and is awaiting European initiatives.

3. Very Old Sprayers

In Belgium, the inspection of sprayers has been implemented on a compulsory basis in 1995 after 5-7 years of a voluntary inspection. During this period, only 24 % of the inspected sprayers were in perfect functioning condition, about 50 % had one or two significant defects and about 25 % of the tested sprayers were to be replaced by new equipment. Since the implementation of the compulsory inspection the results are totally inverse. For the moment less than 15 % of the sprayers are rejected.

Official teams from regional authorities carry out the compulsory inspections. The management of these inspections is done by the Federal Agency for the Safety of the Food Chain (FAVV/AFSCA). In total there are six inspection teams for the whole of Belgium. They inspect approximately 24 500 sprayers every three years. 10 to 14 sprayers are inspected each day by one team.

In Belgium, all spraying equipment used for the distribution of plant protection products has to be inspected. This inspection applies to almost all sprayers regardless of their age, including those used for orchards and vineyards, fixed spraying installations in greenhouses, row sprayers, and equipment for golf courses, recreation areas, parks and streets, railroad. Lever-operated knapsack sprayers and portable compression sprayers, however, are excluded from this compulsory test.

All test results are noted on an inspection chart (rough data). When all tests are performed, this inspection chart is used to make up the inspection certificate. This is done on the spot with specialized software. The certificate shows the found defects in 3 categories of severity:

1. defects that should be repaired immediately - sprayer rejected,
2. defects that should be repaired within 3 years time - sprayer is approved,
3. minor remarks for a better use of the sprayer.

A defect leads to the refusal only when its origin can be ascribed to the user, that it disturbs the spraying in a significant way and that it has been determined in an indisputable an objective way.

Besides the identification of the defect, also an objective advice how to solve the problem is mentioned on the certificate. For the evaluation of parts that necessitate a measurement (e.g. flow rate nozzles), the results of these measurements are also stated on the certificate. The inspection certificate is always printed out in double: one for the farmer and one for the archive of the inspection service.

In case of agreement, the inspection certificate mentions the validity period of the approval (usually 6 semester = 3 years). Additional, a label, which also states the validity period, is attached to the sprayer. These labels have a unique number. Label and inspection certificate are bounded to the sprayer and not to the owner. Each time a sprayer is sold, the current inspection certificate of this sprayer should be handed over to the new owner.

In the case of a rejection of the sprayer, only the certificate is handed to the farmer. It states that he has got 4-month time to repair the defect and to report again for the second inspection. It is up to the farmer how and by whom the defects are repaired. After this period, the sprayer is tested again. If the sprayer is rejected twice consecutively, it cannot be used anymore. At any time, the owner may put his machine out of service. For this, he has to fulfill a specific registration form and send it to the inspection bodies. Moreover, he has to dismantle the boom (or the spraying arc) of his sprayer.

4. Conclusions

Belgium considered that the registration of new type/prototype of sprayer is the starting point of the improvement of the spraying techniques. In 1998, EC has stopped the Belgian project of Registration. Therefore, no special rules for brand new or very old sprayer have been implemented.

All sprayers must fulfil the inspection requirements set for sprayers already in use, regardless of their age. This means that brand new sprayers are submitted to an inspection afterwards. Sometimes, problems raise with 'new' machines and spare parts (nozzles, manometer) that seem to be defecting when tested as

a result of a first official inspection. Anyway, the owner is not penalized in case of inadequate functioning of brand new sprayer or new spare parts.

Very old sprayers fulfilling to inspection are not limited in their use. But since the beginning of the mandatory inspection in 1995, the replacement of the sprayers was accelerated and an important part of the very old sprayer has been put out of service.

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German's way to deal with brand-new and very old sprayers in terms of the legal regulation

1. Introduction

Since 1993 Germany has a mandatory inspection for field crop sprayers since 2001 for sprayers for orchards, vineyards and hops. The mandatory inspection was preceded by a lot of years with voluntary inspections. In these years the inspection stations and workshops could gain experience with the test methods and test equipment.

2. Brand new sprayers

According to the German Regulation on Plant Protection Products and Plant Protection Equipment brand-new sprayers have to be inspected within the first six month of their use. A sticker on these sprayers indicates the date for the next inspection. The owner must produce documents which plausibly show at which time the sprayer was taken into use. This inspection comprises the tests for system leakages and the correct installation of pipes and hoses, a test of the pump and the cross distribution test for booms and nozzles of field crop sprayers or the single nozzle output of air assisted sprayers respectively.



Figure 1 Inspection of a new sprayer comprises pump capacity, pulsations, leakages, safety valve and kinks

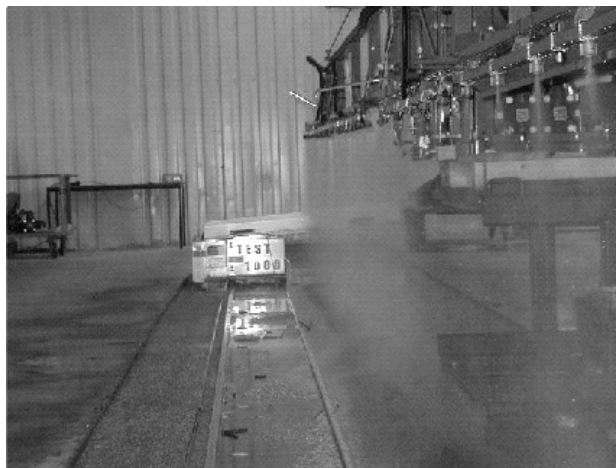


Figure 2 The inspection of new sprayers comprises also the cross distribution, anti-drip devices and size and type of the nozzles

Sprayers to be sold in Germany have to be registered in the German plant protection equipment list. Since 1988 all manufacturers or importers are obliged to declare that their sprayer fulfils all the requirements of the Plant Protection Act and the Regulation on Plant Protection Products and Plant Protection Equipment. These requirements correspond with EN 12761.

All approved workshops may conduct the inspection. Some manufacturers are approved as inspection workshop and deliver their sprayers with the sticker so that the farmer has to have his sprayers tested not before two years. For some manufacturers the inspection of new sprayers is part of their quality management system at the end of the assembly line.



Figure 3 What is the definition of ‘very old sprayers’?

3. Very old sprayers

The German regulation does not differentiate between sprayers in use and ‘very old sprayers’.

Therefore very old sprayers are tested on basis of the same requirements as all other sprayers. There is no special arrangement for very old sprayers. Sometimes additional equipment has to be installed like pressure filters or anti-drip devices on old sprayers to fulfil all requirements. If farmers do not upgrade their sprayers to fulfil the requirements their sprayers may not be used anymore. In Germany after the first years of the mandatory inspection old sprayers either fulfilled the requirements a got a sticker or they were put out of operation.



Figure 4 SOLO Minor

The SOLO Minor sprayer is a good example of an old sprayer that had to be upgraded to fulfil all requirements.

The major faults of these sprayers were:

- No stirring device
- No pressure regulation
- No pressure gauge
- Defect valves
- No pressure filter
- Uneven nozzle output

To upgrade these sprayers, the manufacturer provided an update set with

- a pump with higher capacity,
- new pipes,
- a pressure filter,
- new controls,
- a pressure gauge,
- stirring equipment and
- flat fan nozzles.

The price for this update set was around 400 €. The vine growers were now able to use this sprayers further on.

4. Conclusions

In Germany the inspection of new sprayers is necessary but it does not include all requirements. New sprayers have to be inspected within the first six months. Normally manufacturers or dealers deliver new sprayers with inspection sticker so that farmers have to have their sprayers inspected not until two years.

Concerning old sprayers there are no exceptions for 'very old sprayers'. Sprayers that do not fulfil the requirements have to be upgraded or they have to be put out of operation. In Germany manufacturers provided update sets for their sprayers to ensure that farmers could use their sprayers further on.

Results of Session 2.2.2 – Options for very old sprayer – Options for brand new sprayers

Discussion

Very old sprayers:

1. Definition of “very old” sprayers: Age? Sprayers which do not fit to EN 13790 or EN 12761?
2. Is it necessary to define special criteria for very old sprayers or do they just have to be modernised?
3. Main technical problems with very old sprayers and ways to solve them.

Brand new sprayers:

1. Is it necessary to perform a complete inspection according to EN 13790 to new sprayer?
2. Main technical problems with brand new sprayers.

Results and Conclusions

1. It is not necessary to have specific procedures; even very old sprayers have to fulfill the requirements according to EN 13790 but it is not necessary to retroactively meet EN 12761.
2. Main problems with very old sprayers are insufficient pump and agitation, anti drip devices, filters, worn booms and missing protective guards.
3. If necessary the sprayer should be modernized by high qualified staff and the inspection is to be repeated.
4. Brand new sprayers have to be inspected before selling or they have to be manufactured in such a way to fulfill the EN 13790 standard.
5. Inspection of new sprayers may be of reduced extent compared to sprayers in use.

Further actions

1. To define the minimum requirements from EN 13790 valid for brand new sprayers.

Session 2.3 – Inspection of sprayers not mentioned in EN 13790

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Proposal of a methodology for the inspection of sprayers not considered in EN 13790

Summary

In the ambit of the ENAMA Working Group - that is dealing with the national co-ordination of the sprayers inspection activity - a test methodology and the requirements for the test benches and equipment used to carry out inspections, of the sprayers not mentioned in the EN 13790 standard, have been defined.

In this paper, the test protocol with the related requirements and the main technical specification of the test benches are reported.

Key words: functional inspection, spray lances, knapsack sprayers.

1. Introduction

A test methodology for sprayers that are not considered inside the EN 13790 standard (indicated as “special sprayers”) has been set up in the ambit of the ENAMA national working group – co-ordinated by DEIAFA University of Torino - dealing with sprayers inspections and calibration. Main objectives are: 1) to be prepared for the receipt of the future European Directive on the sustainable use of pesticides, which foresees the mandatory inspection of all types of sprayers in use (COM 2006-372); 2) to face the demands for “environmental certificates” coming from the large-scale retail trade (f.e. Eurepgap). These special sprayers constitute a not negligible percentage of the total number of sprayers used for pesticide application in the Italian agriculture. Especially in floriculture and in horticulture made in glasshouses, these special sprayers represent the majority of spraying equipment used.

A survey carried out in 2006 by a working group co-ordinated by DEIAFA, within a research project funded by the Ministry of University and Research, pointed out that, on the basis of a sample of 200 farms having glasshouses (for floriculture or horticulture), in 75% of cases equipment in use were not traditional sprayers (boom sprayers or air-assisted sprayers) and that 66% of equipment were spray lances.

If we consider to project these values on the total number of farms dealing with glasshouses in Italy (over 32000), we can estimate that more than 24000 special sprayers are professionally used only in this agriculture context.

Enama working group stated that not traditional sprayers like those used for the application on high trees (cannon sprayers), and for band spraying (like those employed for weed control under vineyard/orchard rows or combined with planters/seeder) have not to be considered within the category of special sprayers, as they are comparable to conventional sprayers. So inspections, in these cases, may be carried out following, as far as possible, the EN 13790 standard, only with some limitations (for example exemption of assessment of spray vertical pattern and right/left spray symmetry for cannon sprayers, exemption of assessment of transverse distribution for sprayers combined with seeders, etc.).

Moreover, it has been stated to exempt from the inspection ULV sprayers, as they are mainly used in closed places (therefore they are featured by low environmental impact and low drift risks) and, most of all, because ULV sprayers have not a real hydraulic circuit with the relative regulation system.

Finally, also the aerial sprayers and the long-range sprayers equipped with automatic oscillating nozzles have not been considered in the category of special sprayers, because their use should be not allowed due to their high drift risks and environmental impact.

Summarising, the test methodology proposed refers to the inspection of:

- spray lances connected by hoses to conventional sprayers, power barrows or fixed pumps
- mist blowers and knapsack sprayers with and without autonomous engine (table 1)

Table 1 Methodology suggested for the inspection of sprayers not specifically considered in EN 13790.

Type of sprayers	Methodology suggested to use for the inspection			
	Partially EN 13790	New proposal	Control exempted	No inspection
Air-assisted sprayers with cannon	X			
CDA sprayers			X	
Knapsack mist blowers		X		
Lances and spray guns		X		
Cold and hot Foggers			X	
Manually operated knapsack sprayers		X		
Motorised knapsack sprayers		X		
Sprayers combined with seeding machine	X			
Sprayers combined with aerial devices				X
Sprayers for weed control in tree crops	X			
Sprayers for wiper application			X	
Sprayers with horizontal long range fitted with oscillating automatic movement nozzles				X

2. The proposed test methodology

The proposed test methodology for special sprayers is divided in two parts: one deals with spray lances, the second part deals with knapsack sprayers.

Test methodology related to spray lances takes into account inspections on pump, tank, tank contents indicator, pressure gauge, hoses, filters, pressure drop and nozzles; the methodology addressed to knapsack sprayers considers inspections on pressure gauge (only for sprayers equipped with a circuit under pressure), hoses, filters and nozzles.

Requirements and performance limits (table 2 and table 3) have been taken out, when possible, from existing documents as EN 13790, ISO 19932, FAO guidelines, that have also been considered as references for the instructions how to conduct tests.

Table 2 Main parameters to be inspected and related requirements

Components to be Inspected	Requirements	Type of Control
Main Pump		
Flow Rate	The Pump Shall Have Sufficient Flow Rate Capacity In Order To Be Able To Spray At Maximum Working Pressure As Recommended By The Sprayer Manufacturer While Maintaining A Visible Agitation Or The Pump Capacity Shall Be At Least 90 % Of Its Original Nominal Flow, Given By The Manufacturer Of The Sprayer.	Visual Measurement
Pulsations	There Shall Be No Visible Pulsations Caused By The Pump.	Visual
Losses	There Shall Be No Leakages (E.G. Dripping) From The Pump.	Visual
Pressure Safety Valve	When There Is A Pressure Safety Valve On The Pressure Side Of The Pump, This Valve Shall Work Reliably.	Visual

Components to be Inspected	Requirements	Type of Control
Spray Liquid Tank		
Losses	There Shall Be No Leakages From The Tank	Visual
Emptied Spray Liquid	It Shall Be Possible To Collect The Emptied Spray Liquid Simply, Without Tools, Reliably And Without Spillage	Visual
Non –Return Device	If There Is A Non-Return Device On The Water Filling Device Of The Tank, This Device Shall Work Reliably.	Visual
Agitation	A Clearly Visible Recirculation Shall Be Achieved When Spraying At The Nominal Pump Flow Rate And In The Part Of Tank Farer From The Pump, With The Tank Filled To The Half Of Its Nominal Capacity.	Visual
Liquid Lever Indicator	There Shall Be A Clearly Readable Liquid Level Indicator On The Tank Which Is Visible From Where The Tank Is Filled.	Visual
Measuring And Regulation Systems	All Devices For Measuring, Switching On And Off And Adjusting Pressure And/Or Flow Rate Shall Work Reliably And There Shall Be No Leakages. All Devices For Adjusting Pressure Shall Keep A Constant Pressure With A Tolerance Of $\pm 10\%$ At Constant Flow Rate And Shall Be Able To Achieve The Same Original Operating Pressure After The Equipment Has Been Stopped And Then Reactivated.	Visual
Pressure Gauge		
Presence	Near The Pump It Shall Be Present At Least One Pressure Gauge. If Possible, One Other Pressure Gauge Shall Be Present Also Near The Lance Or Spray Gun.	Visual
Functionality	The Pointer On The Pressure Gauge Shall Remain Stable In Order To Permit Reading-Off Of The Working Pressure. The Pressure Gauge Shall Measure With An Accuracy Of 10 % Of The Real Value.	Measurement
Scale	The Scale Of The Pressure Gauge Shall Be Clearly Readable During All Spraying And Suitable For The Working Pressure Range Used. The Scale Shall Be Marked: - At Least Every 0,2 Bar For Working Pressures Less Than 5 Bar; - At Least Every 1,0 Bar For Working Pressures Between 5 Bar and 20 Bar; - At Least Every 2,0 Bar For Working Pressures More Than 20 Bar.	Visual
Pipes And Hoses	They Shall Be Integral With No Visible Alterations. Their Structural Features Shall Comply With The Operating Pressure. There Shall Be No Leakages From Pipes Or Hoses When Tested Up To The Maximum Pressure Recommended By The Sprayer Manufacturer. In Case Of Pipes And Hoses Breaking, It Shall Be Possible To Stop The Spray Supply At The Beginning Of These Ones (E.G With One Or More Valves On The Delivery Line)	Visual
Filtering System		
Filters	A Filter In The Filling Hole Of The Tank Shall Be Present There Shall Be At Least One Filter On The Pressure Or On The Suction Side Of The Pump. The Filter(S) Shall Be In Good Condition And The Mesh Size Shall Correspond To The Nozzles Fitted According To The Instructions Of Nozzle Manufacturers.	Visual
Isolating Device	If An Isolating Device Is Provided, It Shall Be Possible, With The Tank Filled To Its Nominal Volume, To Clean Filters Without Any Spray Liquid Leaking Out Except For That Which May Be Present In The Filter Casing And The Suction Lines.	Visual
Pressure Losses	If Present, They Shall Be Registered	Measurement
Nozze Flow Rate	The Deviation Of The Flow Rate Of Each Nozzle Type Shall Not Exceed $\pm 10\%$ Of The Nominal Flow Rate Indicated By The Manufacturer. If There Are More Nozzles The Deviation Of The Flow Rate Of Each Nozzle Of The Same Type Shall Not Exceed $\pm 5\%$ Of The Average Value. If It Is Not Possible To Know The Nominal Flow Rate, It Shall Be Indicated In The Test Report And, If Possible, It Shall Be Compared Its Flow Rate With The Flow Rate Of A New Nozzle.	Measurement

Table 3 Mist blowers and knapsack sprayers: main parameters to be inspected and related requirements

Components to be Inspected	Requirements	Type of Control
Measuring And Regulation Systems	All Devices For Measuring, Switching On And Off And Adjusting Pressure And/Or Flow Rate Shall Work Reliably And There Shall Be No Leakages.	Visual
Pressure Gauge		
Presence	It Shall Be Present On The Hydraulic Sprayers	Visual
Functionality	The Pointer On The Pressure Gauge Shall Remain Stable In Order To Permit Reading-Off Of The Working Pressure.	Visual
	The Pressure Gauge Shall Measure With An Accuracy Of 0,2 Bar.	Measurement
Scale	The Scale Shall Be Marked- At Least Every 0,2 Bar	Visual
Pipes And Hoses	There Shall Be No Leakages From Pipes Or Hoses When Tested Up To The Maximum Pressure Recommended By The Sprayer Manufacturer.	Visual
Filtering System	There Shall Be Present A Filter In A Good Condition In The Filling Hole Of The Tank. There Shall Be At Least One Filter On The Pressure Side. The Filter(S) Shall Be In Good Condition And The Mesh Size Shall Correspond To The Nozzles Fitted According To The Instructions Of Nozzle Manufacturers	Visual
Nozzle Flow Rate	The Deviation Of The Flow Rate Shall Not Exceed $\pm 10\%$ Of The Nominal Flow Rate Indicated By The Manufacturer. If It Is Impossible To Know The Nominal Flow Rate And More Nozzles Are Present, The Deviation Of The Flow Rate Of Each Nozzle Of The Same Type Shall Not Exceed $\pm 5\%$ Of The Average Value.	Measurement

3. Devices to use for the inspection

ENAMA working group has defined not only the parameters to be inspected for special sprayers, but also the minimum requirements for devices and instruments that can be used during the inspections of special sprayers.

Flowmeters for measuring the pump capacity, as reported in EN 13790 standard, shall guarantee an error $\leq 2\%$ when the pump capacity is >100 l/min or an error ≤ 2 l/min if the pump capacity is <100 l/min.

To assess the nozzles flow rate, as mentioned in EN 13790 standard, it is possible to use a balance (scale marked at least every 20 g) and a stopwatch (scale marked at least every 1 s) or to use a graduated jar with a capacity ≤ 2 l, scale marked at least every 20 ml and error ≤ 20 ml.

To avoid that during the nozzle flow rate test liquid losses occur (especially when operating high flow rates), a specific test bench studied by DEIAFA and developed and commercialised by AAMS and Salvarani companies can be employed. It is composed by an aluminium frame equipped with an aluminium hopper, in which – thanks to a suitable housing - it is possible to place the spray lance to be tested. The flow rate value can be read on a graduated cylinder positioned under the hopper and connected to it by a pipe fitting (figures 1 and 2).

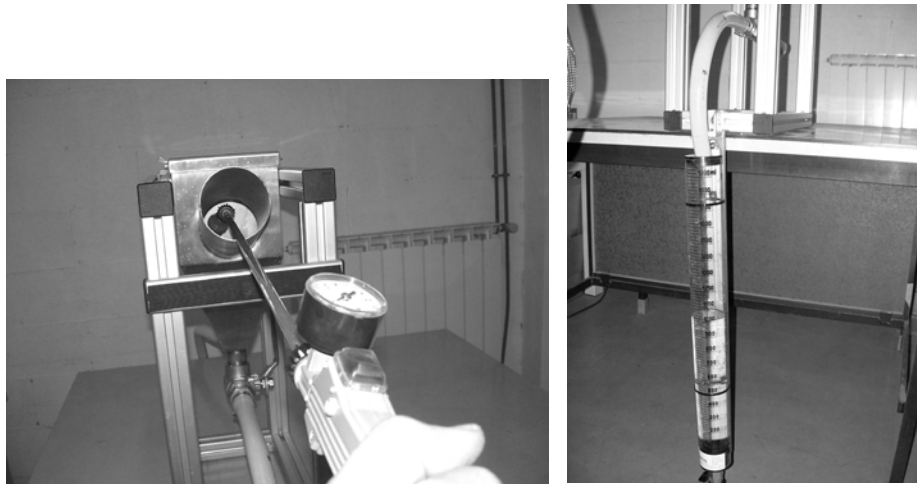


Figure 1 Test bench for measurement of spray guns and spray lances flow rate



Figure 2 Detail of internal hopper for spray lance introduction

To evaluate pressure drop a second special test bench has been designed by DEIAFA in collaboration with AAMS and Salvarani companies. This device enables to measure the operating pressure close to the nozzle of the spray lance (gun) and to compare this value with the pressure registered close to the pump. A precision manometer is mounted on a small aluminium frame; the manometer is positioned between two hoses, whose tips can be connected by quick fittings, on one side, with the body of the lance, and on the other side with the nozzles (figures 3, and 4).



Figure 3 Prototype of test bench to assess pressure drop for spray lances.

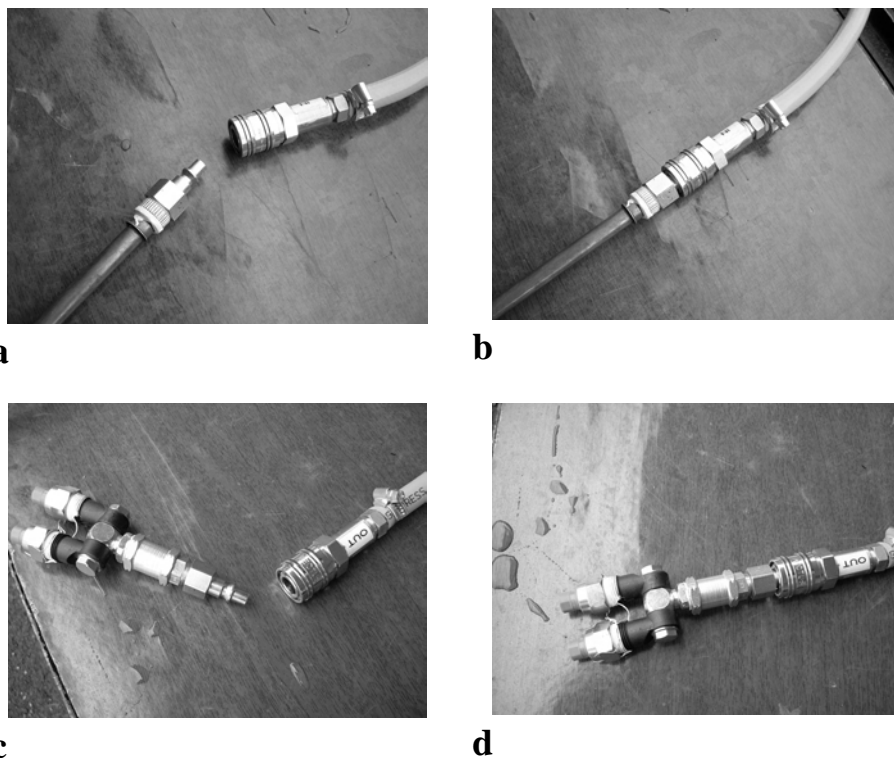


Figure 4 Quick fittings for connection of body of the lance (a-b) and nozzles (c-d) with test bench.

Concerning the characteristics of the precision manometer to be used for this type of test, it shall fulfil the requirements reported in the EN 13790 standard.

4. Conclusions

Taking into account the importance of special sprayers in terms of number of equipment used in the farms, and also in terms of sprayed surface and especially applied volumes, the proposed test methodology can be considered a useful instrument to improve spray application quality. Moreover it could help to face recent normative demands (Eurepgap) or normatives that will soon come into force (European thematic strategy on the sustainable use of pesticides).

Proposed contents will hopefully represent a starting point to define a future European standard about special sprayers or at least to revise and to integrate the actual EN 13790 standard, in order to allow the inspection of most part of sprayers present in Europe according to a standardised methodology.

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Test methodology for sprayers used in greenhouses in the Netherlands

1. Introduction.

In the Netherlands is an obligatory testing scheme for field crop and air assisted sprayers for bush and tree crops. Besides the testing of this equipment the demand for independent inspections of other spraying equipment is increasing. As a result of this demand the Foundation for Quality Control of Agricultural Machinery (SKL) has developed a testing scheme for other spraying equipment. To develop a proper testing scheme a working group of representatives from research institutes, users, manufactures and dealers of the equipment was formed. This working group developed a testing standard, the technical requirements for the testing stations and the requirements for the testing personnel.

2. Definition equipment

For a definition of the testing equipment involved in this inspection scheme, the focus is on high volume spraying equipment powered by an engine. The reason is that with this type of equipment the technical condition and the maintenance condition of the installation is of major impact on the result of the spray job. With hand held or carried machines the skills of the operator are more important as the condition of the machine.

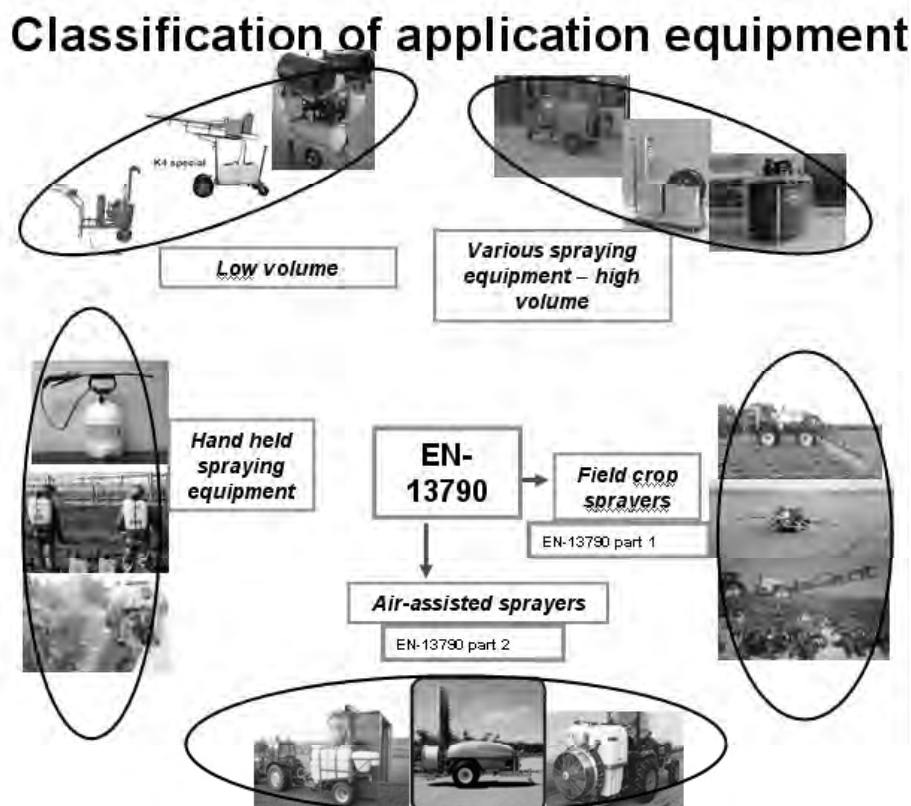


Figure 1 Classification spraying equipment

The equipment involved in the testing scheme is defined as follows:

- High volume spraying equipment
- Content of the spray liquid tank minimum 20 litre.
- Powered by a combustion or electric engine
- The unit can be stationary or mobile
- The installation consists out of a pump, tank and an application device. This application device can be a spray gun, a horizontal or vertical spray boom.

3. Organisation

The organisation of the testing scheme is equal to the existing schemes for the other spraying equipment. The testing is done by approved testing stations, by certified test operators, according to a uniform standard and with certified test equipment. SKL supervise the testing stations and performs inspections to the testing stations and the performed tests. The training of the test operators is done by a trainings institute supervised by SKL. At the end of 2004 the first testing stations were certified. In the meantime the number of testing stations has grown to 6.

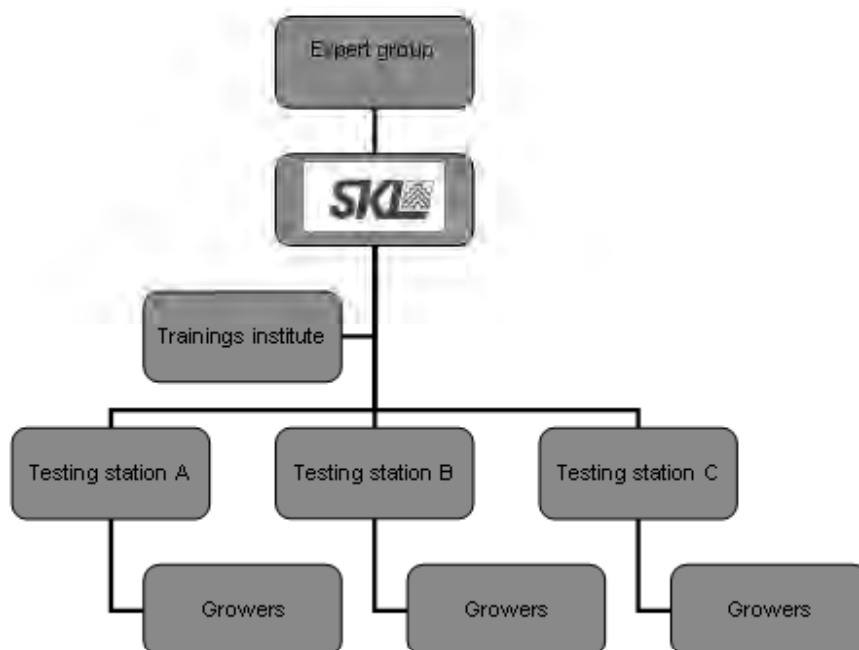


Figure 2 Organisation

4. Testing standards.

In the testing standard all issues what are relevant for a safe, accurate and even application of the plant protection products are included. The standard is developed in line with the existing standards for testing field-crop and air-assisted sprayers and with the EN-13790. During the test the accuracy of measuring devices like pressure gauges is checked, the capacity of the pump is measured and the nozzle flow rate will be measured.

5. Testing equipment

The testing equipment needed for performing the tests are:

- Reference pressure gauge to check the pressure gauge(s) on the installation
- Flowmeter to test the pump capacity
- Nozzle tester to test the output of the spray nozzles

The testing equipment must be mobile so that the inspections can be performed on location, for example in a greenhouse.



Figure 3 Example of a mobile set of testing equipment



Figure 4 Inspection of a spray robot in a greenhouse

6. Future development / recommendations

This testing scheme fits in the requirements of EUREP-GAP and MPS-GAP: the testing scheme is independent, the maintenance condition of the installation is checked and the sprayer is calibrated.

For the growers the inspections are voluntary at this moment, it is stimulated by certification systems like EUREP-GAP/MPS-GAP, Green Label Greenhouse certification programs, etc. The advantages for the growers to participate are: reliable and effective spraying equipment, easier to meet the requirements of the customers and a way to distinguish themselves from other growers.

For a further development of the inspections there should be developed a uniform European standard, this could be the EN-13790-3, which can fit in the requirements of the Thematic Strategy.

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Experiences with the functional inspection of hand held spray guns

Summary

Hand held spray guns are used under growing conditions where machine operated application is difficult or impossible, e.g. vineyards in steep slopes. Spray lances are often mounted to available air blast sprayers or to a unit which is simply a tank and a pump. Sprayers are subject to the mandatory inspection system and if a lance is attached it is covered by the sprayer inspection. Tank-pump-lance (TPL) units form a different type of spraying technique and require specific testing procedures. Such TPLs are mostly used by small holders and in wine growing areas which are protected because of their unique landscape, e.g. at the Rhine and Moselle rivers in Germany. In the year 2004 an inspection system was established. This system will be illustrated.

1. Introduction

In the year 2003 German legislation required spraying equipment with hand held spray lances to be functional inspected in a 2-year-intervall as had been established earlier for boom sprayers and air blast sprayers. Mandatory sprayer inspection in Germany is based on authorised mechanic work shops where the grower has to go to to and where appropriate test stands are available. The typical tank-pump-lance (TPL) units are different in function and it was decided to reduce the inspection procedure to a visual check not using test stands. This in turn allows the inspecting person to go to the grower. It is not necessary to bring the TPL to a specific test site. Hand held spray lances are used in steep slope wine growing areas e.g. along the rivers Rhine and Mosel where tractor operated sprayers are not applicable. The main objective of the inspection is to assure proper function and maintenance in order to avoid leakage and spillage of agrochemicals.



Figure1 Typical tank-pump-lance (TPL) units, with one and two hose reels



Figure 2 Typical steep slope vine growing area where hand held spray lances are used for pesticide application. The tractor is used to transport the spray mixture and to power the pump. A hose (length 100 – 150m) supports the lance.



Figure 3 This situation demonstrates an example of enormous difference in altitude between spray tank position and applicators position. The actual pressure at the lance varies with such height differences.

2. The mandatory sprayer inspection system

The mandatory sprayer inspection is established within a legal framework. Mechanic workshops are authorised after application to the responsible authority. Workshops have to demonstrate that they have trained test-operators, appropriate and checked testing equipment and an appropriate site to place the test stands (e.g. the horizontal patternator). The testing equipment is inspected by the authority in a 2-year-interval.

The training of test-operators ends with a written test where people have to prove their knowledge. Persons who apply for test-operator must have a technical education and thus experience with agricultural machinery.

As has been stated earlier, the inspection of TPL is much simpler than the inspection of tractor operated machines and test stands are not needed. With respect to the purpose of the mandatory inspection which is a functional test, it was decided to install a system which should be simple in the administration as well as in the technical conduct and should assure acceptance by the grower. Persons that apply for testing TPL must have experience with agricultural machinery as e.g. growers are, but do not need a special education in this field of experience. After the training and the successful test such persons can apply for the official status to inspect TPL. They are registered by the authority and are under supervision. Stickers and test report forms are provided by the authority annually on demand where they have to report to.

In this sense such test-operators are in a registered or accredited system.

The grower can decide himself whether he prefers the inspection of his TPL by an authorised mechanic work shop or an authorised test-operator. The test reports have to be sent to the authority.

3. Test after training course and positive effects of the inspection

Persons who follow the one day training program have to pass a test at the end of the course with clear criteria. DLR RNH is responsible for this training program and invites registered test operators for follow up trainings to keep the test operators up to date.

1. Written test, 12 questions - multiple choice
2. Less than 3 Mistakes : OK
3. More than 3 Mistakes : interview
4. The interview allows personal contact between the candidate and the official people. It considers that applicants are not experienced in such type of examination. So we easily find out whether questions were clearly understood or if there is a lack of knowledge.
5. Certification and registration as test operator after the test can be withdrawn in case of „insufficient inspection quality“
6. Authority may go to inspection sites and check activities
7. Authority checks inspection report at on farm inspections
8. Major effort: Sprayer inspection at growers site or any other convenient place saves time and money.
9. This is organised by the authorised personal and reported to authority
10. visual inspection, no test equipment is required.
11. Stickers and report forms are provided by authority on demand
12. Maintenance is responsibility of the grower

4. Inspection relevant features (according BBA-guideline)

The following features are subject of the inspection and are documented in the test report.

1. General: no leakages/dripping at any part of the spraying equipment. All devices and installations of the spraying equipment must function
2. Pump capacity: must be in accordance with size/needs of equipment. Capacity = nozzle output + agitation demand (if no mechanic agitation). Hydraulic agitation : 5% of spray tank volume, if < 1000l, minimum 60 l/min. 3% if spray tank volume is > 2000l.
3. No visible pulsation caused by the pump
4. Agitation: visible agitation at maximum work flow rate. Tank must be equipped with an appropriate and well working agitation installation
5. Returning liquid needs to be connected to a special pipe in order to achieve adequate agitation or a special injector agitator.
6. „air bubble agitation“ is not accepted.
7. Placement and effectivity of agitation is visually checked = clearly visible agitation.
8. Injector agitator devices are recommended in case of low pump capacity
9. Spray tank: clearly readable level indication on the tank scale can be provided by controlled filling of the tank and placing appropriate indication. It must be possible to empty the tank completely and without spillage. Filling hole must be covered to avoid spillage

10. Controls: valves must function and must work without leakages. Pressure adjustment valve must work at switching off and on
11. Pressure gauge: No visible pulsation caused by the pump. Diameter at least 60 mm
12. Pipes and hoses: no leakages at maximum pressure. No visible sharp bends or abrasion
13. Filters: filter inserts shall be changeable
14. Nozzles: Visual check of spray fan formation. Flow rate must be reproducible (l/min, angle) dripping after valve is closed not longer than 5 sec.



Figure4 Official stickers on the TPL demonstrate the mechanical workshop/ test operator and expiry date (second half-year 2006 and 2008 respectively). The colour of the sticker changes annually.

5. Extension – the other most relevant aspect

Parallel to the introduction of the mandatory inspection system of TPL an information campaign was started to inform growers about the new regulation. DLR-RNH worked out a series of papers which were published via grower journals, internet and during grower meetings. This extension work which included technical solutions for most of the upcoming questions made the activity to be successful. Many growers asked for specific information e.g. about the installation of an injector agitation. Growers understood very well the goal and how to achieve a practical solution for their own TPL: Qualified extension is a prerequisite for the rapid and successful implementation of the mandatory inspection.

6. Conclusions

The deregulated system for the mandatory inspection of TPL serves the purpose and saves time and money and reduces the administrative burden. The inspection is a visual check of the basic elements of the sprayer function. No test stands are required. Persons need experience with agricultural machinery (mechanics / growers) and have to apply for the authorisation. They have to follow a training program and pass a test. Inspectors are certified by responsible authority after training and test. The responsible authority provides report forms and official stickers on demand (annually). Inspectors report to the authority. The deregulated system now established for TPL units is proposed to be adapted to other types of application equipment. Air blast sprayers equipped with hose and lance are not understood to be a TPL and have to be presented to an authorised mechanic workshop.

Results of Session 2.3 – Inspection of sprayers not mentioned in EN 13790

Discussion

1. Justification of need and use of an inspection methodology for non EN 13790 sprayers considering environmental risks linked to machine or operator.
2. Discussion about proposed test protocols and methodologies.
3. Listing non EN 13790 sprayers and figures of occurrence and of use in the different countries. Preventing economical losses by means of inspection of this types of spraying equipment.

Results and Conclusions

1. It is necessary to inspect also equipment not mentioned by EN 13790 to achieve sufficient application quality, minimizing environmental risks and to ensure operator and consumer safety.
2. Operator safety may be a more important issue than for other sprayers.
3. Visual inspection is sufficient to prevent environment from major sources of pollution..
4. Start with a very simple approach just to fill the gap and improve the system step by step

Further actions

1. To define a priority list of equipment considering the amount of use and the experiences concerning importance and risks.

Posters

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Sprayers Inspection in the Venetian Region: past experiences and future perspectives

Summary

The north eastern part of Italy, known as Veneto, is one of the most important area for agricultural productions, either field and orchard and vineyard crops. About 100.000 farms with an estimated number of 67000 sprayers are present.

Veneto is one of the first Italian regions where a service of inspection of in-use sprayers was started.

At present the inspection is voluntary, but the Venetian government is inclined to make it compulsory as soon as the EN 13790 Rule will be acknowledged in Italy.

Key words: in-use sprayers, testing, inspection.

1. Introduction

Veneto or Venetia is one of the 20 regions of Italy. The capital is Venice. Once the cradle of the renowned Venetian Republic, then a land of mass emigration, nowadays Veneto, whose population exceeds 4.7 millions, is among the wealthiest and most industrialized regions of Italy. Veneto natural, historical and artistic beauties make it the most visited Italian region, with about 60 million tourists every year.

Veneto is located in the northeastern part of Italy, bordering on the Italian regions of Emilia-Romagna and Lombardy, the autonomous Italian regions of Trentino-Alto Adige/Südtirol and Friuli Venezia Giulia, and the nation of Austria. It lies between the Alps and the Adriatic Sea and is crossed by the rivers Po, Adige, Brenta and Piave. The Veneto itself is subdivided into seven provinces: Venezia (Venice), Padova (Padua), Rovigo, Verona, Vicenza, Treviso and Belluno (Figure 1).



Figure 1 The Venetian Region and its provinces

The agriculture of the region has witnessed significant progress during the past 20-30 years. The territory of Veneto is still dominated by small landholdings and agriculture is mixed. The other phenomenon is part-time work in the agricultural sector; after the working-day on a factory, people cultivate their private pieces of land. The principal agricultural products include maize, sugar beets, forage, vegetables, tobacco; among orchard crops apples, pears, kiwi, peach and cherries. Significant production of grapes occurs in hilly zones, leading to the creation of well-regarded wines.

2. Sprayers inspection in Veneto

2.1 Past experiences

Veneto is one of the first Italian regions where a service of inspection of in-use sprayers was started. This was due to financing programs which included public funding for rationalization of agriculture, with specific reference to spray application.

The inspection service was started in 1988 as an initiative of the Association of Horticultural and Fruit Growers of the Province of Verona, which had kept contacts with similar services in South Tirol and in Austria. On the basis of this experience it was decided to start a mobile workshop which was able to perform a number of checks such as the verification of the working speed, efficiency of the manometer, nozzles flow-rate and uniformity of distribution. The price of the inspection was partially charged to the farmer (about 30 Euros); during six years of activity about 700 orchard sprayers and 50 field sprayers were inspected.

Another important event was the application of European Regulation 2078/92: this directive provided financial contributions to those farms which applied to environmental friendly agricultural practices, among which the sprayers inspection (once every five years) was included; most of those farms were fruit and grapevine growers. Within this framework six workshop were acknowledged by the Regional Government; five of them operated either on orchard and field sprayers, while the last one was actually located in Emilia-Romagna, the Veneto south-bordering region, and operated only on field sprayers (used on sugar beet crops).

Finally, in 1999 the Region was one of those which joint the so-called Action 4 of the Interregional Program for Agriculture and Quality by the Agriculture and Forestry Ministry. The participation to the working group established to draw a common protocol for the inspection was the chance to improve the service with the arrangement of training courses (run by the Department of Land and Agro-forestry systems of Padua University) for the inspectors and the set up of 12 authorized workshops.

2.2 Present situation

Present time is not busy for the activity of inspection centers in Veneto. In fact, after the expiry of the above mentioned Rule 2078/92 a very small number of farmers have been going on submitting their equipment to the inspection. This is due to more than one reason, but first of all, it is seen by the farmers more as an additional cost than as a useful tool for their everyday activity. According to the agricultural surveys taken by the National Institute of Statistics (ISTAT), during the '90 years a relevant decrease in the number of farms and in-use sprayers occurred. Data are shown in Table 1.

Table 1 Number of farms using sprayers and their type of ownership in 1990 and 2000 (source: ISTAT)

Provinces	Farms using sprayers		Owned sprayers		Owned sprayers age < 10		Contractors' sprayers	
	1990	2000	1990	2000	1990	2000	1990	2000
Belluno	814	184	324	128	196	53	5	70
Padova	29.603	21.976	13.923	9.901	2.884	898	15.382	14.415
Rovigo	8.823	7.671	5.779	4.457	1.872	521	2.961	3.666
Treviso	28.511	21.207	16.552	12.446	3.959	1.743	7.754	10.657
Venezia	22.862	16.151	13.351	7.894	2.887	743	12.531	10.400
Verona	19.803	15.738	16.206	13.961	5.477	2.485	2.443	2.878
Vicenza	13.715	11.809	8.187	6.719	2.363	981	4.271	5.747
	124.131	94.736	74.322	55.506	19.638	7.424	45.347	47.833

As shown in the table, the total number of farms decreased about 25%, with a corresponding similar decrease of the number of owned sprayers; in the meanwhile an increase of the number of sprayers in use by contractors occurred. As a consequence, the number of contractors' equipments increase from 60 to 85%; most of them are located in the flat part of the region, where cereals, soybean and sugar beet are the most important crops and there is a larger diffusion of towed and self-propelled boom sprayers (up to 24 and over m working width). The most worrying element is the age of the sprayers: while in 1990 only 25% of the farmers' owned sprayer were less than 10 years aged, in 2000 this percentage decreased further to 13%. Since the statistical tables do not distinguish the type of sprayers (field or orchards), this decrease most likely means that a great number of these older equipments are orchard sprayers: in fact, contractors generally work on field crops while they are not much present among fruit growers. This also means that, if on the one hand the rising diffusion of contractors' sprayers is positive for the quality of the working sprayers stock (because they renew their machinery more often than farmers), on the other hand the aging of orchard sprayers is a negative event for quality of spray distribution and environment pollution.

At present 12 mobile workshops are acknowledged to operate on the region; only ten are actually working. They are located mostly in the provinces of Verona and Treviso, where a greater number of fruit and vine growing farm are present, and the inspection sometimes is required to meet the guidelines of fruit production. Nevertheless, during the last years also field sprayers users are beginning to require the inspection, particularly for the operators who work for horticultural crop producers which are subject to EUREP-GAP requirements.

2.3 Future perspectives

Table 2 Summarizes the activity undertaken during the last three years by the 12 workshops operating in Veneto.

Table 2 Number of inspection carried out during the period 2004-2006

code	Workshop location (province)	Number of inspections		
		2004	2005	2006
1	VR	60	100	60
2	VR	80	75	75
3	TV	60	80	60
5	TV	25	45	20
6	VR	9	--	--
8	RO	14	15	15
9	PD	5	50	50
10	VR	43	23	100
11	RO	13	24	7
12		80	25	100
Total number of inspections		389	437	487

As shown in the table, the number of inspected sprayers is very low compared to the total amount of working equipments; nevertheless, a slight trend to increase is present, and this is partly due to the above mentioned EUREP-GAP requirements.

An important aspect of the workshops work is their educational role for the farmers during the sprayer inspection and calibration, and this is probably the most valuable part of their task, which will be further appreciate in future.

Regarding the number of workshop needed to meet the needs when the sprayers inspection will be full working, considering a number of 70.000 sprayers to check once every two years and a working capacity of a testing plant of 500 inspections/year, about 70 workshops will be to be set up in the near future.

3. Conclusions

At present the inspection is voluntary, but the Venetian government is inclined to make it compulsory with two-year frequency as soon as the EN 13790 Rule will be acknowledged in Italy.

To this purpose the Region is taking part to the national working group which is carrying out the drafting of a common testing procedure for inspection and calibration of in-use sprayers.

This is a very important initiative in the ambit of improving crop protection efficiency, reducing environmental pollution and training agricultural operators.

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The ENAMA Working group for the national coordination of inspection activity in Italy

Summary

In Italy the inspection of sprayers in use started at the beginning of the 1980s, but has not yet spread all over the Country, and methodologies used and relative requirements vary from Region to Region. To remedy this situation the Ministry of Agriculture has funded ENAMA (National Agricultural Mechanisation Agency) to develop a program to harmonise, at a national level, the activities of periodical inspections of sprayers in use. A technical Working Group, coordinated by DEIAFA and in which most of the Italian Regional Administrations are represented, has thus been created.

In this paper the most relevant aspects of ENAMA's Working Group documents thus far published are reported.

Key words: European standard, functional inspection, test bench.

1. Introduction

The functional inspection and calibration of sprayers in use is an indispensable instrument for improving the quality of spraying of crop protection products in agriculture, since it allows a reduction in their use and, above all, a reduction in product losses that occur during such operations (up to 80% of the sprayed), which has consequent undesired environmental effects. At present in Italy the inspection activity, despite being in place for over ten years (Balsari and Vieri, 1996), is only performed in some Regions, and moreover is limited to farms that have adopted ecofriendly production systems (Balsari et al., 2004).

This limited inspection activity is accompanied by the lack of a common test methodology and requirements. This results in a series of differences from Region to Region in terms of: parameters examined during inspections, performance limits, types of equipment (test benches) and instruments used for the inspection, exemption criteria for new and ENAMA/ENTAM certified sprayers, period of validity of the functional inspection, etc.

This situation creates a considerable discrepancy among farmers in different Italian Regions and a series of practical difficulties for both farm contractors working with this equipment in areas close to regional borders and for manufacturers of sprayers. This is considerably at odds with what is happening in the rest of Europe, where functional inspections have been commonly performed for some time (Ganzelmeier, 2004). Furthermore, during the course of 2006, a draft Directive was submitted to the European Parliament on the sustainable use of crop protection products (Thematic Strategy on the Sustainable Use of Pesticides). One of the main proposed actions is the mandatory inspection of all sprayers used at professional level.

In light of the above, and partly with the aim of preparing for the implementation of this Directive, Enama (National Agricultural Mechanisation Agency) proposed an ad hoc Research Project, financed by the MIPAAF (Italian Ministry of Agricultural and Forestry), following which a Technical Work Group was created, coordinated by the DEIAFA (Department of Agriculture, Forestry, Environmental Engineering and Land-based Economics) of the University of Torino, with the participation of Regions through regional officials and scientific referents appointed by the latter (Figure 1).



Figure 1 The working Group visit the Crop Protection Technology laboratory of DEIAFA (Torino University).

The task of the Technical Work Group, without going into the operating and organisational details of individual Regions, is of:

- preparing a common testing methodology for the functional inspection of sprayers, referring to standardised norms (standard EN 13790);
- establishing a common testing methodology for the functional inspection of sprayers not mentioned by standard EN 13790
- defining the minimum manufacturing and functional requirements of inspection instrumentation;
- defining procedures for starting up the service on an agreed basis but with operating procedures at the discretion of the Regions in full compliance with respective powers;
- establishing criteria to obtain the mutual recognition of activity performed by different test centres operating throughout the country;
- defining a common procedure for the recording and filing of inspection findings;
- promoting activity to calibrate sprayers through suitable guidelines.

2. Results obtained

Work group activity, consisting of a series of meetings in which some technical and operating solutions were put forward and agreed upon, has so far led to the production of 12 Enama documents (Table 1), some of which are still in the revision and/or approval phase. When drafting these legislative documents the work group started with the definition of common procedures required to start up the functional inspection service, then drafted guidelines for the calibration of sprayers.

Table 1 Main contents of Enama Documents produced by Technical Working Group.

Activity	Enama Documents	Main Contents
Inspection service starting up and periodical control	n° 1	Technicians training: 40 hours Technicians qualifying examination: written (30 questions) ad oral (theory and practical) Technician qualification expiry: no (except as a result of irregularities during activity) Periodical control of technicians' activity and test bench functionality: 12 or 24 months depending on number of inspections carried out Interval between inspections: 24 months New sprayers must be controlled within 6 months of purchase (36 months if certified in accordance with EN 12761) Documents to be produced: test report and functionality certificate

Activity	Enama Documents	Main Contents																		
Technicians examination	n°2	Type of quiz: multiple-choice Question subjects: general aspects of inspection service preliminary aspects of inspection acceptability limits inspection execution general aspects of pesticide distribution sprayer components bureaucratic and legal aspects																		
Test benches minimum requirements	n°3, 4, 5	See EN 13790-1, 2 + Vertical patternator requirements: Liquid collector size: $\geq 180 \times 220$ mm* Distance within liquid collectors ≤ 300 mm* Measurements repeatability: CV $\leq 10\%$ Tubes graded capacity: ≥ 50 ml Graduated scales: $\geq 1\%$ of capacity																		
Sprayer inspection	n°6, 7	<i>*only for discontinuous vertical walls</i> See EN 13790-1, 2 + Vertical spray pattern (test recommended)																		
Inspection and calibration of sprayers not included in EN 13790	n°8 a, b, c	Sprayers that must be inspected: Lances and spray guns Knapsack sprayers (manually operated and motorized) Sprayer control exemption: CDA sprayers Foggers Sprayers for wiper application Sprayers not inspected: Combined with aerial devices With horizontal long range with oscillating automatic nozzle movement																		
Mutual inspection acknowledgement among regions	n°9	It is necessary: to inspect the sprayers in accordance with Enama Documents to produce a functionality certificate																		
Sprayer calibration	n°10, 11	Parameters that can be calibrated: <table style="width: 100%; border: none;"> <tr> <td>Boom sprayers</td> <td>Tree crop sprayers</td> </tr> <tr> <td>Distribution volume</td> <td>Distribution volume</td> </tr> <tr> <td>Nozzle type</td> <td>Forward speed</td> </tr> <tr> <td>Nozzle flow rate</td> <td>Nozzle type</td> </tr> <tr> <td>Operating pressure</td> <td>Sprayer flow rate</td> </tr> <tr> <td>Work height</td> <td>Operating pressure</td> </tr> <tr> <td>Forward speed</td> <td>Vertical spray pattern</td> </tr> <tr> <td></td> <td>Fan flow rate</td> </tr> <tr> <td></td> <td>Air deflectors inclination</td> </tr> </table>	Boom sprayers	Tree crop sprayers	Distribution volume	Distribution volume	Nozzle type	Forward speed	Nozzle flow rate	Nozzle type	Operating pressure	Sprayer flow rate	Work height	Operating pressure	Forward speed	Vertical spray pattern		Fan flow rate		Air deflectors inclination
Boom sprayers	Tree crop sprayers																			
Distribution volume	Distribution volume																			
Nozzle type	Forward speed																			
Nozzle flow rate	Nozzle type																			
Operating pressure	Sprayer flow rate																			
Work height	Operating pressure																			
Forward speed	Vertical spray pattern																			
	Fan flow rate																			
	Air deflectors inclination																			
	n°12	Glossary of technical terms used in Enama Documents																		

Everything produced will allow test centres that have already been operating for some years in the country (such as those of Emilia Romagna, Piemonte and Lombardia) to have official reference documentation, and centres intending to start up such activities to come into possession of all the technical information needed to perform the service (Figure 2 and Figure 3).

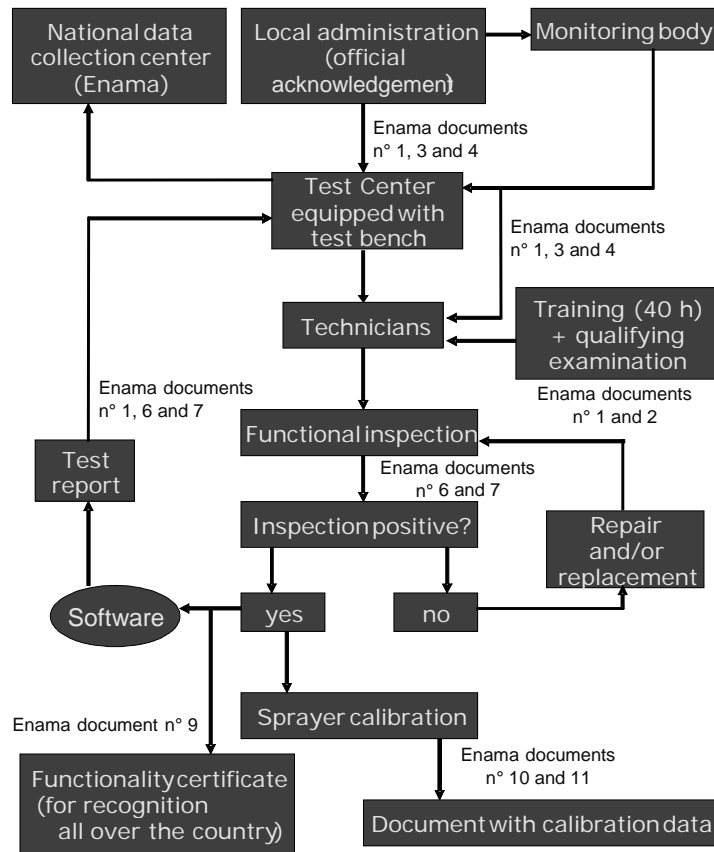


Figure 2 Sprayer inspection and calibration in Italy according to Enama Documents produced by Technical Working Group



A – Measurement of tree crop sprayer nozzles flow rate



B – Vertical spray pattern determination



C – Horizontal spay pattern determination



D – Checking of boom sprayer trim

Figure 3 Main phases of functional inspection in Piemonte Region.

These documents state, in accordance with the decisions of the Work Group, that anyone may ask to take part in the preparatory course in order to qualify to perform functional inspections on sprayers (compulsory secondary education qualifications are sufficient), at the end of which there is a theoretical exam (written + oral) and practical exam (inspection of a sprayer). Once obtained, the qualification does not expire unless it is suspended or revoked because of the proven irregularity of the technician's actions or following repeated and unjustified absence from further training activities required by the respective Region or Autonomous Province.

Functional inspections should be carried out every 2 years. Brand new sprayers need to be controlled for the first time within 6 months of purchase, but if they are ENAMA/ENTAM certified (or endowed with equivalent certification) this period is extended to 30 months.

When the functional inspection is complete a test report must be issued giving the results of tests, and the farmer must be given a certificate on the functionality of the sprayer which, in addition to documenting the positive outcome of the inspection, makes it possible to obtain, if requested and following the required procedure, recognition of the machine's functionality throughout the country.

- Furthermore, activity performed by authorised test centres (and by qualified technicians) should be monitored by Regions and autonomous provinces through a series of controls organised and run autonomously by individual local authorities, but that must be carried out every two years in test centres that carry out fewer than 200 inspections/year, and every year in other cases. During the course of these inspections the correct functionality of equipment used to carry out controls is also checked.
- A series of activities are currently being performed for the final drafting of documents regarding the calibration of sprayers and test protocols for functional inspections and the calibration of "special" sprayers, in addition to the definition of a common procedure for the recording and filing of inspection results and a "glossary" document.
- Documents regarding the calibration of traditional sprayers (one for boom sprayers and one for tree crop sprayers) will serve as support for functional inspection activity, and will provide "guidelines" on how to calibrate sprayers. The thresholds given, indeed, are limited to providing a rough guide on how to regulate and use the sprayer, and may be modified locally depending on specific operating contexts.
- With regard to the preparation of a data gathering system, a common software to be used nationally is to be created so as to permit the creation of a central database to gather data on inspected sprayers in different Italian test centres. The software will be purely technical, and will provide a valid support for functional inspections, facilitating the performance of some of the necessary calculations and making it possible to print out, at the end of the inspection, the certificate on the functionality of the sprayer.

3. Conclusions

It is believed today that agricultural activity must be performed with respect for the environment and ensuring the necessary quality and safety of production. In this sense it is essential to have suitable and perfectly functioning agricultural machines, especially when these can make a considerable impact on the environment, as is the case for machinery for applying chemical products. The hope is therefore that functional inspections of sprayers may spread as soon as possible throughout the country, following the example of other EU countries and anticipating what in the near future will probably be imposed by the EU through a specific Directive.

It is felt that this activity, performed with great commitment and professionalism (thanks to the high degree of expertise of scientific referents and representatives designated by Regions/Self-governing provinces making up the Work Group) and resulting in the drafting of documents, can provide a valid contribution in this sense, not only for Regions and Self-governing provinces that intend to start up a sprayer inspection and calibration service but also for centres that have already been operating in Italy for some years.

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A new vertical patternator for the determination of vertical spray pattern

Summary

A portable vertical patternator was designed and realised at the Department of Agriculture, Forestry, Environmental Engineering and land based Economics at the Torino University. The liquid collectors – consisting of a series of squared stainless steel plates (200 mm x 185 mm) - are inserted on a four meters high aluminium frame. The liquid collected by the trapping systems is carried -by silicone hoses- to a series of graduated measuring tubes supported by an aluminium frame. The amount of liquid collected by each plate is determined by reading its level on the corresponding tube's scale. Experimental tests have been carried out in order to determine the amount of liquid recovered by the vertical patternator as regards the liquid collectors' inclination, nozzle flow rate and the air speed nearby the plates. The trial pointed out that the air speed and the plate's inclination have a significant influence on the patternator efficiency.

Key words: vertical patternator, sprayer, inspection.

1. Introduction

The negative consequences following an inefficient pesticides application are both economical and environmental, due to up to 80% of product loss during application (Balsari et al., 2000). Nevertheless, product saving and environmental pollution control can be achieved by a targeted application. With regards to the tree crops, the efficient product application is linked to both plant morphology and sprayer vertical distribution pattern. This latter can be determined by means of artificial patternator, equipped with collectors mounted at different heights able to simulate the vegetative wall and to enable the determination of the amount of liquid delivered at different heights.

Currently, different patternators types are available with different shapes and constructive materials. The collectors must ensure the recovery of the largest part of the sprayed mixture without influencing the air current generated by the sprayer. The best option in terms of liquid recovery as regards to the sprayed amount is the lamellate test bench, with recovery percentages close to 90% (Ade e Venturi, 1994, Gil et al., 1994). Nevertheless, this latter is efficient when the lamellae are exposed to the air stream for short periods of time only. Furthermore it is an expensive and bulky device.

Patternators with funnels or absorption material are more easily handled and transported, but don't allow to reach such a high recovery efficiency (Balsari and Tamagnone, 1997; Balsari and Tamagnone, 1998).

It must be pointed out that the vertical patternators must ensure a good measurement repeatability and must be able to reproduce the effect of the spraying technique on the real vegetation. With the aim to combine both the patternator efficiency with its easy handling, a new vertical patternator was designed and tested by DEIAFA University of Torino.

2. Materials and methods

2.1 Vertical patternator description

The device is made up of a vertical aluminium frame on which the stainless steel collectors (200 mm wide, 185 high and 25 mm deep) are inserted. In the lower part, the collectors are narrower than the upper part in order to ensure the liquid sliding towards the silicon tubing connecting the captor to a graduated collecting plastic test tube (100 ml volume – 1 ml reading interval). All the test tubes are lined up and carried by an aluminium frame positioned at the foot of the patternator. This frame can be removed from the rest of the patternator to facilitate the operator in reading the amount of liquid

collected by each test tube and for unloading of the tubes set. The total patternator height is 4.5 m. Each captor is inserted on an aluminium bar (40 mm x 40 mm) fixed at the desired height to the vertical main frame. This latter is linked to a triangular base that can move on two rails. A 12V electric engine allows the device movement along the rails with a forward speed of 0.2 m/s, this allowing to maintain a constant distance between the sprayer and the patternator.

2.2 Tests performed

Trials were carried out in order to assess the device efficiency in different operative conditions by adjusting the following operative parameters:

- Application rate;
- collectors inclination as regards to the direction of the sprayed jet;
- air velocity.

All the trials were performed by using a single nozzle placed in correspondence of the centre of a pipe (250mm diameter) linked by means of a flexible hose to a centrifugal fan, in order to simulate the air assisted droplets transport system.

The rail for the test bench translation was placed perpendicularly to the nozzle jet and the section of the sprayed liquid was aligned with the collectors centre. The test bench velocity along the rail was adjusted at 0.2 m/s and the nozzle operative pressure at 5 bar . The distance between the captor and the nozzle was maintained at 600 mm. Six collectors were mounted on the vertical test bench axle (three per each side) at 1.6 m from the ground level (Figure 1). The collectors were positioned in series so that six replicates per passage of the test bench in front of the spraying nozzle were obtained.

The Coefficient of Variation (CV) of the collected data was then calculated. In order to evaluate the test bench efficiency in different operative conditions, different nozzle flow rates (1.01, 2.07 e 3.10 l/min), air velocities measured close to the collectors (0, 8, 12, 15 m/s) and collectors inclination as regards to the sprayed jet (90°, 75°, 60°) were used. These latter trials aimed to simulate the different angle of incidence of the sprayed mixture on the collectors surface placed at different heights (Figure 2). In detail (Table 1) 36 trials were carried out.

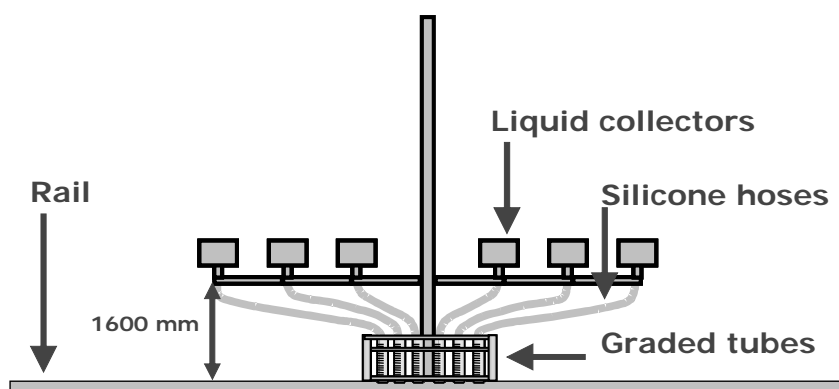


Figure 1 Test bench configuration during tests execution.

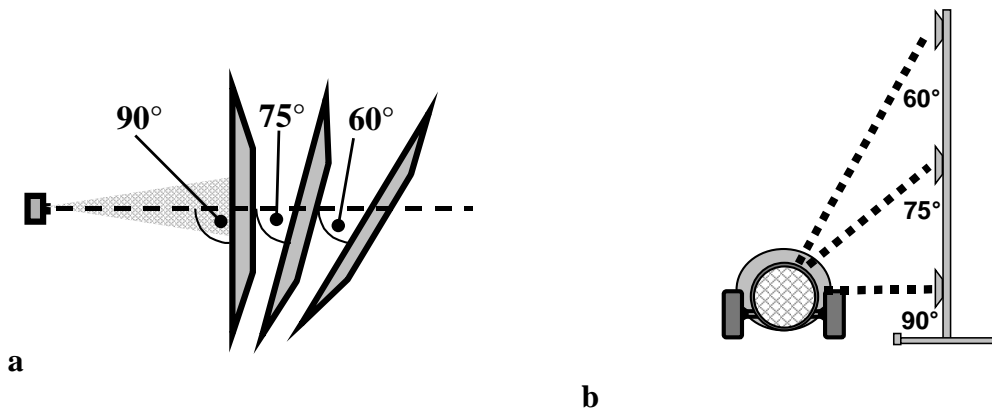


Figure 2 a) Liquid collectors inclination as regards to the nozzle - b) Nozzle angles of incidence as regards to the liquid collector surface

Table 1 Main operating parameters used in the test carried out

Nozzle	Flow rate @ 5 bar (l/min)	VMD μm	Air velocity (m/s)	Collectors inclination
TeeJet XR110 02	1,03	195	0	
TeeJet XR110 04	2,07	240	8	0°
TeeJet XR110 06	3,10	320	12	15°
			15	30°

3. Results

The amount of liquid collected in the same operative conditions resulted to be even: the coefficient of variation calculated on the amount of liquid collected by all the captors resulted always lower than 6%. When the trials were performed with the fan turned off and the nozzles jet perpendicular to the collectors, on average 82% of the sprayed liquid was recovered. Nevertheless, the collector inclination determined a sensible decrease of the recovered fraction: 80% and 76% of the sprayed liquid was recovered with 75° and 60° captors inclinations respectively. With the fan turned on, the highest recovery capacity was obtained with a 75° captor angle of incidence. Lower angles (60°) determined a higher product loss and, consequently, a lower recovery.

Trials results showed as the collectors efficiency decreases with the air velocity increase: with high air velocity (15m/s) and 60° captors inclination, on average the only 45% of the sprayed liquid was recovered by the system (Figure 3).

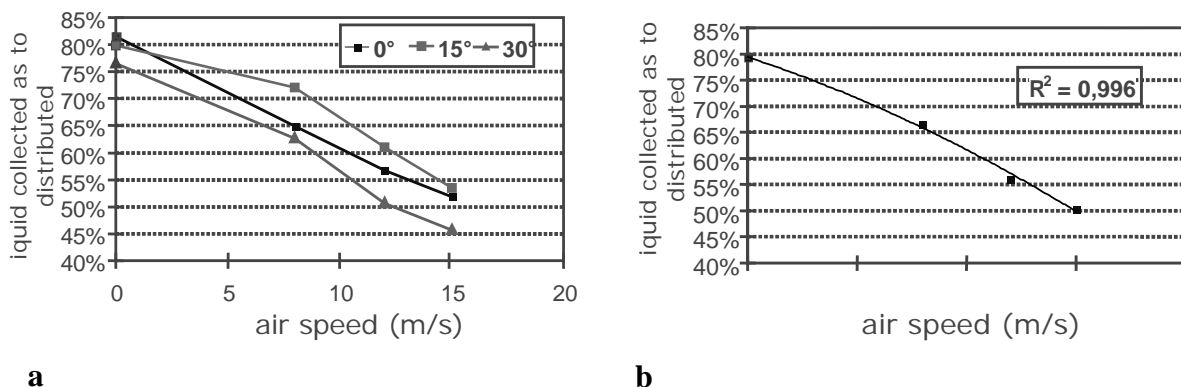


Figure 3 a) Effect of liquid collectors inclination on patternator efficiency - b) Effect of air speed on patternator efficiency

Furthermore, it was shown that increasing the nozzle application rate decreases the recovery performance of the collectors (Figure 4) with 1,03 and 2,07 l/min application rates and an air velocity of 8 m/s, the percentages of recovered liquid are very similar, whereas with a higher air velocity the efficiency decreases more rapidly with a 2,07 l/min application rate.

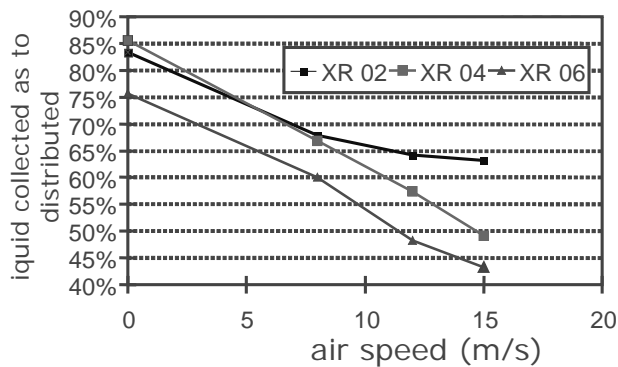


Figure 4 Effect of liquid flow rate on patternator efficiency

With 3,10 l/min application rate, the test bench efficiency always resulted lower than in all other conditions.

According to the results of the trials performed to assess the effect of the air velocity on the system recovery efficiency, a calculation model for the correction of the distribution pattern of the sprayers obtained by means of the tested vertical patternator was developed. Such a model showed as the distribution pattern obtained with the test bench is underestimated (on average of the 15%) in the bottom part (1,5 m from the ground) and it is on average 10% overestimated over 2.5m of height, whereas the measured data and the recalculated ones are coincident in the middle part of the distribution pattern (Figure 5).

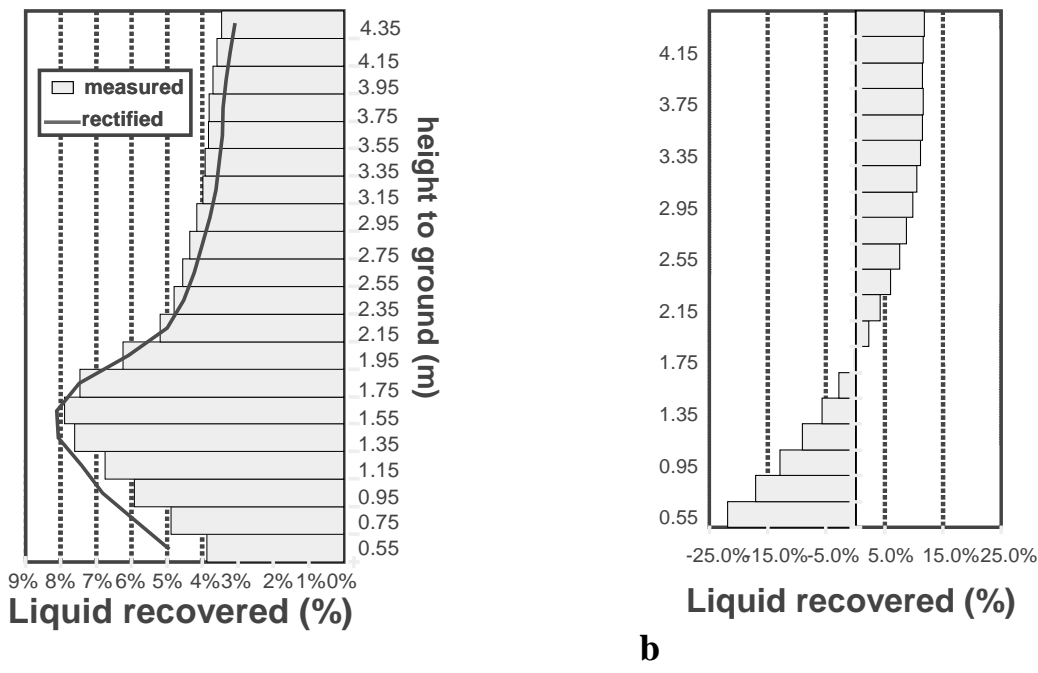


Figure 5 a) Measured and rectified - on the basis of experimental data - spray pattern - b) Deviation rate between amount of liquid recovered and calculated one on the basis of experimental data

4. Conclusions

The trials showed a good measurement repeatability (CV <6%) in all operative conditions and that the amount of recovered liquid as regards to the sprayed amount is included between 82% and 45% (decreasing with increasing air speed).

A high influence of the angle of incidence of the sprayed jet on the collectors efficiency (lower efficiency with 30° collector inclination) was also pointed out. Nevertheless, it is possible to rectify the resulting distribution pattern in function of the air speed and the angle of incidence of the sprayed jet on the collectors surface.

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Optimisation of mandatory sprayers inspection system in Lithuania

Summary

The legal act on inspection of sprayers in use and certification of new and reconstructed sprayers in Lithuania was introduced in 2001. The functioning of the system, in particular –the inspection of sprayers in use was problematic at the beginning. Therefore, it was optimized via the introduction of an amendment on the legal act concerning the inspection of sprayers (18 October 2005). Now, after changes have been made, inspection and certification of sprayers in Lithuania is in progress.

- **Sprayers in use** – sprayers being used now and in past;
- **New sprayers** – newly produced sprayers presented on the market for sale and use;
- **Reconstructed sprayers** – new sprayers and sprayers in use which have been reconstructed (modified);
- **Inspection of sprayers in use** – test of sprayers using the methodology according to the LST EN 13790:2000 standard;
- **Certification of new and reconstructed sprayers** - test of sprayers using methodology according to the LST EN 907:1998 and LST ISO 5682:1997 standards.

1. Introduction

According to the legal acts in force LAW ON THE AMENDMENT OF THE LAW ON PLANT PROTECTION (14 October 2003, No. IX-1761, Vilnius) “2. ...Plant protection products for professional use must be applied by certified equipment”.

The procedures of inspection and certification of field sprayers are set in THE REGULATIONS FOR THE CONTROL OF SPRAYERS (Regulations) approved by order of the Minister of the Republic of Lithuania on 19 June 2001 No 199 (amended on 18 October 2005). It states that all the sprayers with a tank capacity of more than 30 l shall be inspected.

The Regulations in general are prepared according to the EN 907:1998 and ISO 5682:1997 standards concerning certification of new and modified sprayers and the EN 13790:2000 standard concerning sprayers in use.

2. Inspection procedures and situation

2.1 General requirements and responsible bodies

Regulations for the control of sprayers are applied for all the sprayers with a tank capacity of more than 30 l. Regulations are compulsory for all people and companies who trade and use sprayers.

According to the Regulations for the control of sprayers:

- Only sprayers having sprayer certificates of a defined format (hereinafter referred to as Certificates) shall be sold and used;
- Certificates shall be valid for 3 years from the authorization or extension day;
- The expenses of the new sprayers inspection shall be paid by manufacturers or sellers;
- The expenses of inspection of reconstructed and sprayers in use shall be paid by their owners according to the established procedure;
- The new and reconstructed sprayers as well as the sprayers in use shall be inspected by National Machinery Testing Station (NMTS).
- The inspections of sprayers already in use shall also be organized and carried out by authorized private companies;

- The State Plant Protection service (SPPS) shall organize and control the sprayer inspection process.
- SPPS shall authorize companies to inspect sprayers in use.
- The national plant protection inspectors shall ensure that sprayers used shall have a valid inspection certificate.

2.2 Situation

- In 2006 in Lithuania there are around 15 000 sprayers. Around 80% of the sprayers are old and of poor quality (condition). Most popular sprayers (around 70%) are 400-800 l tank volume and have a boom width of 10-16 m.
- Despite legal obligations to start mandatory sprayer inspections in 2001, the actual inspection of sprayers in use started in 2003 by authorized engineers-inspectors. Lithuania is divided into 10 administrative zones. In each zone one engineer-inspector was obliged to make inspections on sprayers in use. Each engineer-inspector was supplied with a mobile sprayer inspection kit which wasn't very accurate and reliable (i.e. it couldn't fulfil the sprayer inspection standard requirements).
- The inspections (certification) of new and reconstructed sprayers started in 2003 by NMTS which had good knowledge and the appropriate equipment to perform the task.
- After a few years of problematic inspection of sprayers in use new regulations, - the *Regulations for the control of sprayers* -amendments were introduced in 2005. The additional function to inspect sprayers in use was delegated to NMTS creating 4 mobile teams. Private companies were also involved in carrying out this activity. There are now established eight accredited private sprayers inspection centres. This has significantly improved the performance of inspections of sprayers in use.

2.2.1 Sprayer inspections 2003-2006

- New and reconstructed sprayers (NMTS)
2003 / 2004 (year) – 134 (sprayer units tested)
2005 – 198
2006 – 217
- Sprayers in use (municipality engineers)
2003 / 2004 – 12
2005 – 54
- Sprayers in use (NMTS 4 mobile teams + private companies)
2006 – 397



Figure 1 Inspection of sprayers in use by private company.

2.2.2 Main faults usually found during inspections on sprayers are

- Allowed spraying distribution variation coefficient across the boom is exceeded;
- Worn out sprayer nozzles;
- Worn out pump;
- Wrong manometer;
- Faults on sprayer boom sections flow distribution controller;
- Sprayer boom is damaged (bends in vertical and horizontal directions).

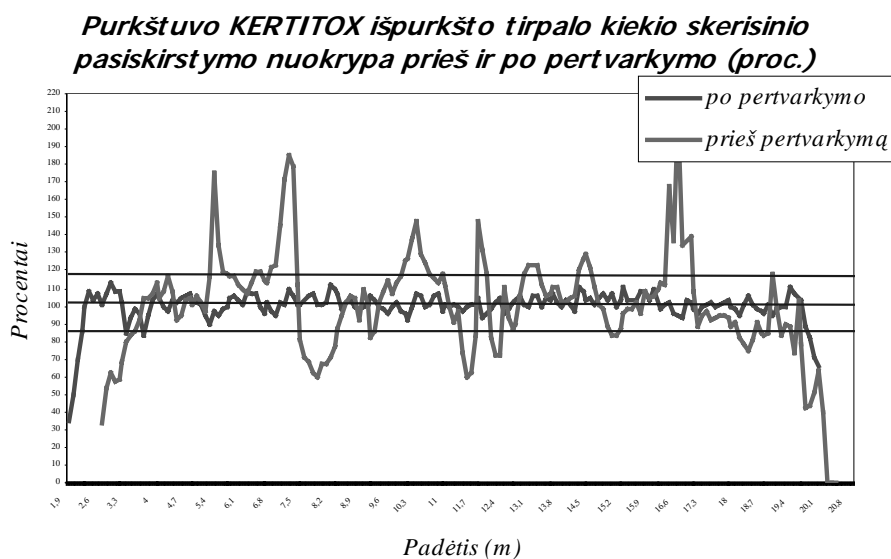


Figure 2 Functioning of the old sprayer before reconstruction (modernisation) and after ...

2.2.4 Information on training

- Regular training seminars on the preparation for inspection of sprayers are organized in different regions of Lithuania;
- At the completion of training certificates are awarded.

2.2.5 Main problems/risks on inspection of sprayers

- Low number of inspected sprayers;
- Sprayer owners unwillingness to bring sprayers for inspection (because is very difficult to ensure that all farmers use only inspected sprayers);

- High seasonal sprayer inspection work load for the sprayer testing personnel (short inspection period);
- Poor work quality risk of sprayer testing personnel;
- Lack of proper equipment and knowledge to test very modern, air-assisted sprayers;
- Quality assurance system of sprayer inspection is under implemented.

3. Conclusions

- The system of inspection and certification of sprayers in Lithuania has been recently modernised and inspections are now in progress.
- The legal document relating to uniform sprayer inspection procedures in Europe has to be developed and enforced to ensure human protection and to minimise risks to the environment .
- Training courses should be periodically organized to upgrade knowledge on sprayer inspection issues for sprayer testing specialists (trainers).

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Equipment used in Belgium to apply PPP's: compliance with inspection standards

Summary

At the moment, more than 600 active ingredients are authorized to be used for plant protection and/or pest control in Belgium. Most commercial products are formulated in such a way that they allow a comfortable liquid application, but others are applied in gaseous or solid state. Application of plant protection products can be directly aimed at the crop or it can be done indirectly by treating the space or the environment where the plants are located. These specifications determine in a significant way the equipment and techniques that will be used to accomplish the plant protection. Examples of used equipment and techniques are: dusting, smoking, vaporising and scattering (all non-liquid applications) and pouring, dripping, fogging, LVM, knap sack sprayer, lance sprayer, row spraying, horizontal, vertical and composed boom sprayers and air-assisted sprayers (all liquid applications). Nevertheless, regardless of what type of equipment is used, it should be well maintained and calibrated to perform an efficient plant protection. An important instrument to achieve this are the test results obtained from regular technical inspections. Unfortunately, of the listed equipment and techniques, only horizontal boom sprayers and air-assisted bush and tree sprayers are treated in the specific 'inspection' standard EN 13790! The official Belgian inspection protocols for field crop and orchard sprayers correspond well to EN 13790. The inspection of vertical and composed boom sprayers is also mandatory in Belgium. Unfortunately, no international standard about the preferable inspection methodology for this kind of sprayers is available. Because of this, a harmonisation within Europe between countries with a voluntary or compulsory inspection for this type of sprayers is hampered.

Key words: plant protection, equipment, inspection, standard

1. Introduction

Belgium was in the mid nineties one of the first countries in Europe to give attention to the used spray equipment. Among other things, training activities for farmers were organised which also included a voluntary inspection of their sprayer. This initiative showed that 1) only a small group of highly motivated farmers took part in these activities and 2) for more than 80 % of the participating sprayers smaller or even important defects could be stated ! Because of this situation, the government decided, in consultation with independent experts, manufacturers and importers of sprayers and farmer unions, to introduce a mandatory inspection scheme. Since a total new organisation had to be set up, it was decided to focus on field crop and orchard sprayers in the early years of the mandatory inspection. After all, these types of spray equipment counted for approximately 90 to 95 % of the spray equipment used in Belgium ! That's why until now only for field crop and orchard sprayers, well documented and technical justifiable inspection methodologies were established.

However, lately, more and more agricultural and horticultural productions have to meet requirements set in legal and/or private 'assured crop production' schemes ! This applies especially also to the production of vegetables under glass and ornamentals. Two agricultural sectors which produce mainly for export ! A lot of these national or international schemes require compliance with the national instructions on the inspection of spray equipment. This situation triggered a renewed interest to establish a specific inspection methodology for the kind of spray equipment used in these sectors.

2. Survey and classification of the different types of sprayers used in Belgium for agricultural and horticultural productions

Belgian plant production shows an enormous diversity: classical arable crops (cereals, maize, potatoes, sugar beet, flax, ...), fruit (apple, pear, cherries, strawberry, raspberry, berries), outdoor vegetables (leak, carrots, peas, beans, cabbage, lettuce, ...), indoor vegetables (tomatoes, cucumber, peppers, lettuce, ...), nurseries (shrubs and trees), outdoor field container plants (azalea, small shrubs and trees, chrysanthemum, ...) and indoor ornamental growing (cut flowers, pot plants, ...). It's no wonder this diversity results in a broad range of spray equipment used for chemical plant protection! Where the used equipment for classical arable crops and fruit growing is still rather limited (respectively horizontal boom sprayers and air-assisted orchard sprayers) the variety of spray equipment and techniques in the other sectors is huge.

Identification and classification of these different techniques and equipment in use in Belgian agricultural and horticultural productions can be done by answering some successive questions. Firstly, one should determine if the plant protection product is applied in a liquid way or not. Examples of non liquid applications are dusting, scattering, vaporizing or smoking of plant protection products. Also in Belgium, the number of authorized products with this kind of application has become very low. Examples of such kind of products still on the market are these to control snail or to control nematodes.

Plant protection products that are applied in a liquid way, can be used for a direct or indirect treatment. Indirect means that the spray liquid is not aimed directly at the plants. Pouring, dripping, fogging and applying by LVM (Low Volume Misting) are the most important examples of an indirect application. All these techniques are (still) quite popular amongst Belgian growers with indoor ornamental plant production. These techniques and equipment are rather simple and/or do not allow a lot of adjustment possibilities.

Equipment that is used to treat directly plants with plant protection products can be manually operated, not only what the locomotion concerns, but particularly in regard to the distribution of the spray liquid. Knapsack and lance sprayers are to types of sprayer that can be classified in this group.

All other spray equipment that applies plant protection products in a liquid way, directly on the crop and where there is no human interference for what concerns the liquid distribution are classified in a last group. It's clear that the majority of the used spray equipment can be classified in this group. Some examples: field crop sprayers, horizontal, vertical and combined boom sprayers in glasshouse productions, orchard sprayers, row sprayers and equipment for soil disinfection.

3. Discussion and Conclusions

As already mentioned in the introduction, Belgium was one of the first countries in Europe to establish a mandatory inspection for the sprayers in use. Recently, during the revision of the legislation, it was explicitly mentioned that all spray equipment belonging to the fourth group described in point 2. is subjected to the compulsory inspection. The new act will stipulate expressly that knapsack sprayers, lance sprayers, foggers and LVM equipment is not subjected to the inspection. Since the start of the inspections in the mid nineties, a specific inspection methodology and protocol for the inspection of field crop and orchard sprayers was established. Lately, adapted protocols for glasshouse spray equipment and equipment for soil disinfection were made up and will soon be published. The actual revision of the applying legislation was also used to compare and to line up the existing Belgian inspection methodology and protocol for field crop and orchard sprayers with the European standard EN 13790.

The inspection of vertical and composed boom sprayers is also mandatory in Belgium. Unfortunately, no international standard about the preferable inspection methodology for this kind of sprayers is available.

The expected EU Directive on the sustainable use of plant protection products describes in article 8 that 'Member states shall ensure that pesticide application equipment and accessories in professional use shall be subject to inspections at regular intervals'. If this definition is restrained in the final directive, this means that all equipment in professional use described in point 2. should be subjected to a periodical inspection. Although Belgium for the moment has already developed inspection protocols for specific spray equipment for which there was no really European standard and/or guidelines available, it would very much welcome a broad European initiative to establish uniform inspection protocols for all kinds of spray equipment actually not mentioned in the standard EN 13790.

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First inspections of mist blowers in Serbia

Summary

During 2006, first inspections of mist blower machines were conducted in Serbia. The inspection is not yet mandatory for mist blowers in Serbia, but it will be by the beginning of 2007. During 2005 and 2006, Faculty of Agriculture in Novi Sad has purchased modern equipment from AAMS (Belgium) for inspection of mist blowers, while also developing some original solutions.

The equipment was used for inspections in compliance with EN 13790. The inspections were conducted on machine owners' demands as a result of introduction of HACCP quality control system in processing industry. The inspection results showed that the machines, despite being relatively new, (6 years old) failed to meet set criteria.

Most common cause of failure was clogged nozzle, caused by inadequate maintenance. In some cases, pump capacity did not match the nominal value, deviating more than 20 % from the nominal capacity. Suggested in this paper are recommendations for removal of specified inadequacies.

Due to future mandatory inspection in Serbia, it would be interesting to share experiences with colleagues from the countries which have been practicing mandatory inspection for a longer period. Thus detected inadequacies could be removed in an optimal way, reducing space for manipulations by machine owners, who try to avoid the corrective procedure.

Of special interest is future initiation of inspection of new mist blowers. Inspectors shall be facing dilemma whether new machines should meet standards more stringent than the machines already in use. Another question is how manufacturers, who opt for inspection of newly produced machines, can receive Certificate of Quality which is valid in all EU countries.

Key words: mist blowers, inspections, Certificate of Quality

1. Introduction

Regular inspection of working condition of devices for application of pesticides is a necessary measure in modern agricultural production which uses pesticides on a large scale (Sedlar, 2006). In order to provide for production of eco-safe food, environment protection, and decrease of production costs, it is necessary to ensure controlled application of pesticides (Đukić, 2005). Such application is possible only with machines in perfect working condition (Langenakens 1999).

In June 2006, at the Faculty of Agriculture in Novi Sad, within the Department of Agricultural Engineering, Central laboratory was established for inspection of machines for pesticide application. Basic purpose of this Laboratory is to allow inspection of working condition of both new and used sprayers, mist blowers and other machines for application of pesticides. In addition, the idea for this Laboratory is to coordinate and assist establishment and operation of local - regional laboratories for inspection, helping them hire and train personnel, acquire and complete machine inspection equipment and homologize documentation. The Central laboratory has professional personnel and modern equipment which is necessary for inspection of sprayers and mist blowers in compliance with European norm EN 13790. The inspection of the spraying machines according to the harmonised EU standard EN 13790 will represent a major piece of the whole thematic strategy together with product comparison and training users. (Liegeois 2004). Eight years ago, according to the Law on plants protection, Federal Ministry of Agriculture of former FRY passed a Policy on services rendered in the area of plants protection, with an important novelty for users of plant protection machines, namely, the mandatory machine inspection every two years followed by inspection of working condition. Unfortunately, the

stated parts of the Law and Policy so far have not been duly respected (Bugarin, 2000). During 2007, new Law on usage of pesticides should enter into force which is compliant with the European directive 91/414/ EEC and which introduces mandatory machine inspection.

One of the first tasks for the newly established Central laboratory was the testing of 4 Munckhof - type 105 tractor-hauled mist blowers which are used for orchard protection. The mist blowers are used for protection of sour cherries which are exported to France for further processing, i.e. for production of cherry liquor pralines. Cherries are processed according to HACCP (Hayard Analysis Control Critical Point) system. Since January 2006, in our processing and food industry HACCP is mandatory system of food safety and quality control. European market is closed for products which are not manufactured according to HACCP system. One of prerequisites for later HACCP-compliant processing of agricultural products is inspection of machines for pesticides application (Sedlar, 2006). In modern European countries, factories which buy agricultural products demand of manufacturers to submit certificate of inspection for the machine which was used for application of pesticides. All these facts motivated introduction of working condition inspection for mist blowers.

2. Material and methods

The inspected mist blowers were hauled, manufactured in 2000 and with tank capacity of 1000 lit. Inspected were the working state and number of revolutions of crank shaft, tank (visual inspection), tubing, filters and valves, pump flow rate, nozzle, left- and right side nozzle distribution pattern and, finally, manometer. All of these tests were conducted in compliance with EN 13790 standards.

3. Results and discussion

3.1. PTO drive shaft inspection

Inspected were the working condition and number of revolutions of the PTO drive shaft (Figure 1).



Figure 1 PTO drive shaft

PTO drive shafts were visually inspected in all four aggregates, and it was established that they have the required protective coating and that it is set-up correctly. Number of revolutions was checked for the connecting shaft and it was established that it provides 540 o/min to the PTO drive shaft.

3.2 Visual inspection of storage tank, tubing and filters

Visual inspection of storage tanks in all four mist blowers showed that the main tank and the tank for technical water are in good condition. The deficiency of storage tanks is that their liquid level indicator does not have a floater. Instead, it is glued to the tank. Inspection of level indicator proved its correctness and its visibility from tractor cabin and from the spot where the tank is filled.

Inspection of all filters on the misting machines showed that their mesh structure is adequate and that they are in good condition.

During visual tubing inspection, 5 seconds after stopping and pressure shut-down, no leakage was detected in any of inspected mist blowers, thus the tubing is in good condition.

3.3 Pump flow rate inspection

Pump flow rate was inspected using pump flow rate gauge shown in Figure 2. It was measured at working pressure of 11 bar.



Figure 2 Pump flow rate gauge

Flow rate measured in the A mist blower was 52,72 l/min, which is 21,40 % below nominal flow rate which is 64 l/min. Flow rate measured in the B mist blower was similar to the first one, i.e. 52,88 l/min, which is 21,03 % less than nominal flow rate.

Flow rate measured in the C mist blower was 43,10 l/min, which is 48,49 % less than nominal flow rate, while flow rate of the D misting machine was 41,50 l/min, which is 54,21 % less than nominal flow rate.

According to EN 13790 the allowed deviation is 10 %, which means that the inspected pump requires maintenance (change of membranes, valves, thorough cleaning...).

3.4 Inspection of nozzles flow rate

Nozzle flow rate was measured at working pressures of 11, 13 and 14 bar for the duration of 1 minute. The mist blowers were fitted with nozzles made of synthetics and ceramics, type Whirl AMTP-223 and AMTP-230 Albus (green and blue inserts).

- Capacity of the mist blowers was measured by two special devices shown in Figure 3.
- A stop-watch was used for measuring nozzle flow rate.
- Mist blowers are fitted with seven nozzles on the left and right side. Measured values are shown in Table 1.
- Mist blowers A and B were inspected in Irig. As recommended by Norm 13790, inspection was done at pressures that are most often used by machine owner, which in this case was 11 bar. Four front nozzles on the left and right side, as seen from the ground, are green coded and their flow rate at 11 bar pressure is 2,65 l/min. Aft three nozzles are blue coded and their nominal flow rate is 3,66 l/min
- Mist blowers C and D were inspected at a farming estate in Nova Crvenka. Since they usually operate at 13 and 14 bar, they were also inspected at these pressures. All nozzles on mist blower C are green coded and their working pressure was 13 bar. Nominal flow rate at this pressure is 2,88 l/min.
- All nozzles on mist blower D are also green coded and their working pressure was 14 bar. Nominal flow rate at this pressure is 3,00 l/min.
- The above listed values are taken from the flow rate table for whirl nozzles Albuz. Nozzles were assigned numbers from the ground - up.
- Analysis of Tab.1 shows that each of the misting machines A and B had 2 nozzles whose flow rate increased above the allowed 15 %. These nozzles should immediately be replaced by new ones. In misting machine D, one nozzle was detected with flow rate increased by 15 %. As this is on the edge of tolerance, the nozzle should be replaced by a new one.
- However, much larger problem is a number of nozzles with flow rate diminished in comparison with the table value. Diminished capacity is due to inadequate nozzle maintenance which resulted in clogging. All these nozzles should be taken off and washed thoroughly in lukewarm water. The washing should be done using brush for nozzle cleaning, rather than using sharp objects which are likely to cause damage to the nozzles. Beside the nozzles, filters - which are placed in the nozzle holder, should also be washed in lukewarm water.



Figure 3 Measuring nozzle flow rate

Table 1 Nozzles flow rate

Mist blower No. A				
Nozzle No.	Flow rate deviation (%)	Left-side nozzles		Flow rate deviation (%)
		Flow rate (l/min)	Flow rate (l/min)	
1	Decrease 4,41	2,533	1,666	Decrease 37,13
2	Decrease 6,94	2,466	2,733	Increase 3,13
3	Increase 0,60	2,666	2,600	Decrease 1,88
4	Increase 0,60	2,666	2,600	Decrease 1,88
5	Decrease 16,55	4,266	3,066	Decrease 16,23
6	Decrease 7,10	3,400	3,666	Increase 0,16
7	Increase 20,21	4,400	3,200	Decrease 12,56

Mist blower No. B				
Nozzle No.	Flow rate deviation (%)	Left-side nozzles		Flow rate deviation (%)
		Flow rate (l/min)	Flow rate (l/min)	
1	Decrease 19,24	2,14	2,81	Increase 6,04
2	Increase 3,39	2,74	1,80	Decrease 32,07
3	Increase 11,69	2,96	2,81	Increase 6,04
4	Increase 3,39	2,74	2,77	Increase 4,53
5	Decrease 5,74	3,45	3,97	Increase 8,47
6	Increase 4,37	3,82	4,61	Increase 25,96
7	Increase 4,37	3,82	4,80	Increase 31,15

Mist blower No. C				
Nozzle No.	Flow rate deviation (%)	Left-side nozzles		Flow rate deviation (%)
		Flow rate deviation (%)	Flow rate deviation (%)	
1	Increase 2,43	2,95	2,77	Decrease 3,82
2	Increase 9,37	3,15	3,12	Increase 8,33
3	Increase 6,59	3,07	2,4	Decrease 16,66
4	Increase 4,16	3	2,62	Decrease 9,03
5	Increase 4,16	3	2,74	Decrease 4,86
6	Increase 2,77	2,96	2,55	Decrease 11,46
7	Increase 5,55	3,04	3	Increase 4,16

Mist blower No. D				
Nozzle No.	Flow rate deviation (%)	Left-side nozzles		Flow rate deviation (%)
		Flow rate deviation (%)	Flow rate deviation (%)	
1	Decrease 15	2,55	2,88	Decrease 4
2	Decrease 22,66	2,32	2,51	Decrease 16,33
3	Increase 15	3,45	2,92	Decrease 2,66
4	Decrease 15	2,55	2,88	Decrease 4
5	Decrease 27,66	2,17	2,88	Decrease 4
6	Increase 11,33	3,34	2,96	Decrease 1,33
7	Decrease 22,66	2,32	3,19	Increase 6,33

Measurement of left- and right-side nozzle distribution pattern

For the measurement of right- and left-side nozzle distribution, the data for nozzle flow rates were processed in MsExcel producing distribution histogram shown in Figure 4.

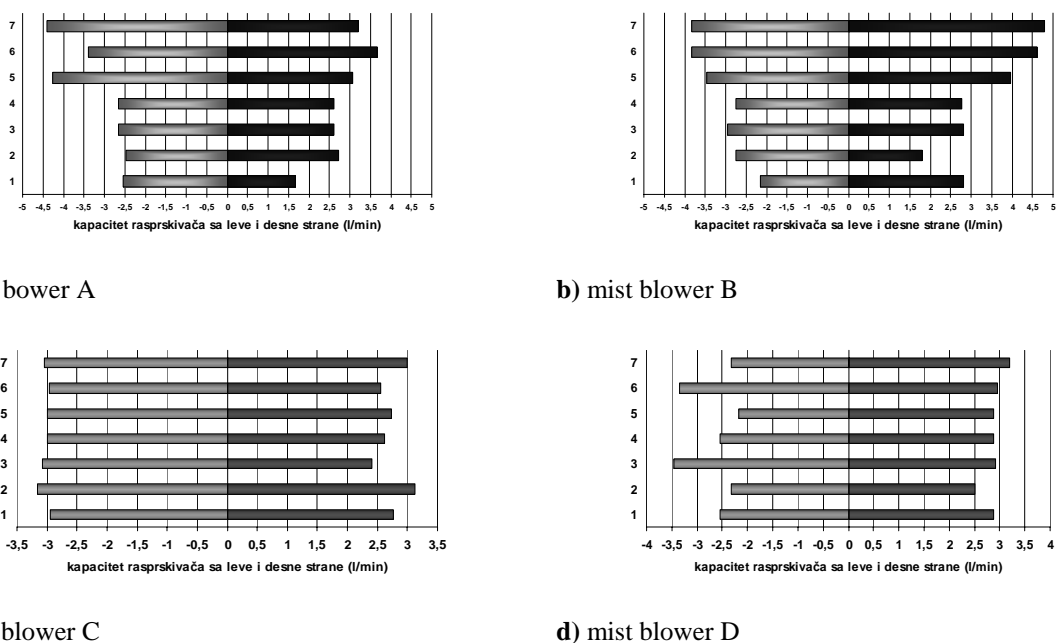


Figure 4 Mist blowers distribution histogram

Nozzle flow rate on the left side is prefixed by minus sign (-) for efficient presentation. According to EN 13790, mist blowers distribution is acceptable if the difference in flow rates of left and right-side nozzles does not exceed 10 %. Statistical processing of data revealed that an average nozzle flow rate for mist blowers A, equals 3,20 l/min on the left side, and 2,79 l/min on the right side. Comparing these two values shows that the difference in average nozzle flow rates for the left and right side is 15 %, which exceeds the allowed 10 %. Similar was found in mist blower C, where left-side nozzle flow rate average was 3,00 l/min, and for the right-side nozzle 2,7 l/min. Comparing these two values shows that the difference in average nozzle flow rate for the two sides is 11 %, which also exceeds the allowed 10 %.

In mist blowers B and D the left-side nozzle flow rate is 3,10 l/min, i.e. 2,67 l/min, while for the right-side nozzles the corresponding values are 3,37 and 2,88 l/min. When compared, these two values show an average difference in nozzle flow rate of 8 %, for mist blower B, and 7 % by mist blowers C, which is below the allowed 10 %.

3.5 Manotest

Manotest means inspection of working condition and correctness of manometer. Before the inspection, diameter radius was measured and it was established at 100 mm, which is more than the mandatory 63 mm as required by EN 13790.

Manometer scale is graduated from 0 to 20 bar in 0,2 bar increments, while from 20 to 60 bar the increments are 10 bar, which is compliant with EN 13790.

Control manometer, calibrated according to EN 837-1, was used for measuring correctness of manometer (Figure 5).



Figure 5 Inspection of manometer correctness

Measurement for mist blowers A, B and D was done at 5 and 10 bar. While the control manometer indicated these pressures, the inspected manometers of misting machines A and D indicated pressures of 5 bar and 10 bar. The result shows that these manometers are correct. Manometer of mist blower B indicated pressures of 5,5 bar and 10,5 bar. The inspected manometer showed error of 0,5 bar and that deviation was constant with pressure change. The deviation is caused by the pointer failing to reset to 0 bar position.

In mist blower C, measurement was performed at pressures of 5, 10 and 15 bar. While the control manometer indicated these pressures, the inspected manometer indicated pressures of 5,2 bar, 10,3 bar and 15,4 bar. The inspected manometer showed a 4 % error at 5 bar and the error decreases with pressure increase, so that at 15 bar pressure, the error equals 2,6 %. Detected manometer deviation is within allowed deviation according to EN 13790.

4. Conclusions

Inspected mist blowers are in reasonably good condition. However, certain corrections are required in order to receive Certificate of Quality in compliance with EN 13790.

First, it is necessary to determine the reason for diminished pump flow rate in all mist blowers. For mist blowers A and B the decrease equals 21,40 % and 21,03 %, while for machines C and D the decrease is doubled and equals 48,49 %, i.e. 54,21 %. For that reason it is necessary to inspect pump pistons and valves. All sealers on the pump should be checked and replaced if worn out. Upon inspection and performed corrections, pump flow rate shall be inspected again.

All nozzles with flow rate increased over the limit, need replacement. Such nozzles are few - only 5. Alarming is the fact about numerous nozzles with diminished flow rate. This is due to inadequate maintenance of mist blowers. In order to solve this problem, liquid supply tubing needs to be inspected, working of filter in nozzle holder needs checking and nozzles should be washed thoroughly in lukewarm water. Once the corrections are done, nozzle flow rate is to be inspected again.

For future inspections, it is important to stress out that in order to obtain precise and valid results of nozzle distribution inspection, all working parts in the system must be thoroughly clean and prepared.

Due to future mandatory inspection in Serbia, it would be interesting to share experiences with colleagues from the countries which have been practicing mandatory inspection for a longer period. Thus detected inadequacies could be removed in an optimal way, reducing space for manipulations by machine owners, who try to avoid the corrective procedure.

Of special interest is inspection of new mist blowers. Inspectors shall be facing dilemma whether new machines should meet standards more stringent than the machines already in use. Another question is how can manufacturers who opt for inspection of newly produced machines, receive Certificate of Quality which is valid in all European countries.

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Periodical inspection of sprayers in Hungary

Summary

On several occasions in last years our Institute submitted a lot of proposals to The Ministry of Agriculture and Rural Development for modification of implementing regulations of The Plant Protection Act. After the acceptance of our proposals all of the field and air-assisted sprayers in use with a tank of more than 100 dm³ will be subject to a periodic inspection in Hungary. The testing station having a certificate issued by the HIAE (Hungarian Institute of Agricultural Engineering) will make these inspections. The inspection must be repeated every two years. The inspection fee will be stipulate in the special decree approved by the public authorities. The Plant Protection Act and its implementing regulations issued by the Ministry of Agriculture and Rural Development ordain the personal details of testing station. The respective requirements, methods of periodic inspection, equipment of testing stations, design and metrological parameters of measuring equipments are included in the standard EN 13790. The testing stations are controlled by HIAE and the authorization of sprayers is controlled by the supervisors of Plant and Soil Protection Service within their own sphere of authority.

Key words: sprayers in use, periodical inspection, testing station.

1. Introduction

The plant protection based on chemicals is not only a series determined mainly quantity and quality of the yield, but also a dangerous activity against our environment. The result of the protection operations and their effect on the environment depends also from the utilized machines. The design and the technical status of the plant protection machines has great influence on the accuracy of the dispersing of chemicals, determines the losses what contaminating or damaging the environment. It exists in Hungary since 1968. A decree for fulfilling of plant protection operations with convenient machines in a way not to contaminate the environment and having a uniform distribution, but only the Plant Protection Act issued in 2000 and its enacting clauses regulated in detail the conditions of the supervision. The examinations are carried out in three steps:

- Type approval before distribution/selling (obligatory from 1st January 2004).
- Regular inspection of sprayers in use (will be obligatory)
- Control on site during operation.

The inauguration will be made by progressive stages. The establishment and the carrying out of the supervisions are highly supported by the European standards.

2. Materials and Methods

After the acceptance of our proposals, the regular inspection of all sprayers in use with a tank volume of more than 100 dm³ will be obligatory in every second year. The aim, the methodology and the requirements of the inspection of sprayers in use are determined in the standard EN 13790.

Control stations having the authorization of Hungarian Institute of Agricultural Engineering will carry out the regular inspections.

An authorized station should possess:

- A leader having the qualification as technician at least,
- one skilled workman at least, suitable prepared for performing his task;
- the prescribed measuring equipments and devices.

The devices and measuring equipments necessary for the inspection of sprayers are the followings:

Inspection of field crop sprayers: The design, the technical and metrological parameters of measuring equipments are included in the standard EN 13790.

Spray table for measurement of the uniformity of the transverse volume distribution;

- flow meter for measuring of the capacity of pumps;
- pressure gauge used for testing;
- tachometer (P.T.O.);
- measuring tape (nozzle spacing and height);
- stop watch (flow rate, distribution);
- measuring cylinder or flow meter (nozzle output);
- air pressure gauge (pressure pulsation damper);
- motor vehicle for transport of the measuring equipments.

Inspection of air-assisted sprayers for vineyards and orchards: The design, the technical and metrological parameters of measuring equipments are included in the standard EN 13790.

- flow meter for measuring of the capacity of pumps;
- pressure gauge used for testing;
- tachometer (P.T.O.);
- measuring tape (nozzle spacing and height);
- stop watch (flow rate, distribution);
- measuring cylinder or flow meter (nozzle output);
- air pressure gauge (pressure pulsation damper);
- motor vehicle for transport of the measuring equipments.

To the devices belongs in both cases a trough to collect the liquid running out at the measurement.

The mobile stations should be equipped in interest of an effective measurement and of the assuring of similar measuring results with uniform measuring devices. Following instruments should be obtained at first:

- Spray scanner (patternator), computer-controlled, telemetrically, with ultrasound level measuring for determination of the liquid distribution under the spray boom;
- Electronic flow rate measurement device with ultrasound level measuring for nozzles.

The control stations will work prospectively according to a yearly plan. Every station will publish its field of action, site and date of inspections. The control stations present their plans of inspection to the Institute HIAE for checking up in every year. At compiling a plan, the control stations have to strive for accomplish the inspection from not more than 30 km distance of any operation site in the given year. Inspections can be carried out at the given habitation or region several times within a year. The plan has to be collected in a way that it can be kept independent of the number of applicants and other circumstances. The plan of inspections should be published after its confirmation.

Owner of the sprayer have to present oneself for inspection 30 days before the end of the inspection obligatory. Registering for inspection have to send to the address of a given control station, that will inform the applicant about the date of inspection by mail. The sprayer can be used up to the date of inspection according to its function.

The owner of the machine or his representative is obliged to appear in the appointed time with the clean machine, ready for working and with a tractor for its operation. The tank of the sprayer should be filled up to 25% of the nominal volume with clear water. The inspection will be carried out against payment. The owner of the machine or his representative has to present the receipt of payment of the inspection's fee to the leader of the station before beginning of the inspection. The machines will be controlled on the base of the uniform methodology. The owner of the machine or his representative may be present at the inspection. The results of the inspection will be registered in a prescribed protocol.

If the result of the inspection is satisfactory, the station issues the licence verifying the operational permission of the sprayer. If the technical condition of the machine is – on the base of the results of the inspection – unsatisfied, the permission cannot be issued. If the detected troubles or defects can be repaired in a short time (e.g. by exchange of the nozzles or of the manometer), the inspection should be repeated – if possible – at the given station in a new appointed time against payment of a new fee.

The plant protection authority will control the operating permission of the sprayers. It is expected that 15-20 mobile stations would be enough at the beginning for carrying out of the inspections.

The staff/employees of the stations should be complete training courses to become acquainted with the system, the requirements and the methodology of the inspection.

3. Conclusions

It is expected that the initiated control system of plant protection machines in Hungary contribute to the increasing of the security of the operator, to the reducing the damage of the environment and to the improvement of the effectiveness of the treatment with chemicals. It seems to be necessary to extend the inspection to all operating sprayers under using the first gained experiences.

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GUVERTO – internet based software for sprayer control

Summary

With “GUVERTO” an Internet based software solution for the comprehensive documentation, develops administration and analysis of all activities concerning plant protection equipment control is realized. This software represents a uniform platform for all levels which play a part on this field. These are: Farmers, control workshops, experts for the control equipment, state authorities.

All data are brought together at this software solution in a central place. They are documented thus centrally and therefore also can be analyzed by different users at the respective level. The advantages are the high standard to data security and a flexible data use at all levels. A quite important advantage is the time and labour-saving analysis for authorized users of the database of selected data. This is possible in the supra regional area any time, too.

1. Introduction

Under protection of plants equipment control a lot of data has to be grasped, documented and also evaluated at different levels. This concerns the farmers, the control workshops, the experts for the control equipment as well as the responsible state authorities.

About 250 control workshops are working in protection of plants equipment control in Baden-Wuerttemberg at present time. Controls are carried out by altogether over 500 employees who were trained particularly for this task.

In Baden-Wuerttemberg the DEULA is engaged by state authority to manage the execution of the regular check of control equipment of the workshops, control places as well as the regular training of the control staff. Therefore the DEULA also can be described as an “interface” between control workshops and state authorities.

2. Data acquisition

2.1. Level “control workshop ”

Check of the plant protection equipment: At present, DEULA has to check approximately 20000 field sprayers and about 10000 air-assisted sprays regularly in Baden-Wuerttemberg. At the moment, the predominant number of control workshops in Baden-Wuerttemberg still is checking the field sprayers using the mechanical patternator for horizontal distribution. A uniform inspection report has to be used for the documentation of the results.

Using “GUVERTO” the control workshop prints the control report as a form now itself. This form is registered while printing with an ongoing number which is allocated by the program internally automatically.

	geringer Mangel	Mangel bzw. fehler	In Ordnung / Mangel beseitigt
1. Antrieb			
K.1.1 Funktion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Pumpe			
K.2.1 Volumenstrom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.2.2 Pulsationen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.2.3 Dichtheit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Rührwerk			
K.3.1 Umwälzung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Behälter			
K.4.1 Dichtheit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.4.2 Einfüllsieb	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.4.3 Druckausgleich	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.4.4 Füllstandsanzeige	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
K.4.5 Entleerung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In addition, the control report already contains the master data of the client (farmer) including the master data of the plant protection device. After equipment examination having been carried out the handwritten results on this report are entered in “GUVERTO” with mouse clicks. The screen mode corresponds to the form of the control report. This guarantees a timesaving data input.

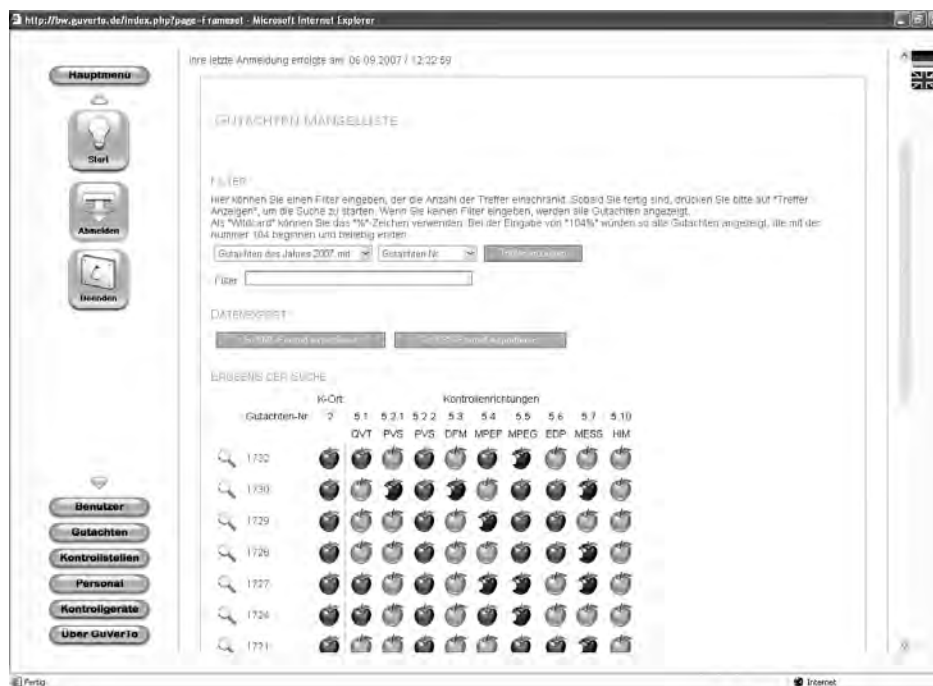
With this process the control workshop has also carried out the obligatory documentation of the data and the specified passing of select data to the competent authorities.

Using an electronic patternator the data transmission of the control report to “GUVERTO” is carried out by an interface already integrated. Through this additional working time can be saved.

In addition to this the modular “control workshop” contains a complete administration of master data of all clients . If the client is coming to the test again data can be used only by several mouse clicks and new data of the measurement are added. A take-over of the required data for the invoicing is also possible.

2.2 Level “expert ” (DEULA)

Check of the testing equipment: The check of the testing equipment of the workshops is carried out by the DEULA in a two-year distance. The result of this check is recorded in a expert report which is transferred to the corresponding module in “GUVERTO”. All reports are therefore available as fast information to the authorized users (state authorities). They are interested in the reports of the examinations in which defects have arisen concerning components of the testing equipment, such as devices to measure the flow rate of pumps and to test flow meters, pressure gauge as a matter of priority. This “*List with defects and faults*” is shown first for information purposes separately and makes possible a reacting fast of the administration mentioned above.



The control workshops exchange occasionally the testing equipments or single components of the testing equipments under each other.

Therefore every component of the testing equipment was provided with a so-called “Ident number”, allocated centrally and fixed at the equipment parts since the year 2007 by the DEULA. Using “GUVERTO” it is very easy to establish at which control places checks are carried out possibly with a faulty testing equipment.

Training of the control staff: The DEULA is responsible for the execution of the regular (3-year) training of the control staff. The master data of these persons are registered in GUVERTO. The participation in the specified trainings particularly is documented. The program reports those persons on schedule through who must take part at the next training. GUVERTO thus also contains a complete seminar administration for the control staff.

2.3. Level “state authorities”

Control supervision: The responsible state authorities are engaged to do the supervision of the operations flow of plant protection control. Using the internet based GUVERTO all relevant data are available at any time and everywhere for these persons. Control tasks can be run through it efficiently and labor saving.

Data analysis: Using GUVERTO makes an individual evaluation of all data possible for Baden-Württemberg after quite different points of view or questions. This is possible due to the database structure of GUVERTO within shortest time with minimal effort of working time.

3. Conclusions

GUVERTO is an efficient software tool for recording and analysis of all data of sprayer inspection. All these data can reliably and labor saving be managed and evaluated at all levels with that. Particularly the specified documentation of these data is ensured reliably.

Necessary controls can be carried out purposefully because GUVERTO informs where need for action is given currently. Through this the personnel resources available are used efficiently.

The structure of GUVERTO makes a cross border (EU member countries) use of this software possible at any time, too. For the data analysis thus broader possibilities on the field of sprayer control can be recognized here. This concerns not only state authorities but also primarily the equipment manufacturer.

GUVERTO multi lingual available. In addition country-specific customizations can be taken into account any time.

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Twinning and Taiex, two pre-accession instruments of the EC

Summary

The DG Enlargement – Institution Building Unit of the European Commission (EC) proposes two pre-accession instruments, Twinning and Taiex, which help the New Member States (NMS), the acceding or candidate countries as well the European Neighbourhood to “rebuild” their institutions according to the EU acquis. Twinning instrument provides mid to long-term projects (6 months to 3 years) assistance for the emergent countries. The projects aim at helping the administration of the beneficiary country to integrate the European legislation and acquis. Technical Assistance and Information Exchange (Taiex) provides short-term technical assistance (few days) in all areas of the EU acquis with the view to support the alignment, application, and an enforcement of the acquis in the beneficiary countries. Both instruments are based on a demand driven approach. Beneficiary countries have to introduce their needs. Based on those needs and priorities, European Commission will select the most appropriate projects.

Key words: Twinning, Taiex, pre-accession instrument, European Commission

1. Introduction

Enlargement is one of the EU’s most powerful policy tools. The pull of the EU has helped to transform Central and Eastern Europe into modern, well-functioning democracies. More recently it has inspired far-reaching reforms in the candidate and potential candidate countries. All European citizens benefit from having neighbours that are stable democracies and prosperous market economies. Enlargement is a carefully managed process which helps the transformation of the countries involved, extending peace, stability, prosperity, democracy, human rights and the rule of law across Europe.

The European Union has undergone a number of enlargements since its creation. More and more countries have joined the first six Member States. After Bulgaria and Romania acceded on the 1 January 2007, the EU is composed of 27 Member States.

The EU provides specific targeted financial aid for candidate and potential candidate countries and limited assistance to new Member States in order to support their efforts to enhance political, economic and institutional reforms.

2. Pre-accession instruments

2.1. Former Assistance

The EU developed several financial instruments as Phare programme, ISPA programme, SAPARD programme, Turkey and CARDS. For example, the budget of the pre-accession instruments reached in 2005 3.286 Mio € which corresponded to $\pm 3\%$ of the EU budget.

The **Phare programme** applied to acceding and candidate countries, principally involving Institution Building measures (with accompanying Investment) as well as measures designed to promote Economic and Social Cohesion.

The **ISPA programme** dealt with large-scale environment and transport investment support, and comes under the responsibility of the Directorate-General for Regional Policy.

The **SAPARD programme** has supported agricultural and rural development and comes under the responsibility of the Directorate-General for Agriculture.

Turkey has in the past received pre-accession assistance via similar but different instruments, budget lines and procedures.

The **CARDS** (Community Assistance for Reconstruction, Development and Stabilisation) Programme has underpinned the objectives and mechanisms of the Stabilisation and Association Process, which remains the EU policy framework for the Western Balkan countries until their eventual accession.

All these instruments have now been replaced from 2007 by the new instrument for pre-accession **IPA**. Existing projects under these former programmes will continue. All new pre-accession actions will now come under the new **Instrument for Pre-accession Assistance**.

2.2. The new Instrument for Pre-accession Assistance (IPA)

The new Instrument for Pre-accession Assistance came into force on 1 January 2007, bringing all pre-accession support into one single, focussed instrument.

The Council regulation establishing IPA was adopted on 17 July 2006, replacing the 2000-06 pre-accession financial instruments PHARE, ISPA, SAPARD, the Turkish pre-accession instrument, and the financial instrument for the Western Balkans CARDS.

IPA covers the countries with candidate status (currently Croatia, the former Yugoslav Republic of Macedonia, Turkey) and potential candidate status (Albania, Bosnia and Herzegovina, Montenegro, Serbia including Kosovo according to UNSCR 1244).

IPA has five components: the transition assistance and institution building (which principally involves institution building measures with accompanying investment); cross-border cooperation; regional development; human resources development; and rural development.

3. Projects

The projects are concrete actions of the European Union to assist the acceding, the candidate and the potential candidate countries in their preparations for joining the European Union. There are hundreds of on-going projects across all sectors, countries and regions.

The projects are funded under various programmes agreed between the European Commission and the authorities of the countries concerned.

The EU regularly publishes invitations to tender and calls for proposals. These are organised either by the Commission services in Brussels, or under "deconcentration" by its delegations in the beneficiary countries, or under "decentralisation" by contracting authorities that are part of the beneficiary countries' public administrations.

Information on invitations to tender can be found in the European Commission's specialised data bases, the Official Journal of the European Union and on the sites of the European Commission Delegations in the eligible countries:

- New Member States: Bulgaria and Romania.
- Candidate countries: Croatia, Turkey and the former Yugoslav Republic of Macedonia.
- Potential candidate countries: Albania, Bosnia and Herzegovina, Montenegro, Serbia including Kosovo (under United Nations Security Council Resolution 1244 of 10 June 1999).

At any one moment, hundreds of European Commission sponsored Member State experts are active in beneficiary countries reinforcing the institutional and administrative capacity of their administrations. Technical Institution Building assistance to the beneficiary countries aims to support their on-going efforts to transpose, apply and enforce the “acquis communautaire”. This assistance comes mainly through the Twinning Programme, which involves longer-term secondments of EU Member State experts, and the TAIEX instrument, which provides short-term expertise.

4. Twinning

Launched in May 1998, the Twinning programme is one of the principal tools of Institution Building accession assistance. Twinning aims to help beneficiary countries in the development of modern and efficient administrations, with the structures, human resources and management skills needed to implement the “acquis communautaire” to the same standards as Member States. Twinning provides the framework for administrations and semi-public organisations in the beneficiary countries to work with their counterparts in Member States. Together they develop and implement a project that targets the transposition, enforcement and implementation of a specific part of the “acquis communautaire”.

The main feature of a Twinning project is that it sets out to deliver specific and guaranteed results and not to foster general co-operation. The parties agree in advance on a detailed work programme to meet an objective concerning priority areas of the acquis, as set out in the Accession Partnerships. Since 1998, beneficiary countries (Figure 1) have benefited from over 1 100 Twinning projects (Table 1).

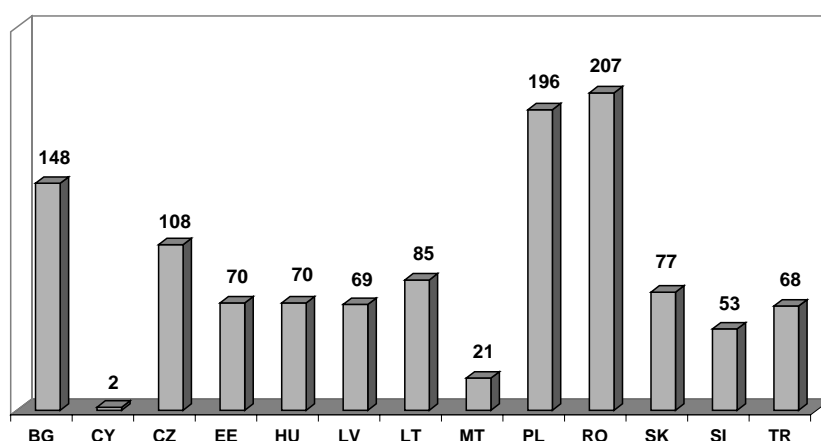


Figure 1 Twinning Projects 1998-2006, Beneficiaries

Table 1 Overall contracted amount for Twinning projects 1998-2006

	Contracted amount (M€)	Number of projects	Average per project (M€)
1998	76,8	104	0,74
1999	118,4	122	0,97
2000	145,8	146	1,00
2001	146,3	132	1,11
2002	163,2	190	0,86
2003	127,5	153	0,83
2004	168,4	178	0,95
2005	84,9	96	0,88
2006	53,6	65	0,82
Total	1.084,9	1.186	0,91

The key input from the Member State administration to effect longer-term change is in the core team of long-term seconded EU experts, practitioners in the implementation of the *acquis*, to the new Member State, acceding, candidate or potential candidate country. Each Twinning project has at least one Resident Twinning Adviser (RTA) and a Project leader.

The RTA is seconded from a Member State administration or from another approved body in a Member State to work full time for a minimum of 12 months in the corresponding ministry in partner country to implement the project. The Project Leader is responsible for the overall thrust and coordination of the project. They are supplemented by carefully planned and timed missions of other specialists, training events, awareness raising visits, etc to accompany the reform process towards the targeted result.

5. TAIEX

The Technical Assistance and Information Exchange Instrument (TAIEX) provide centrally managed short-term technical assistance in the field of approximation, application and enforcement of European Union legislation. The role of TAIEX is that of a catalyst, channelling requests for assistance as well as that of a facilitator between the concerned institutions and Member States for the delivery of appropriate tailor-made expertise to address well defined issues at short notice.

Services currently provided by TAIEX come in the form of seminars, workshops, expert and study visits; training, Peer Review and Assessment type assistance, database and translation services. The beneficiaries of TAIEX assistance includes those sectors, both public and private, which have a role to play in the beneficiary countries in the transposition, implementation and enforcement of EU legislation. Demand driven, most TAIEX assistance responds to requests from the beneficiary countries and Member States. TAIEX is also strategy driven in that requests are addressed in accordance with the priorities identified by the Commission. The strategic approach is also evident in a number of TAIEX' own initiatives.

Twinning and TAIEX programmes provide services also for implementing the inspection of sprayers in the New Member States, the acceding or candidate countries.

Public officials of the MS can register on the online database of EU Experts. Validation of the registration and access of the Expert Database (<http://taiex.cec.eu.int/ExpertDatabase>) are restricted to the Institution Building unit.

6. Conclusions

The DG Enlargement – Institution Building Unit of the European Commission (EC) proposed several instruments which help the New Member States (NMS), the acceding or candidate countries as well the European Neighbourhood to integrate the EU *acquis* in their process of accession.

A new Instrument for Pre-accession Assistance (IPA) came into force on 1 January 2007, bringing all pre-accession support into one single, focussed instrument.

Technical Institution Building assistance to the beneficiary countries aims to support their on-going efforts to transpose, apply and enforce the “*acquis communautaire*”. This assistance comes mainly through the Twinning Programme, which involves longer-term secondments of EU Member State experts, and the TAIEX instrument, which provides short-term expertise. In this context, sprayer inspection become a real EU *acquis* and could be integrated into the Twinning or TAIEX programme.

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Performance of regular inspections of sprayers

1. Introduction

The obligatory regular inspections in Slovakia have been performing since 1st January 2003. The regular inspections of aircraft sprayers and seed dressers joined the sprayers on 16.3.2005. This obligation is due to The Act. No. 193/2005 about plant healthcare. The inspections are performed every 2 years. The Agricultural Technical and Testing Institute in Rovinka is authorised to do this inspections in Slovakia. It established 16 inspection stations according to this Act on the whole area of Slovakia.

Table 1 Amount of inspections carried out since 2003

	Amount of inspections			
	2003	2004	2005	2006
Field sprayers	159	522	635	668
Air-assisted sprayers	13	40	91	109

2. Materials and Methods

The inspection stations for performance of inspections of field sprayers and air-assisted sprayers have to be equipped by electronic scanner (in most cases they are the scanners of the type-Hardi spray scanner). The scope of inspection is determined by TSUP Rovinka and the scope and assessment for field sprayers and air-assisted sprayers is in accordance with the standard STN EN 13790-1,2. The inspection station elaborates the final report in three issues from the inspection findings. It includes also diagnostic chart of sprayer before the inspection and the chart after eventual repair and setting. The repairs and settings have to be done by the inspection station on request of the sprayer owner. The inspection stations have to be mobile and be able perform the inspection in the places determined by sprayer' owner. The fees for inspections are determined by one price list for the whole area of Slovakia in relation with the width of working stroke of sprayer. The average price of inspection is 7500 SK, i.e. 220 Euro. This price does not include the eventual repair and setting. Regarding the infrastructure of Slovak agriculture most of sprayers has the width over 18 m.

When performing this system of regular inspections of sprayers, there were found surprising facts. More than a half of the number of sprayers is older than 8 years. More than 25 % of sprayers do not fulfil determined variation coefficient. About 13% of them gave dosages of pesticides bigger than normal and 12 % of sprayers gave less than normal. Only those sprayers that were repaired before the inspection fulfilled the criteria of the standard.

The most frequent faults were used nozzles or nozzles of unknown origin with insufficient quality. Much amount of sprayers had faults on their booms. Very frequent was the occurrence of leakage, lack of manometers, filters and valves. The output of pump did not fulfil the required standard criteria.

3. Conclusions

According to the Statistical office of SR, the total amount of sprayers in the year 2007 is 4500 pieces. New sprayers have to be registered in the central evidence in the ATTI Rovinka and once a year it is published in the Official Journal of the Ministry of Agriculture. The registration is free of charge and the salesman (distributor) is obliged to do this registration. The new sprayer has to be inspected for the first time two years after its operation. If the results of inspection are positive the inspection station issues the Certificate about inspection (see annex 1) with the date of inspection and the date of validity.

The mark is stucked on the sprayer (see annex 2). The Certificate and the mark are registered documents and are distributed by ATTI Rovinka to the all inspection stations. The ATTI provides all the methodics of inspection and also trains the staff of inspection stations and leads central evidence and archive of documents from inspections. ATTI uses the software EPOS. Keeping the Act regarding the inspections of sprayers is watched by the phyto-inspectors from the Central Agricultural Inspection and Testing Institute. The eventual penalty for not keeping the Act is possible up to 500 000 Sk (15000 Euro).

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The First Year of the Sprayer Inspection in Portugal

Summary

The inspection of the sprayers is not compulsory in Portugal. However after the required application training courses starting in 2001 and, mainly due the market rules, the farmers started to ask assistance to check if the sprayers were working properly and for the certification of the orchards sprayers. One of the biggest Portuguese sprayer manufacturers (TOMIX) initiated to do it and have checked 480 sprayers.

A voluntary sprayer inspection service began in Portugal in 2006, by COTHN (Centro Operativo Tecnológico Hortofrutícola Nacional) with technical support of DGCRA (Direcção-Geral de Agricultura e Desenvolvimento Rural, former DGPC – Direcção-Geral de Protecção das Culturas).

COTHN is a private association and their members are fruit and horticulture producer organizations. The main objective of the Centre is the technical advice concerning the horticulture and fruit production chain. In order to answer to the increasing market requests (Eurepgap, and other certification quality systems), concerning the plant protection products application equipment, COTHN developed this service according to the EN 13790, with the DRADR. Until now, 180 equipment inspections were done in different regions of Portugal, regarding orchard sprayers (air assisted hydraulic sprayers). The main problems detected, related to the high age of the equipment (half of them with more than 15 years), with deficient maintenance, were the deviation of the flow rate of each nozzle of the same type exceeding, 10% of the nominal value, the precision of the pressure gauge and leakages of the pumps.

The inspection of the horticulture conventional sprayers is beginning now and just a few sprayers of this type have been recently submitted to that inspection.

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Present and Future in the Control of the Spraying Machines in Romania - Inma’S Concerns in view of Aligning to the Eu-Requirements

Summary

The large variety of equipment for the plant health protection treatment available on the Romanian market (different brands, various state of wear), the users training level and the conditions of Romania’s accession to the European Union ask for adopting such norms and regulations that comply with the European ones, for the field of sprayers in use in our country too. This paper presents the present-day situation in Romania in the field of checking the spraying equipment and the concerns INMA in view of adopting and implementing the European norms in this domain. In this respect, in our institute there have been produced the functional models of two stands for checking the characteristics of the sprayers used for the field respectively vineyards and orchards and the Testing Department of INMA has started the process of purchasing the equipment necessary in order to be approved and authorized by RENAR (Romanian Accreditation Association) to certify the equipment according to EN 13790.

1. Introduction

In Romania, the consumption of plant health protection substances, as compared to that in European countries, is 10 to 15 times smaller due to the fact that the majority of the farmers practice an agriculture for subsistence in this moment of transition for our country. The distribution of the farming land according to the use of the land is shown in Figure 1.

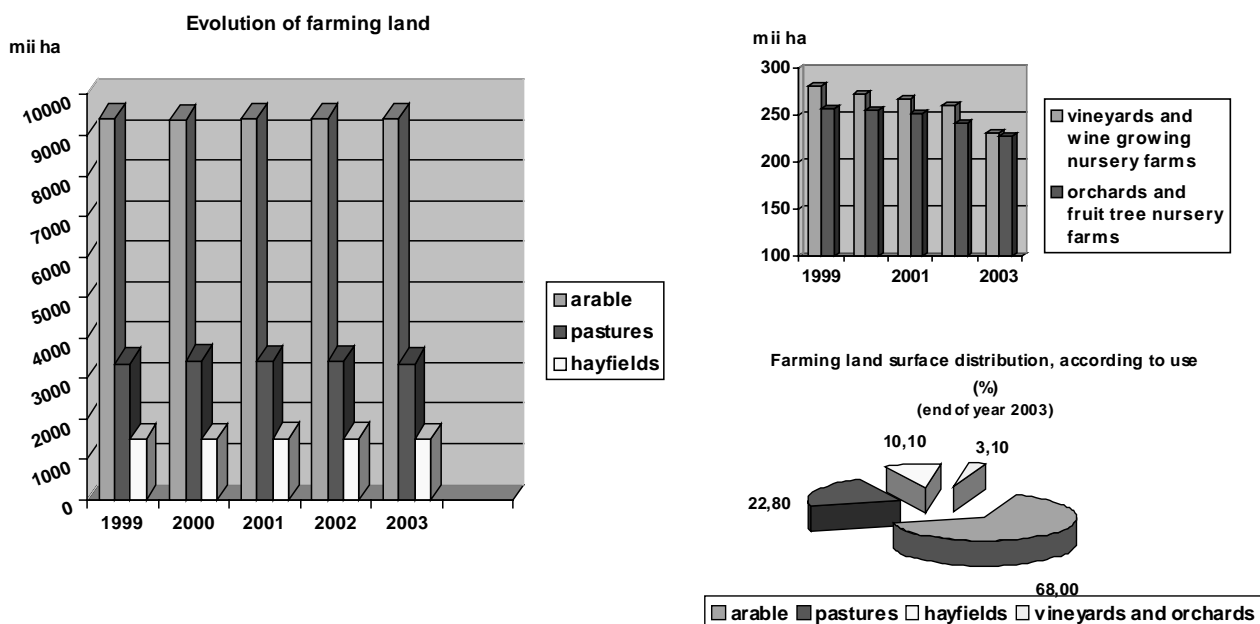


Figure 1 Farming land distribution, according to use (Source: Roumanian Statistical Yearbook)

The variation of the farming areas, according to their use, refers to: up to 14 thousand ha–arable land; up to 20 thousand ha- pastures; up to 10 thousand ha – hayfields.

The areas covered by vineyards and orchards diminish today. In 2003, the surface covered by vineyards was of 230,5 thousand ha, while orchards could be found on a surface of 227,2 thousand ha.

As for the power propelled spraying and dusting fleet, we present the situation in 2003 in Figure 2, one can notice the small number of specific equipment.

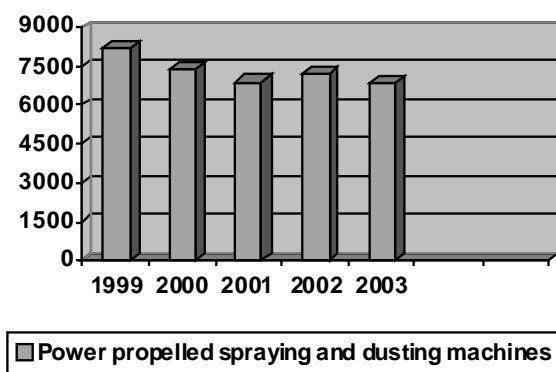


Figure 2 Evolution of the number of power propelled sprayers and dusting machines (Source: Roumanian Statistical Yearbook)

The diminishing of the environment and operator pesticide contamination risk can be achieved by using more means, such as: developing the professional competence of the operator in charge with the works of pesticide spreading, using lower toxicity and biodegradable pesticides, and using proper spraying equipment having parameters complying with the aim established.

2. Materials and Methods

The prospect of aligning to the E.U. regulations concerning the development and achievement of a sustainable agriculture requires the proper management of pesticides. In order to reach this aim, it is necessary to have in operation both the administrative and legislative framework to compulsorily check periodically the technical equipment needed to use the pesticides and the adequate technical means and procedures as well.

The directions of the action of INMA, in this respect, have been turned practically into two stands and in the designing and production of the measurement methods for assessing the characteristics of the sprayers (one stand for the assessment of the field crop sprayers and one stand for checking the uniformity of the rates of flow of the air-assisted sprayers for vineyards and orchards) with a view to preserving the quality level according to the European exigencies. Another aim has been the setting up of a laboratory for testing the machines for plant health protection complying with the harmonized European norms in view of evaluating and certifying for conformity the plant health protection equipment.

2.1 Stand used for checking the uniformity of distribution of the field crop sprayers

The stand tested and used to check the uniformity of distribution of the field crop sprayers presented in operation in Fig.3, has the following characteristics:

- Overall dimension, LxWxH, 1100x1000x450 mm;
- Liquid collecting plate, of 1m² surface;
- Test tube holder with 10 test tubes of similar volume;
- Rail path, 11 segments of 2m lengths;
- Electronic system for data acquisition, transmission and processing



Figure 3 Checking the uniformity of distribution of the EEP 500 equipment with the stand designed by INMA

Tested parameters are: the working pressure, the uniformity of distribution over the working width; the nozzle flow rate; application rate.

The operation of the stand is based upon the principle that the determination of the nozzles flow rate is measured and calculated on the basis of the times necessary for filling of similar volumes.

The stand that is an easy to move modular construction of small dimensions made of anticorrosive material, allows obtaining and registering the values for nozzle flow rates and variation of distribution uniformity on the working width. The results are displayed and printed in a table and a graph form in a Test Bulletin.

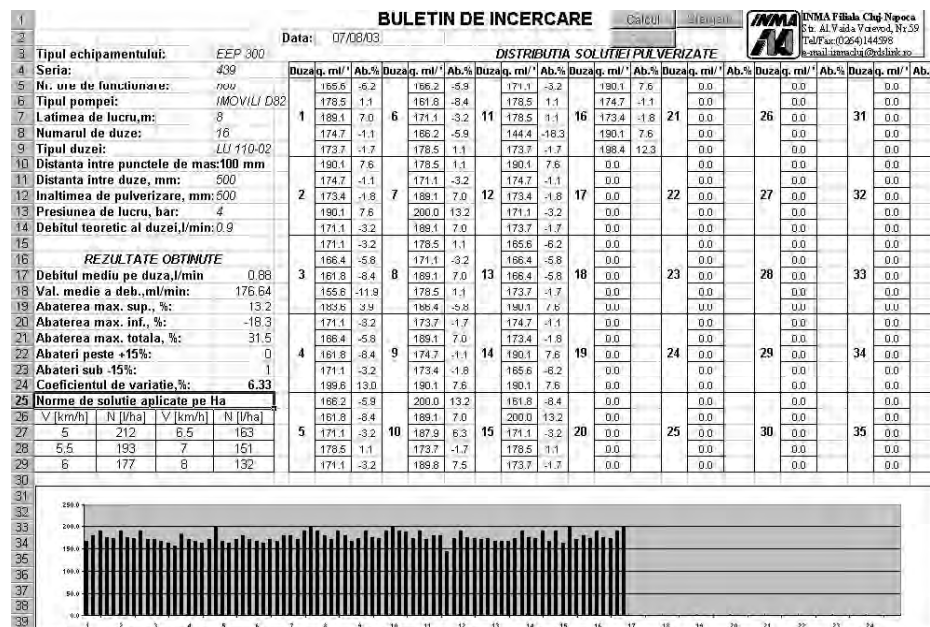


Figure 4 Test Bulletin produced at testing an EPM 500 equipment

2.2 Stand for testing the characteristics of the equipment dedicated to plant health protection treatment in vineyards and orchards

The stand for testing the characteristics of the air-assisted sprayers for vineyards and orchards (Figure 5) provides the measurement of the technical characteristics of the attached and hauled equipment, that is equipped with up to 16 nozzles, is used for the plant health protection treatment against diseases and pests in vineyards and orchards by spraying insecticide and fungicide substances.



Figure 5 Testing the functional parameters of an air-assisted sprayer ATOM 1000, with the help of the stand built

The main technical characteristics of the stand testing the properties of the air-assisted sprayers for vineyards and orchards are presented below:

- - Dimensions, LxWxH, 1150x550x1000 mm
- - Collecting test tubes, of constant volume, 16 pieces.
- - Supply source- direct current 12V,
- - Electronic system for measurement, control and data acquisition;

The tested parameters are: the working pressure, the nozzle flow rate, the uniformity of flow rates, application rate.

The determination of the flow rates per nozzles, in the case of this stand too, is based upon the measurement of the time needed to fill in constant volumes.

The whole structure of the stand is built with anticorrosive material, has small size, is easy to move and enables getting values and recording them for the flow rates per nozzle and for the flow rates uniformity variation. The results are displayed and printed, in the form of tables and graphs, in a Test Bulletin (Figure 6).

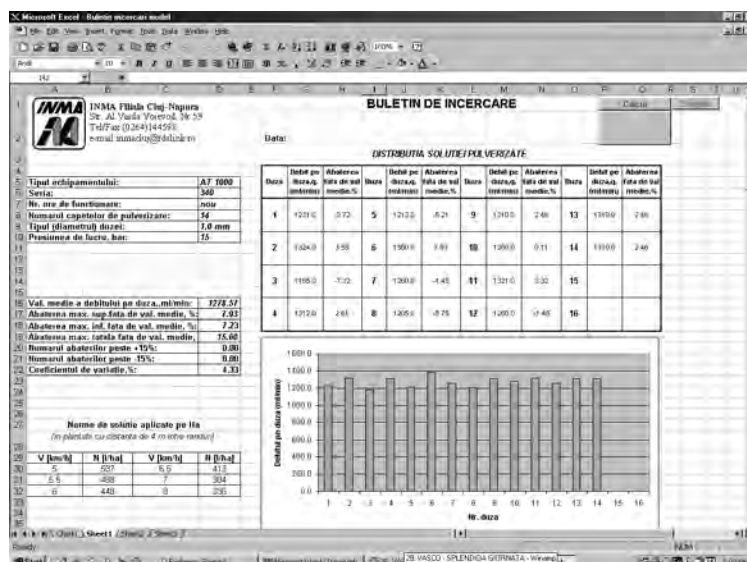


Figure 6 Results of the tests for the equipment ATOM 1000

2.3 Testing laboratory

At present, in Romania operates a national institute of research (INMA Bucharest) dealing, among others, with the testing, approval and certification of the weed killing sprinklers. The tests for the weed killing equipment are carried out in the Testing Department (DITRMA) – a test laboratory accredited by RENAR (The National Authorization/Accreditation Body) – which has the competence and capability of controlling the field crop sprayers according to the European norms in force. In order to respond to the requirements of the time, DITRMA has purchased recently modern equipment that allow the carrying out of the tests according to these requirements and has organized a specialized laboratory for the testing of the equipment for plant health protection. This laboratory is now in the process of authorization. Though some of the requirements in: EN 13790-1, EN 13790-2, EN 12761-1, EN 12761-2 and EN 907 are not yet compulsory for Romania, as they are not yet included in a directive, the producers and importers of sprayers will have to start testing their equipment according to the norms in the documents listed above as the environment protection requirements ask for them and are very severe.

3. Conclusions

The stands designed by INMA represent the first step towards the introduction and implementation of the European norms in the control of the sprayers. The advantages of these stands for the testing and checking consist in: increased measuring accuracy, reduced trial time, increased reliability of results, automated printout of the Test bulletin including the test results, easily used in the field.

The test laboratory (authorized by RENAR) will carry out tests according to the European norms in force and the results will be recognized in EU as RENAR is authorized by ILAC-MRA and EA - MLA.

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Influences of single nozzle adapters on the flowmeasurements results

Summary

The flow measurements of nozzles during the inspection of sprayers often are done with test benches with single nozzle adapters. In a series of measurements the influence of adapters on the measurement result has to be determined with different nozzles and pressures. These measurements show that the use of adapters increase the flow rate of especially injection nozzles at pressures lower than 10 bar. At flat fan nozzles the influence of the used adapters (adapters from the company's "Herbst" and "Schachtner") seems to be bigger than with hollow cone nozzles. Also standard nozzles show an increased volume flow especially at low pressures. The consequences for the inspection of sprayers are that measurements of injection nozzles at pressures less than 10 bar should be refrained, but relative measurements for comparison purposes of nozzles are possible.

Key words: Inspection, nozzle adapter.

1. Introduction

The flow measurements of nozzles during the inspection of sprayers often are done with test benches with single nozzle adapters and measuring cylinders with or without electronic measurement devices. With the adapters it is possible, to collect the whole output of each nozzle of the sprayer. The adapters are normally connected by a hose with diameters between 8 mm to 19 mm to the test bench. Examinations in the past showed partial deviations between measurement results with and without adapters. It was suspected that the measuring of the volume flow of injection nozzles is particularly distorted by the use of nozzle adapters.

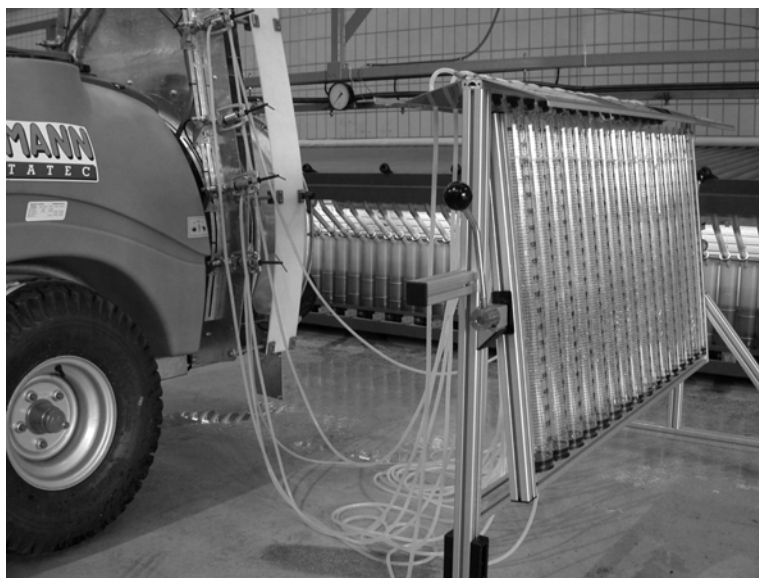


Figure 1 Inspection of a sprayer with nozzle adapters

2. Measurements and results

In a series of measurements the influence of the adapters on the measurement result has been determined with different nozzles and pressures. Some of these influences have not been suspected before, but got more clear now. The picture left show a scheme of the used adapters. The scheme "a)" shows the BBA-standard-adapter without any influence of closed injection wholes. The scheme's "b)" and "c)" shows the often used adapters from "Schachtner" and "Herbst". The principle of the adapters is comparable with others. These adapters collect all of the nozzle flow but they block injection wholes and hoses between adapters and measuring cylinders are often completely filled with water.

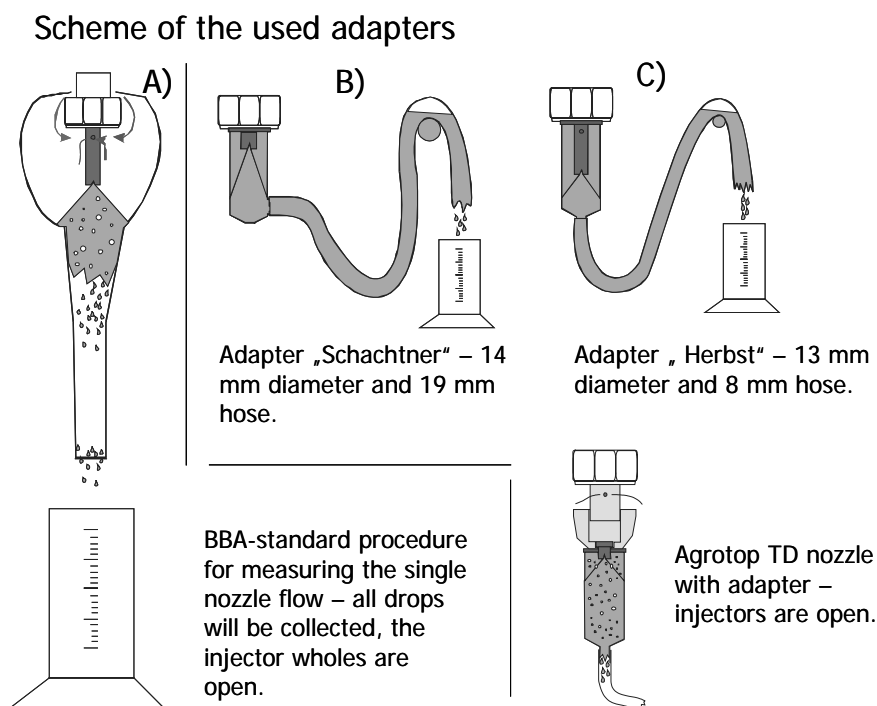


Figure 2 Scheme of the used nozzle adapters

The tables below show the results of measurements with standard nozzle adapters and with "handmade" Adapters from the test station "LFP – Stuttgart". The measurements show, that the use of single nozzle adapters increase the flowrate of injection nozzles – specially at pressures lower than 10 bar. In some cases deviations up to 20 " were measured. The Agrotop "TD nozzles" form an exception because the injectors stay freely at use of the adapter. With flat fan nozzles the influence of the adapters seems to be bigger than with hollow cone nozzles. Also standard nozzels show an increased volume flow by using of adapters and pressures lower than 5 bar.

Table 1 Results by using adapters for collecting the nozzle flow.

Measured single nozzle flowrate with and without nozzle adapters "Schachtner" and "Herbst"						
Nozzle type	Pressure (bar)	"BBA" A) (ml/min)	"Schachtner" B) (ml/min)	Deviation to A) (%)	"Herbst" C) (ml/min)	Deviation to A) (%)
Standard nozzles for field crops						
XR 110 04 VP	1,5	1097	1177	7,3	1175,0	7,1
	3,0	1535	1616	5,3	1637,0	6,6
	5,0	1989	2064	3,9	2061,0	3,6
XR 110 04 VS	1,5	1141	1185	5,2	1247,0	9,5
	3,0	1577	1644	5,7	1673,0	6,1
	5,0	2003	2085	3,8	2107,0	5,1
Hardi ISO 03	1,5	823	846	1,7	880,0	6,7
	3,0	1163	1222	3,7	1248,0	7,1
	5,0	1519	1552	1,7	1573,0	3,3
Standard nozzles for orchards and vineyards						
ATR gelb	5,0	736	730	-1,3	726,0	-0,9
	10,0	1015	1013	-0,5	1012,0	0,0
	15,0	1233	1221	-0,9	1239,0	0,4
TXA 80 03 VK	5,0	1503	1491	0,0	1497,0	-0,6
	10,0	2081	2070	0,0	2092,0	0,0
	15,0	2492	2475	-0,2	2490,0	-0,5
DG 80 02 VS	2,0	632	651	1,8	677,0	8,7
	5,0	998	1013	0,0	1029,0	3,9
	10,0	1430	1450	1,3	1462,0	2,4
	15,0	1764	1773	-0,2	1750,0	-0,1
Injection nozzles for orchards and vineyards						
TVI 80 015	5,0	752	799	5,6	800,0	7,2
	8,0	955	991	2,9	990,0	4,4
	12,0	1159	1186	1,6	1180,0	2,4
TD 80 02	5,0	955	958	0,1	955,0	0,2
	8,0	1196	1199	0,0	1195,0	0,0
	12,0	1456	1467	0,6	1462,0	0,6
AVI 80 02	2,0	649	692	6,7	773,0	19,0
	5,0	1013	1075	6,1	1103,0	8,8
	10,0	1427	1460	2,3	1482,0	3,9
	15,0	1728	1773	2,6	1787,0	3,4
Injection nozzles for field crops						
AI 110 04 VS	3,0	1597			1719,0	7,6
	5,0	2022			2146,0	6,1
	7,0	2370			2506,0	5,8
ID 120 04	3,0	1528	1746	13,1	1700	12,5
	5,0	1979	2144	7,2	2092	6,9
	7,0	2294	2476	6,8	2417	6,5
IDK 120 03	1,5	845	887	4,9	974,0	15,5
	4,0	1366	1462	6,9	1475,0	8,1
	6,0	1670	1770	5,9	1776,0	6,5
IDK 120 04	1,5	1122	1179	4,7	1183,0	5,9
	4,0	1795	1936	7,6	1933,0	7,9
	6,0	2190	2293	4,5	2303,0	5,4
IDK 120 05	1,5	1381	1425	3,0	1432,0	3,8
	4,0	2212	2392	8,2	2392,0	8,1
	6,0	2698	2854	5,8	2845,0	5,4

Table 2 Results of measurements of single nozzle flowrate with “handmade” adapters.

Nozzles for orchards and vineyards	5 bar		Deviation (%)	10 bar		Deviation in %
	without adapter	with adapter		without adapter	with adapter	
	l/min.	l/min.	l/min.	l/min.		
DG 80 015	0,763	0,795	4,19	1,044	1,078	3,26
DG 80 02	1,029	1,066	3,60	1,465	1,477	0,82
DG 80 03	1,565	1,608	2,75	2,216	2,244	1,26
DG 80 04	1,992	2,061	3,46	2,791	2,855	2,29
DG 80 05	2,598	2,678	3,08	3,657	3,736	2,16
ID 90 015	0,760	0,817	7,50	1,067	1,108	3,84
ID 90 02	1,010	1,070	5,94	1,400	1,452	3,71
ID 90 025	1,305	1,400	7,28	1,839	1,907	3,70
AVI 80 01	0,506	0,544	7,51	0,714	0,735	2,94
AVI 80 015	0,777	0,836	7,59	1,090	1,125	3,21
AVI 80 02	1,000	1,080	8,00	1,400	1,460	4,29
AVI 80 025	1,310	1,415	8,02	1,842	1,922	4,34
AVI 80 03	1,509	1,633	8,22	2,115	2,211	4,54
AVI 80 04	2,036	2,203	8,20	2,866	2,981	4,01
AVI 110 04	2,058	2,215	7,63	2,874	2,990	4,04
TVI 80 0050	0,272	0,272	0,00	0,380	0,380	0,00
TVI 80 0075	0,391	0,411	5,12	0,557	0,562	0,90
TVI 80 010	0,511	0,537	5,09	0,716	0,728	1,68
TVI 80 015	0,773	0,790	2,20	1,085	1,107	1,11
TVI 80 020	1,031	1,068	3,59	1,443	1,455	0,83
TVI 80 025	1,291	1,364	5,65	1,808	1,840	1,77
TVI 80 030	1,527	1,615	5,76	2,139	2,186	2,20

3. Conclusions

The possible falsification of the measurement results, particularly in the examination of field sprayers, band sprayers and others with pressures between 1.0 and 8.0 bar must be taken into consideration more strongly in future. The measurement of injection nozzles at pressures less than 10 bar (with sprayers for vineyards and orchards and hopgardens) should be refrained. The check of the nozzle flowrate to assess the wear must especially be seen critical after depending on these results. Relative measurements for comparison purposes of nozzles are possible.

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Voluntary testing of sprayers in Sweden – still voluntary

At the time of the SPISE conference in 2004 we thought a mandatory testing programme of sprayers was going to be introduced in Sweden. This did not happen due to concerns for the farmers in sparsely populated areas. So what happened?

- 2004 and 2005 voluntary, 50 % subsidy on test equipment.
- 2006 voluntary, 75 % subsidy on test equipment and 110 €per test.
- 2007 voluntary, 75 % subsidy on test equipment, indirectly also on tests (se below).

The requirements from retailers are increasing and due to that about 40 % of the Swedish milk producers now have a demand on them to use tested sprayers.

While waiting for a common agreement in the European Union ("A Thematic Strategy on the Sustainable Use of Pesticides") and further demands from retailers other measures are taken. During 2007 a new subsidised package of "environmentally beneficial measures" will be introduced. This package includes that sprayers must be tested regularly, other measures are unsprayed field margins and documentation of pest/disease incidence. To encourage the testers to change from our old set of test rules which have been in use since 1988 to the standard EN-13790, buying of test equipment that meets the demands of EN-13790 has been subsidised during 2006 and will be so also during 2007.

Work on an official certification scheme of the testers, their procedures and equipment has started. The ambition of this is to make tests performed by different actors on the market more uniform. It will probably also make the change from today voluntary to a future mandatory system easier.

During 2006 protocols were collected from 1798 tests performed according to the Swedish test procedure of 1988. A test performed according to EN-13790 has more focus on leakages but other than that there are no significant differences between these sets of rules. The results show that problems with pumps are common (frozen/fractured, broken valves, leakages, faulty power transmission parts), 10 %. Manometers are still an area where improvements are needed (misreading, damage by frost), 12 %. Wear and tear on nozzles and hosing are also common, 6 %. On the whole 65 % of the sprayers left the test sites without any remarks, either because they were in perfect order or because the problems were easily corrected and no remarks were made.

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Establishing sprayer inspection in Serbia

Summary

In Serbia, since 1999, there is an article within the „Policy on services rendered in plant protection” which regulates mandatory inspection of sprayers and mist blowers in use. Due to transitional problems which have been troubling Serbia during the last seven years, the inspection has not yet seen proper implementation in practice.

By the beginning of the 2007 year, a new plant protection law is to come into power, to regulate the field of pesticide application. This law is compliant with the EU directive 91/414/EEC, and shall also include the article on mandatory inspection of sprayers and mist blowers.

In order for the inspection to be applied in practice after the law has been enacted, experts of the Faculty of Agriculture have been campaigning for the last three years to educate agricultural producers and establish technical and organizational prerequisites for the beginning of the inspection.

In lieu with the above mentioned, a Procedure for sprayer inspection has been proposed, which is compliant with EN 13790. Also proposed is the regional management which should conduct the inspection. In the course of making this proposal, all positive experiences from the countries which already have established such inspection, were taken into account.

What is still missing for efficient work on analysis of the number of sprayers and their state of readiness in Serbia, is the work on a joint project with the colleagues from the European countries which already have established regular inspection practice. Such joint effort not only would advance the whole agricultural production in Serbia, but would also help lower users' fear of inspection and thus facilitate the introduction of mandatory inspection into practice

Key words: Serbia, sprayer, mandatory inspection, EN 13790.

1. Introduction

Amongst various methods of plant protection, surely the most widespread one is the chemical protection. Chemical protection is performed using equipment for pesticide application, whereby the equipment must meet several conditions:

- it should apply sufficient quantity of protective agent on the plant, which should remain in place for the required period
- protective agent should penetrate to reach all plant parts
- protective agent should be applied so as to cover the largest possible area
- protective agent should be spread evenly.

These conditions imply that the equipment for pesticide application is extremely important, since it accounts for more than 50% of inadequate applications of protective agent, lowering agent efficiency and causing pollution.

All this leads to conclusions that the only way towards controlled application of pesticides is regular inspection of sprayers, which – of all machines and devices - are the most frequently used for pesticide application. Quality performance means capability of maintaining spraying standards while evenly distributing pesticide over the treated area. Knowing the small ratios in which modern pesticides mix with water (several ml per liter), the reliability and quality performance of sprayers becomes even more important.

In order to achieve maximum precision of application and thus allow full protection, the sprayers not only must have modern construction and impeccable performance, but also must have adequate exploitation potential.

Exploitation potential of tractor sprayers is defined as their ability to continuously and reliably perform through all operational stages during pesticide application. It comprises both quantitative and qualitative parameters.

The quantitative parameters are: pump flow rate, nozzle flow rate, flow rate of devices for hydraulic mixing, adjustment of the three flow rates, the range of operating speeds, tank volume, etc. The qualitative parameters are: precision of feed and flow rate, consistent distribution of protective agent, consistency of spray droplets.

Applying optimal pesticide quantities while using proven machinery, strengthens the consumers' confidence in fruits, vegetables and crop farming products, while guaranteeing that quantities of pesticides remain below the allowed maximum (MAQ) as required for the specific pesticide or treated plant (Sedlar, 2006).

This procedure is favourable to soil and water, which gradually become less polluted. This proves that mandatory inspection of sprayers, as emphasized by Langenakens (1999), contributes to healthier environment.

2. Discussions

In order to successfully implement the regular inspection of sprayers in domestic conditions, it is necessary that all factors relevant to this task perform their share of duties:

Machine users should inspect, prepare and ready machines for protection, enhance the maintenance and get informed about the testing procedure. Certified laboratories, together with the manufacturers they contract for technical and business co-operation, should recruit and train personnel, purchase and complete the testing equipment, homologize documentation. The central laboratory prepares instructions for inspection of technical correctness of spraying machines and devices and delivers it to manufacturers, it also organizes and conducts machine-testing training courses for manufacturers, training for operators of equipment for chemical protection on farms, or training for a group of individual farmers (agricultural cooperatives).

The Ministry of Agriculture legally mandates the inspection and coordinates forming of regional inspection stations, the Ministry also constantly improves regulations for machine inspection and plants protection.

The public media (the press, radio, TV) are also involved, informing readers and viewers, especially the machine users, of the necessity and benefits of regular inspection of machines for plant protection, providing useful information on the organization of inspection, etc. For the last three years, the experts of the Department for agricultural engineering of the Faculty of Agriculture in Novi Sad, have been conducting a widespread campaign aimed at educating agricultural producers and creating technical and organizational requisites for the beginning of the inspection. Considering the above mentioned, a proposal has been made entitled the Procedure for sprayer inspection, which is compliant with EN 13790, as well as the proposal for the regional management which is to conduct the inspection. In the course of making this proposal, all positive experiences from the countries which already have established such inspection, were taken into account.

2.1 Proposal of "Procedure for sprayer inspection "

The Proposal was made using ISO standards (subject area: Equipment for plant protection), Policy on rendering services in plant protection ("Službeni glasnik SRJ", 1999.) and regulation EN 13790 which was fundamental. In addition, analysis has been conducted regarding procedures which are used in other EU countries. All positive experiences have been taken into account with the intention of producing a proposal for a simple and efficient procedure (Sedlar, 2006). The proposal was also done in an electronic

form The proposal of “Procedure for sprayer inspection” requires inspection of all sprayer components and comprises four segments:

I.) Review of a typical set-up: Review of a typical set-up is the first segment which comprises six articles. The first article is 1.1 General, and it contains data on the sprayer owner, manufacturer and type of sprayer and vintage. The next five articles specify the sprayer in more detail.

II.) General Specification: General Specification is the second segment of the procedure which comprises the specifications of tank, pump, booms, tube, filters, nozzle.

III.) Inspection methods for hydraulic sprayers: Inspection methods for hydraulic sprayers as the third segment of the Procedure, it defines methods for testing particular sprayer components, as well as the standards they should meet. The sprayer components undergoing tests are pump, manometer and nozzles. All other components such as the tank, hoses, filters, valves, etc. undergo visual inspection. The capacity of pump will be testing by flow rate gauge, shown in Fig. 1. Pump is considered to be in order if the deviation from the nominal capacity does not exceed 10 %. The tested analogous manometer, Fig. 2, must satisfy standards defined by EN 13790, i.e. must have a minimum diameter of 63 mm and a clearly visible scale. The scale must be subdivided into 0.2 bar segments for manometers measuring up to 5 bar, or 1 and 2 bar segments, for manometers measuring up to, and more than 20 bar. Manometer is considered correct if the deviation of the measured pressure, when working with pressures over 2 bar, falls within the limits of $\pm 10\%$ as compared to the referential manometer. Thus when working with pressures of up to 2 bar, the allowed deviation is 0.2 bar.



Figure 1 Pump flow rate gauge (AAMS-Belgium)



Figure 2 Manotester (AAMS-Belgium)

Inspection of nozzle requires testing their capacity and transversal distribution of pesticides. To test capacity of nozzle an electronic flow rate gauge is used, as shown in Fig.3 and Fig. 4 shows spray scanner for transversal distribution.



Figure 3 Electronic nozzle flow rate gauge (AAMS-Belgium)

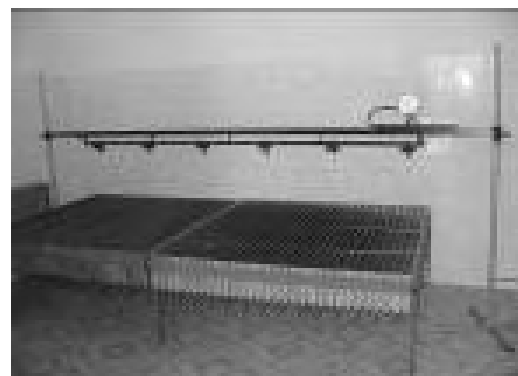


Figure 4 Mechanical spray scanner

Inspection results are presented in tabular form and by a diagram. The allowed CV (Coefficient of Variation) is 10 % which is compliant with EN 13790.

IV.) Inspection report: Inspection report is the segment which contains data on time of inspection, names of inspectors and the laboratory conducting the inspection, as well as the number of Inspection log and number of the issued Certificate of Quality. The data which are given in the "Review of a typical setup" and "General specification" are logged in the "Sprayer Inspection Log". The log also contains the results of inspection. After the inspection of sprayer is finished, three copies of inspection log are printed out. In addition, every sprayer that passes inspection is awarded the "Certificate Of Quality" which is issued by the "Central laboratory". The party that ordered the inspection (owner or user of sprayer) receives one copy of the log, while the other two copies are kept by the institution which conducted inspection and the central laboratory. The inspected sprayer is also marked with the "Label" which states the date of inspection. Should the results of inspection be unsatisfactory, the Inspector informs the orderer of inspection results by issuing him the Inspection log. In this case, the log also features a chapter entitled "Note" in which the Inspector suggests the detected faults in the sprayer to the inspection orderer, also suggesting ways to correct the errors in order to become eligible for the "Certificate of quality".

2.2 Organization of sprayer inspection in Serbia – forming the regional management

Analysis of sprayer inspection in other EU countries, reveals the differences among these countries, regarding both the organization of inspection, and the sprayer components being subjected to inspection. Generally speaking, the inspection in all EU countries is conducted in two principal ways: using mobile teams and through a network of laboratories.

The first way of inspection organization is adopted in Norway and Belgium. In December 2000, Norwegian authorities decided to make inspection mandatory as of January 1, 2006. Department of Agricultural Engineering of the Faculty of Agriculture in Norway, also produced a mobile inspection unit, i.e. one trailer which is following inspectors in the field and which contains the equipment for inspection (Bjugstad, N, Hermansen, P, 2004). Similar situation is in Belgium, their inspectors using a van which carries the inspection equipment.

The other way of organizing inspection is prevailing in the majority of EU countries and it features a Central laboratory which organizes and coordinates operation of a larger number of regional laboratories. This type of organization is also suggested for Serbia. However, in order for sprayer inspection to be widely accepted, legal prerequisites are necessary, meaning that the Ministry of Agriculture and Ministry of Science and Environmental Protection should declare sprayer inspection mandatory. The above mentioned Ministries should provide legislation which would create a legal framework for sprayer inspection.

The required legislation is: Declaration of procedure for certification of new equipment for plant protection and Declaration of procedure for inspection of plant protection equipment in use. The Procedure for sprayer inspection should find its place in the above mentioned declarations.

The other solution is to pass legislation on the use of pesticides which is compliant with European directive 91/414/EEC, followed by EN 13790. Thus the Procedure for sprayer inspection should be legally introduced.

The Ministry of Agriculture has opted for the latter way, which means that in 2007, the new plant protection law shall enter into force which shall regulate use of pesticides and render sprayer inspection mandatory.

All this must be supported by the appropriate media campaign. Experts from the Faculty, regional inspection stations and members of the Ministry, shall in the future appear in the electronic media (radio, TV), publish papers in the printed media, and take part in country-wide public discussions in order to introduce agricultural producers, domestic manufacturers of plant protection equipment and importers of equipment with the goals and importance of sprayer inspection.

Figure 5 shows organization chart of the future sprayer inspection with the afore mentioned accompanying measures which should allow its practical implementation. The Ministry of Science and Environment Protection plays special role in sprayer inspection implementation. For the last three years, this Ministry has been cooperating with the Faculty of Agriculture on joint projects which created these technical and organizational measures vital to the beginning of inspection. One of the measures is to equip and put into operation a Laboratory for inspection of equipment for application of pesticides, at the Faculty of Agriculture in Novi Sad, which is eventually to become the Central laboratory with the role to organize operation of future regional laboratories and to train their personnel for implementation of inspection.

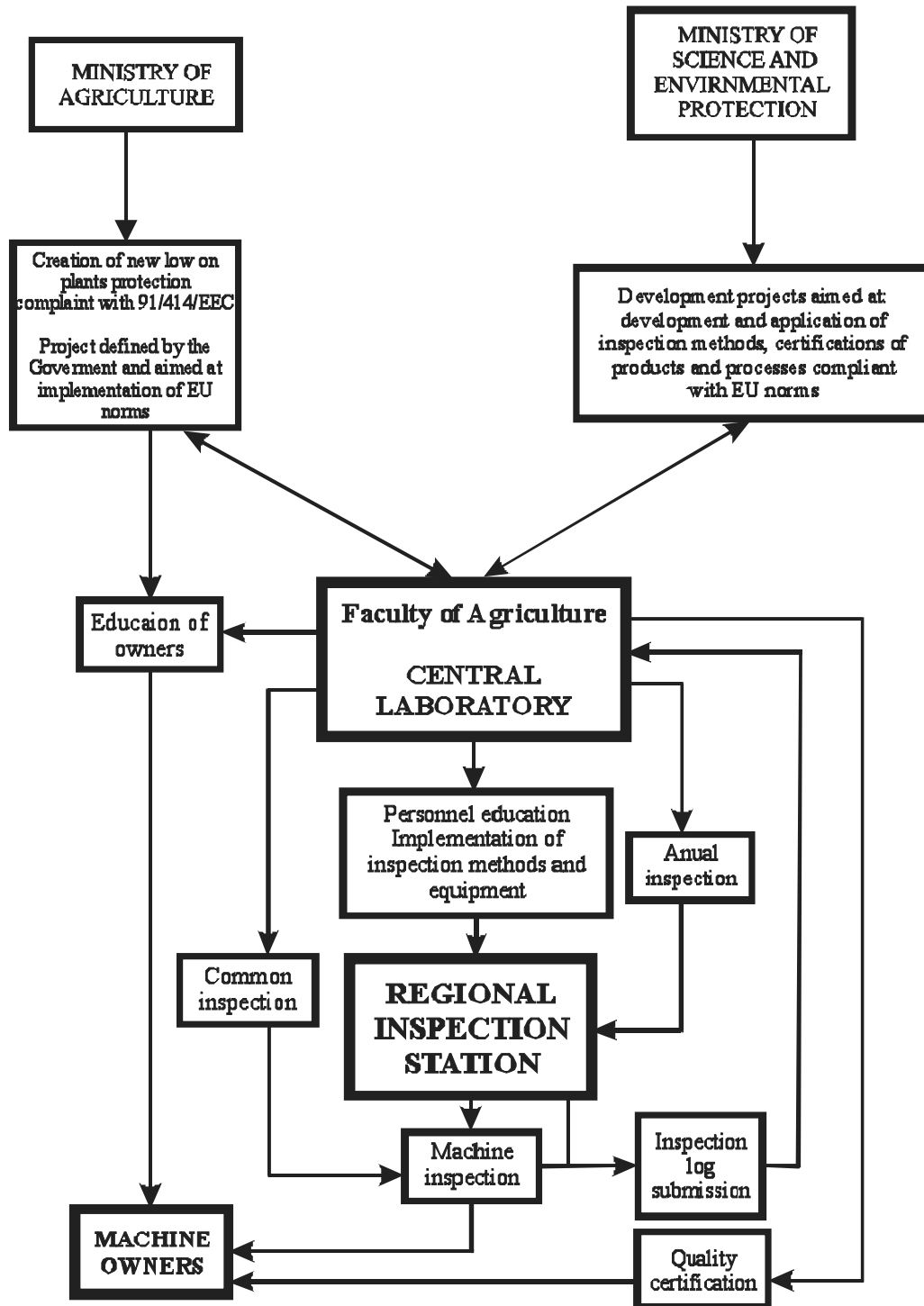


Figure 5 Organization of sprayer inspection

The Regional inspection laboratories should conduct machine inspection within their regions and submit one of the three copies of inspection log to the "Central laboratory". The inspection log is to be analyzed in the "Central Laboratory" and a "Certificate of Quality" should be issued to machine owner accordingly. The owners of the machines which failed the inspection shall be ordered by professional personnel of the regional inspection stations to repeat inspection, while the logs of failing inspections would not be submitted to the Central laboratory, but would be archived locally instead. Sprayer inspection logs should be kept in the archives of the "Central laboratory" and Regional inspection stations for at least three inspection cycles. Inspections should take place every two years, meaning that the inspection logs should be kept in the archives for at least six years.

Experts of the "Central laboratory" should be obliged to visit regional inspection stations in order to check on the state of their equipment and competence level of their personnel. In addition, experts of the "Central laboratory" are obliged to notify regional inspection stations about any eventual changes in sprayer inspection methodology. All measuring equipment used by inspection stations should be calibrated on an annual basis.

Regional inspection stations are obliged to report on the planned number of inspections for the particular year, followed by the final report on the number of realized inspections. Supported by regional laboratories and the Ministry of Agriculture, "Central laboratory" inspectors should be required once a year to conduct a series of training seminars intended for local machine owners in the regions where inspections are taking place. Also, in conjunction with the regional laboratories, the experts of the Central laboratory should conduct some joined inspections in the field following a predetermined schedule for each year of inspection.

Inspections of new machines, as well as their operational components (pumps, nozzles) should be conducted in the "Central laboratory".

2.3 Analysis of the state and number of sprayers in Serbia

Before the mandatory inspection of sprayers begins in Serbia, by the year 2007, future inspectors shall confront a huge task. It is the task to analyze the state and number of sprayers in Serbia.

Therefore, task number one is to establish correct number and state of sprayers currently in use. According to the Statistical yearly report from 2005, a total of 9515 sprayers are owned by agricultural companies in Serbia. Of that number, 1430 sprayers are located in Serbia proper, while 8085 are in Vojvodina. This leads to conclusions that 84% of sprayers owned by agricultural companies are located in Vojvodina, with Serbia proper holding the remaining 16 %. Considering the fact that agricultural companies hold 600 000 ha of land, one concludes that there is 1 sprayer per 63.05 ha. There are no official data on the number of sprayers in private agricultural holdings. However, in the period of 1990-1992, experts of the Faculty of Agriculture in Novi Sad gathered sample data from five locations (Bački Petrovac, Nadalj, Ratkovo, Sonta and Mokrin) and concluded that 1 sprayer is used per 22.67 ha of land. Substantial difference in the number of ha per sprayer on individual holdings and agricultural companies is expected, because agricultural companies own large sprayers (large volume and big working width), while individual farmers usually own small sprayers which are most often carried and with a 10m working width. Experts in this area estimate that Serbia is currently using approximately 18 800 sprayers with the average age of about 18 years. Of course, the data here quoted can only serve as preliminary indicators before a detailed analysis such as that done in the Srem district.

The number of sprayers in agricultural companies in Srem district is 234 and in private agricultural holdings it is 2389. This data should provide basis for establishing dynamics of sprayer inspection in Srem. In other words, based on the number of sprayers per municipality, the experts from the regional Srem laboratory should be able to calculate the exact number of days required for inspection, as well as the beginning and ending dates for inspection of sprayers in the Srem district. The experts from the Srem regional laboratory submit that plan to the "Central laboratory" before commencing the inspection. The analysis of state and number of sprayers in Srem district revealed that the average age of sprayers is 11 years.

3. Conclusions

Sprayer inspection should become mandatory in Serbia by 2007, as is already the case in most of the European countries. Experts of the Faculty of Agriculture in Novi Sad have endeavoured to create technical and organizational prerequisites for the beginning of regular inspection.

Through a number of projects sponsored by the Ministry of Science and Environmental Protection of the Republic of Serbia, as well as through cooperation with the Provincial Secretariat for Agriculture, Water Resources and Forestry (Provincial Vojvodina), a Laboratory for inspection of pesticide-application equipment has been established at the faculty of Agriculture in Novi Sad. The Laboratory is equipped with modern equipment by the Advanced Agricultural Measurement System of Belgium. Beside the Laboratory, a regional management is proposed which should conduct inspection. There is also proposal of Sprayer inspection procedure which is compliant with EN 13790.

Successful beginning of the mandatory sprayer inspection requires new plant protection legislation to regulate application of pesticides and application technique. In the course of 2007, the Ministry of Agriculture of the Republic of Serbia shall pass new legislation on plant protection which shall regulate sprayer inspection in compliance with the European directive 91/414/EEC.

What is still missing for efficient work on analysis of the number of sprayers and their state of readiness in Serbia, is the work on a joint project with the colleagues from the European countries which already have established regular inspection practice. Such joint effort not only would advance the whole agricultural production in Serbia, but would also help lower users' fear of inspection and thus facilitate the introduction of mandatory inspection into practice.

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Results of Inspection of Field Sprayers in Estonia in 2001...2006

Inspection of field sprayers is compulsory in Estonia since 2000. Sprayers in use shall undergo inspection once every three years. The procedure for the inspection of sprayers was worked out on the basis of draft of standard EN 13790 and modified according to Estonian standard EVS-EN 13790-1:2005.

The inspections of sprayers are performed by legal persons, having the contract with Minister of Agriculture and by Estonian Research Institute of Agriculture.

Since 2001 in Estonia are inspected 770 sprayers (figure 1). 10,5 % from inspected sprayers was with failures. Most of all were out of order nozzles. Other more common failures were leakages, defective manometers, PTO drive guards and booms (figure 2).

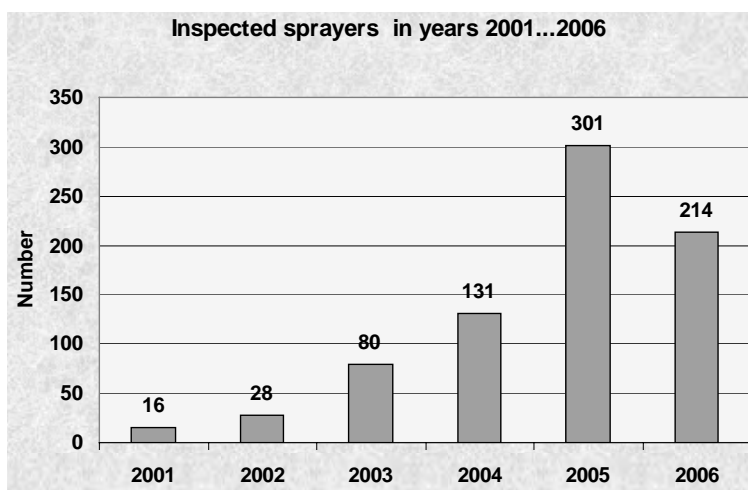


Figure 1 Inspected sprayers in years 2001 to 2006

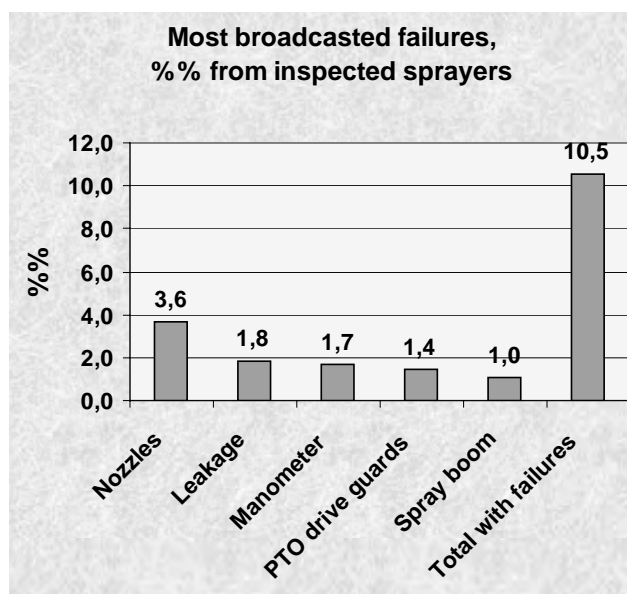


Figure 2 Most broadcasted failures

From sprayers producing companies predominantly on first place is Hardi (figure 3). On second place is old OP-2000 which are renovated on the basis mainly Hardi spare parts.

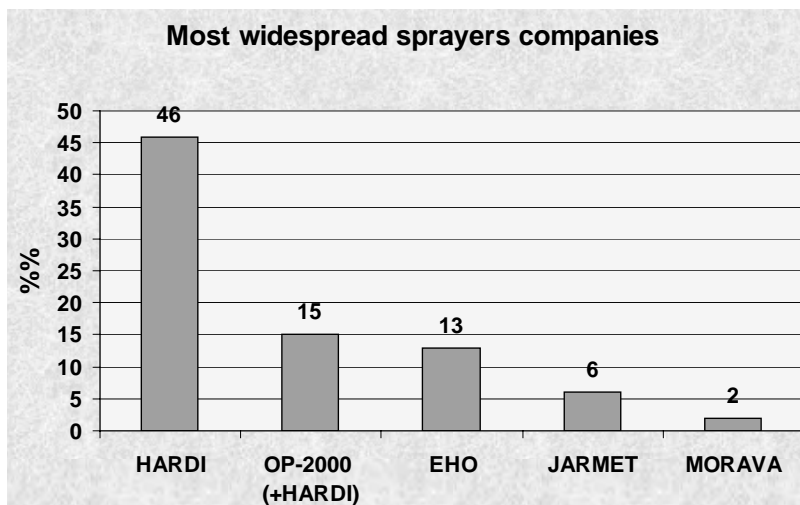


Figure 3 Most widespread sprayers companies

Inspection of sprayers have been provided in all counties of Estonia (figure 4), although there are no legal persons in all of them. Regretfully there are no data about total number of sprayers in use, therefore we can't even speculate the percentage of inspected sprayers.

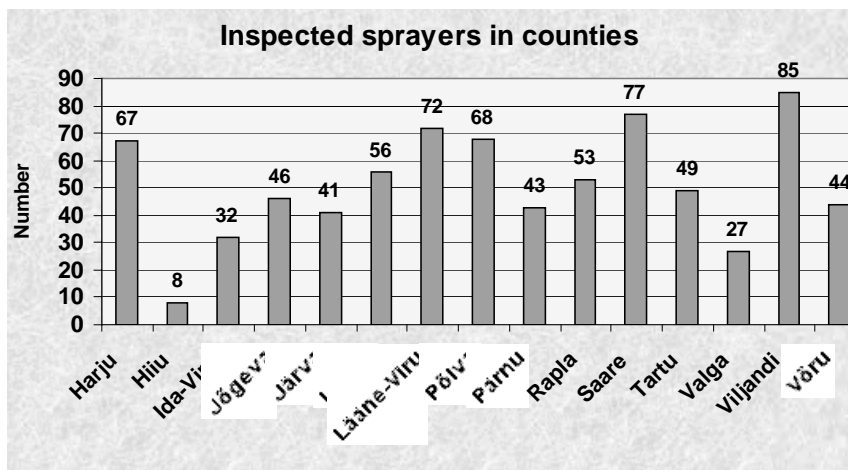


Figure 4 Inspected sprayers in countries

Also local inspectors of Estonian Plant Production Inspectorate are performing supervision of technical condition and usage of sprayers, but they are making this visually. In last four years they have supervised over 800 sprayers (figure 5).

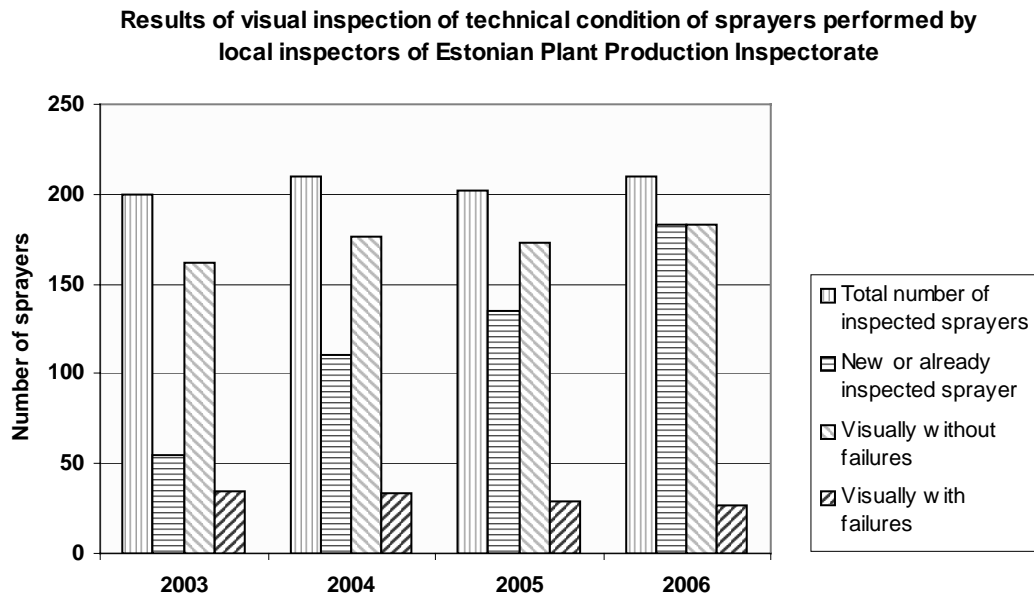


Figure 5 Results of visual inspections

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Requirements and settlements regarding the pest and disease control equipment verification in Romania in the period of pre adhesion at EU

Summary

At present, in Romania, the pest and diseases from the agricultural crops it is effected in proportion of 95 percent, by sprinkling and spraying of pesticides in the shape of liquid. These involve a very high risk of contamination of the operator and of the ambient environment with toxic substances. On that account, at present in our country, this risk has to be reduced through the introduction in our legislation of some European standards that suit with UE requirements (example: SR EN 907:2003, SR EN 13790-1:2004, SR EN 13790-2:2004 and so on). As part of this paper the authors presents the settlements that exist at present in Romania, as concerns the machinery test used for the pest and diseases control in agriculture, fruit growing and forestry and which of the European standards are applied.

Key words: weed-killing equipments, the pump output, the fan output, output coefficient

1. The current conditions in our country's agriculture regarding the agriculture surface, sprinkled machinery etc.

Romania was and is a prevalent agricultural country. The agricultural surface evolution between 1989 and 2004 is presented in the table from below.

Table 1 The agriculture surface evolution, thousands hectares.

Year	Agricultural Total	Arable	Grasslands	Hay fields	Vineyards and viticulture nursery	Orchards and fruit-growing
1989	14759,0	9458,0	3257,0	1448,0	278,0	318,0
1990	14769,0	9450,0	3263,0	1465,0	277,0	131,0
1991	14798,0	9423,5	3309,8	1467,9	285,8	311,3
1992	14790,0	9356,9	3349,2	1480,6	298,6	304,8
1993	14793,1	9341,5	3362,6	1489,3	303,9	295,8
1994	14797,5	9338,0	3378,4	1493,7	298,4	289,0
1995	14797,2	9337,1	3392,4	1497,7	292,4	277,6
1996	14788,7	9338,9	3391,7	1498,5	289,0	270,6
1997	14794,0	9341,4	3409,8	1490,8	286,3	265,7
1998	14801,7	9350,8	3402,7	1503,4	281,8	263,0
1999	14730,7	9358,1	3322,8	1512,0	281,1	256,7
2000	14856,8	9381,1	3441,7	1507,1	272,3	254,6
2001	14852,3	9401,5	3421,4	1510,0	267,4	252,0
2002	14836,6	9398,5	3424,0	1513,6	259,6	240,9
2003	14717,4	9414,3	3355,0	1490,4	230,5	227,2
2004	14711,6	9421,9	3346,9	1498,4	223,3	221,1

The source: The statistical year-book of Romania, 1990-2005 issues

The main indicators bound of human potential in Romanian agriculture are presented in table 2.

Table 2 The main indicators evolution of the human potential in Romanian agriculture (1990-2004).

Year	The total population	The rural population	The total engaged population	The population engaged in agriculture	The rural population weight in total population	The population weight engaged in agriculture in rural population	The population weight engaged in agriculture in total engaged population
	thousands persons	thousands persons	thousands persons	thousands persons	%	%	%
1990	23.207	10.598	10.840	3.055	45,7	28,8	28,2
1991	23.185	10.633	10.786	3.116	45,9	29,3	28,9
1992	22.789	10.422	10.458	3.362	45,7	32,2	32,1
1993	22.755	10.349	10.062	3.537	45,5	34,2	35,2
1994	22.731	10.303	10.011	3.561	45,3	34,6	35,6
1995	22.681	10.224	9.493	3.187	45,1	31,2	33,6
1996	22.608	10.196	9.379	3.249	45,1	31,9	34,6
1997	22.546	10.141	9.023	3.322	45,0	32,8	36,8
1998	22.503	10.155	8.813	3.296	45,1	32,5	37,4
1999	22.458	10.155	8.420	3.419	45,2	33,7	40,6
2000	22.435	10.190	8.629	3.523	45,4	34,6	40,8
2001	22.408	10.164	8.563	3.456	45,4	34,0	40,4
2002	21.795	10.186	9.234	3.357	46,7	32,9	36,3
2003	21.733	10.133	9.223	3.286	46,6	32,4	35,6
2004	21.673	9.777	9.158	2.893	45,1	29,6	31,6

The source: The statistic year-book of Romania, 1991 – 2005 issues

At present, the best and diseases control in Romanian agriculture is done, in proportion of 95 % (per cent), by spraying with pesticides in liquid aspect.

In 2005, in Romania, there were 14800 (14832) sprayers for cereal crops and 5640 (5641) sprayers for vineyards and orchards.

Sprayers mealing machinery with mechanical pull park evolution and structure related at the arable surface between 1990 and 2004 is presented in the table from below:

Table 3 The sprayers and mealing machinery with mechanical pull evolution and structure

Specification	1990	1994	1998	2002	2004	2004/1990
Arable surface, thousands hectares	9.450,0	9338,0	9350,8	9398,5	9421,9	1,00
Arable surface that correspond on a physical tractor-hectares	74,37	57,92	56,76	55,53	54,84	0,74
Sprayers and mealing machinery with mechanical pull sprayers	14994	12099	9424	7191	6573	0,44

The source: Calculated after the statistic year-book of Romania, 1991 – 2005

2. What has been achieved until now

At present, in Romania, there is not a legislative framework (lawful stipulations regarding the obligatory character), equipment and skilled staff in this domain. 13790 European Norm (EN) concerning the "Sprayers control that are in exploitation" is known by the specialists from Romania, but it is not applied because there are not structures at national level to allow its application.

The operator staff training is actually null, the spraying being inadequately made, that is in discord with the current European norms from this domain. The control measures effected with unskilled staff lead to an accented pollution of the environment.

At present, the National institute is master regarding the new equipments acceptance. The specialists are occupied with: the plant protection machinery certification from the product concordance point of view, the samples effectuation from performance point of view and work safety.

The weed-killing equipments control and verification mainly follows the technical, constructive-functional characteristic properties establishing and of the manner in which, through their engineering and working, they jeopardize the users life safety or pollute the environment.

The institute performs the following determinations:

- the constructive parameters determination;
- the equipment enfeed at the tractor verification;
- the combiner stability determination;
- the working qualitative coefficients determination;
- the power coefficients determination;
- the working coefficients determinations.

The working qualitative coefficients are established at different operating speeds of the machinery. For the optional run establishing, the tests manager has to pursue the obtaining of some qualitative coefficients with maximum values. At test the specialists establish:

- the pump output;
- the volumetrical productive capacity of the pump;
- the nozzle output;
- output coefficient;
- the transversal distribution measurement on the test stand;
- the pressure loss measurement;
- the pressure oscillation measurement at the spraying stopping on sections (apron segments);
- the substances norms;
- the fan output;
- the drops size;
- the operating pressure variation during the tanks evacuation;
- the agitation system efficiency.

The specialists from INMA, Cluj-Napoca branch have achieved two test stands of the distribution uniformity of the solution at sprayers, one of them for the sprayers in the field (uniformity on the working breadth) and the other one for the sprayers in space (for the output verification on nozzle).



a)



b)

Figure 1 INMA Cluj – Napoca: a) – the stand achieved by INMA Cluj for spraying in field; b) –the team from Cluj together with specialist from Germany.

3. What is it done at present in order to increase the professional qualification of the specialists from the agriculture?

A few achievements that contribute to the professional qualification bettering of the specialists from agriculture:

- the “Plant Protection” section establishment at the Agricultural Science and Veterinary Medicine University of Banat – Timisoara in 2002. As part of this specialization, the students also study pest and diseases control machinery in horticulture, vegetable growing, agriculture, fruit growing – viticulture and forestry. In the 3rd year of faculty they study the discipline “Machinery and Equipments for Plant Protection” (28 hours of course and 14 hours of laboratory). The discipline is directed by Dr. eng. Walter Stahli from Germany, co-worker being Dr. eng. Sorin – Tiberiu Bungescu. The discipline has a recent bibliographical material and a modern laboratory (machinery, devices component parts, measuring and control instrumentations) this being possible due to the collaboration with the companies: Lechler, Agrotop, Hardi, albus and with Hohenheim University from Germany (Prof. dr. Siegfried Kleisinger)



Figure 2 The students attend at practical demonstrations in field with Berthoud sprayer.



Figure 3 The student attend at practical demonstrations of utilitarian aviation.



Figure 4 Demonstration in Plant Protection Machinery and Equipments discipline laboratory.

- At the University from Craiova - Romania (Agriculture Faculty) there were already made the first steps for the establishment of this specialization, being, at present, under way of accreditation;
- For the operative staff with medium professional preparedness: agricultural mechanics, school leaver of agricultural high school, farmers from practice it is foreseen the establishment of a school of increasing of professional preparedness at Voiteni (Timis Country) with the support of Mechanization School from DEULA Germany, of Germany's Government, of USAMVB Timisoara and of German forum from Romania.

4. The legislation that is applied at present in Romania, but that is not compulsor

- SR ISO 5681:1995
- Machinery and equipments for plant protection. Vocabulary;
- STAS 9924-74
- Machinery for plant protection. The liquid tanks capacity;
- STAS 9926-91
- Machinery for plant protection. Work protection and hygiene limitations;
- SR ISO 6686:1999
- Machinery and equipments for plant protection. Nozzles with anti-eye dropper. Performances determinations;
- SR ISO 6720:1999
- Agricultural machinery. Sowing machinery, fertilizer sower planting machinery and spraying equipments. Recommended working breadth.
- STAS 12836-90
- Tractors and agricultural machinery. Methods for the conditions determination at experiments in field;
- STAS 13042/1-91
- Agricultural machinery. Determination methods of constructive parameters;
- STAS 13042/2-91
- Agricultural machinery. Determination methods of working coefficient;
- SR EN ISO 12100-2
- Machinery safety. Basis drafts. General principles of projection. Part 2: Technical principles.
- SR ISO 730-1+C1
- Agricultural tractors on wheels. Suspension machinery in three points mounted in the back. Part 1: The categories 1, 2, 3 and 4.
- SR ISO 4254-6:2000
- Forest agricultural machinery and tractors. Technical devices that allow the security ensurance. Part 6: Machinery and equipments for plant protection;

The basis European Norms used for the technical verification of the plant protection equipment in use are:

- SR EN 13790-1:2003
- Agricultural Machinery. – Sprayers – Inspection of sprayers in use – Part 1: Field crop sprayers, CEN, 2004, Brussels;
- SR EN 13790-2:2003
- Agricultural Machinery. Sprayers. Inspection of sprayers in use – Part 2: Sprayers with flash used for shrubs in fruit growing.
- SR EN 12761-1:2001
- Forest and agricultural machinery. Sprayers for plant protection and applied liquid fertilizers, environmental protection. Part 1: Generalities
- SR EN 907:2003
- Agricultural and forest machinery. Sprayers and liquid fertilizers administer machinery. Security.

5. What are the expectations for the future?

- The staff schooling that works in this domain with skilled specialists from UE countries;
- The creation of a control network of the sprayers in use from Romania (see figure 6);
- The new European legislation implementation in this domain at national level;
- The compulsory periodical control introduction of these machinery, control that should be effected by state. Working points: Bucharest, Cluj-Napoca and Timisoara (there were chosen these three cities because at present here there is interest for this domain).
- The organization possibility in the future of a Workshop at the University from Timisoara with Plant Protection Federal Office support from Germany – BBA on control themes of sprayers with a view to implementation in Romania of the European Norms in this domain.

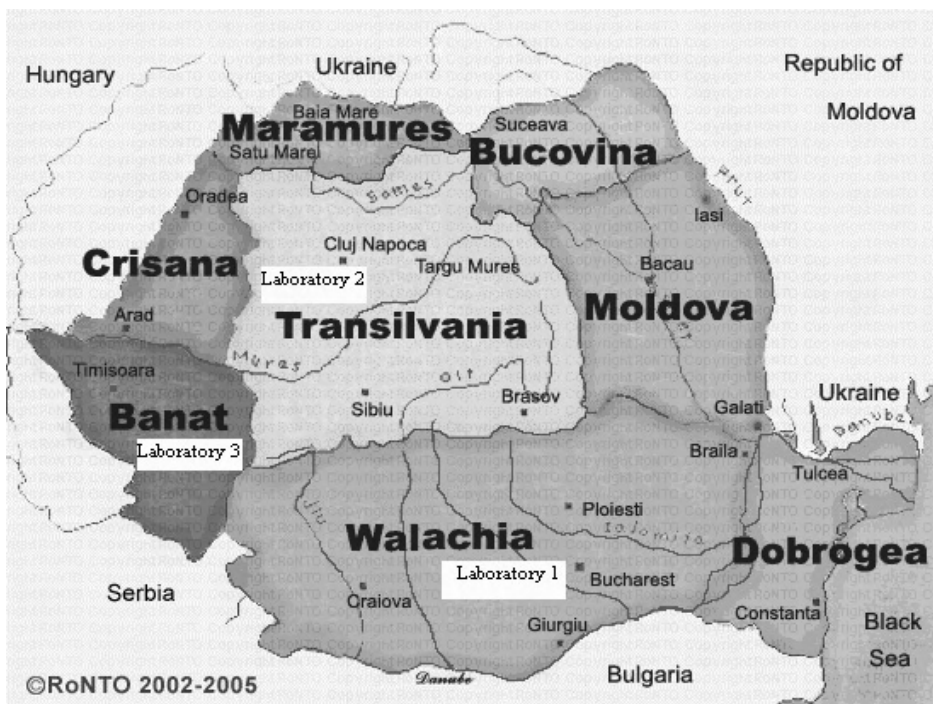


Figure 5 A possible control network of sprayers in Romania.



Figure 6 The team who can implement in Romania in the future the European legislation in this domain (Bucuresti – Cluj-Napoca – Timisoara).

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Concluding remarks

Recommendations of the Workshop 'Standardised Procedure for the Inspection of Sprayers in Europe -SPISE 2-'

The participants welcomed the initiative of the SPISE Working Group and expressed their expectations to continue efforts toward harmonising sprayers inspections with the following resolution:

Taking into consideration that

- plant protection is an essential instrument for ensuring sufficient high-quality and healthy food,
- justified demands of consumer- and environmental protection and nature conservation are to be implemented in the interests of society and politics,
- technical equipment is particularly important in complementing the use of authorised plant protection products according to good plant protection practice,
- the Member States (MS) and the European Commission (EC) are discussing measures for improving the sustainability of plant protection within the framework directive on the sustainable use of pesticides, where the introduction of obligatory inspection of plant protection equipment which is in use in the MS has been stated as one of the main measures,
- CEN has drafted several standards for new sprayers and sprayers in use; ISO carries out comprehensive work to improve and harmonise sprayer standards on an international level,
- with the publication of European standard EN 13790 'Agricultural machinery – Sprayers – Inspection of sprayers in use' – part 1: Field crop sprayers and part 2: Air-assisted sprayers for bush and tree crops - and the technical demands placed on equipment mentioned here, an important element for the harmonisation of equipment inspections has already been created,
- further requirements, on EU- and national level, are necessary for equipment inspections of a high technical standard and comparable quality throughout the MS,
- the EC offers the MS support within the TAIEX (Technical Assistance Information Exchange Instrument - DG Enlargement) when introducing equipment inspections,

it is welcomed by the participants of the SPISE-Workshop

- that it is intended to improve the sustainability of plant protection through suitable measures, and that at the same time the introduction of an obligatory equipment inspection in the MS is proposed as an important contribution to sustainable plant protection.

The participants of the SPISE-Workshop recommend

- that there should be a clear reference to the EN 13790 standard (which was published back in 2004), in Article 8 “Inspection of equipment in use” of the proposed framework directive on the sustainable use of pesticides, for field crop sprayers and air-assisted sprayers for bush and tree crops – and that EN 13790 would be recognised as the current standard. If this is not possible, an explanation should be given in order to review EN 13790,
- that the EU Commission should clarify the types of application equipment to be inspected,
- that further criteria should be considered in the framework directive, for example, inspection frequency, inspection stickers, mutual recognition with a view to high-quality inspections,
- that the information packages on plant protection equipment available on the internet (BBA website) were maintained and adapted to the needs of the MS by Belgium, Germany and the Netherlands,
- that it should be considered to develop further standards and inspection protocols for plant protection equipment not covered by EN 13790 but subject to obligatory inspections covered by the framework directive,
- that the SPISE working group should continue its work on promoting harmonisation and mutual recognition of equipment inspections in the MS, and that it may serve as a pool of experts for questions on plant protection equipment and would prepare a 3rd SPISE workshop in collaboration with the EU Commission in the near future.

Excursion for visiting inspection centres

First of all this excursion should serve a better understanding for the information packages from Germany, The Netherlands and Belgium presented in session 1. With this it was possible to experience the establishment in practise. The lengths of the circuit amounts to about 250 km.

The summarized programme:

08:00

Departure by bus from meeting point for workshop participants in front of the building of the Information and Education Centre for Horticulture, Hans-Tenhaeff-Str. 40-42

08:30 – 09:30

Lottum – Coenders – Dutch inspection site (Kole)

09:45 – 11:15

Horst – John Deere – inspection of brand new sprayers (Audenaert)

12:45 – 14:15

Vlijtingen – Belgian inspection site Lunch with sandwiches and coffee (Breakman)

15:45 – 16:45

Grevenbroich-Wevelinghofen – Peiffer – German inspection site (Kramer)

19:30 – 22:30

Workshop Dinner at brewery Diebels at Issum.



Figure 1 The course of the bus tour

The first visit was planned for the company Coenders at Lottum situated in the Netherlands near the German border. Here an inspection of a special sprayer used in asparagus and furthermore an inspection of an air-assisted sprayer were demonstrated (Figure 2).



Figure 2 Determination of the nozzle output of a orchard sprayer at Coenders Company in the Netherlands

Only five kilometres away from here the John Deere Company at Horst is situated. Here a walk through the factory leads to the inspection of brand new sprayers carried out for each sprayer before delivery (Figure 3).



Figure 3 Inspection of brand new sprayers by built in spray scanner at John Deere Company

After that the Belgian inspection system was visited. At Vlijtingen near Maastricht on the court of a building contractor the normal inspection activity was shown at some field and air-assisted sprayers (Figure 4).



Figure 4 Inspection of an orchard sprayer in Belgium

At last the German inspection site was visited. At Grevenbroich-Wevelinghofen the company Peiffer is an approved inspection workshop. Here the inspection of a field sprayer is carried out inside a hall (Figure 5).

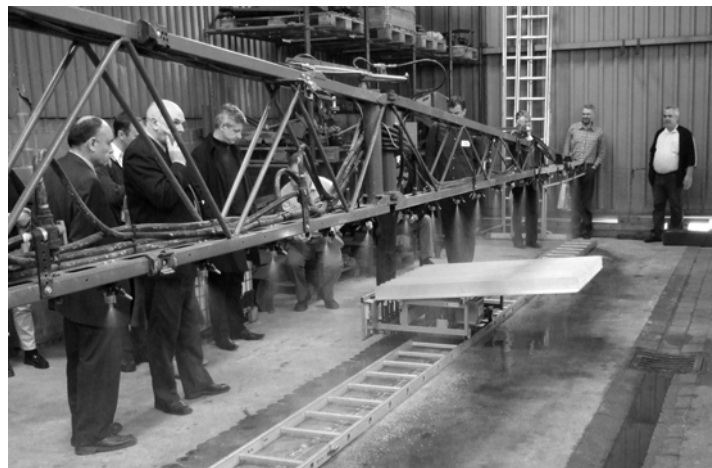


Figure 5 Measuring the cross distribution at the German inspection site Peiffer Company

List of authors

B

Baldoin, C.	96
Balsari, P.	60, 82, 100, 106
Bánszki, P.	126
Baskys, D.	111
Biris, S.	140, 160
Bjugstad, N.	50
Böhmer, B.	10
Bolintineanu, G.	140
Bondesan, D.	96
Braekman, P.	36, 74, 115
Bugarin, R.	118, 150
Bungescu, S.	140, 160

C

Coetzer, E.	19
Cota, C.	140

D

Dalla Pace, A.	96
De Zanche, C.	96
Declercq, J.	36, 74, 115
Dimitrievits, Gy.	126
Do Carmo Martins, M.	139
Doruchowski, G.	43
Đukić, N.	118, 150

G

Ganzelmeier, H.	3, 13, 15, 29
Ghigo, D.	82, 100
Gioelli, F.	106
Godyn, A.	43
Gulyás, Z.	126

H

Haller, G.	129
Harasta, P.	48
Hermansen, P.	50
Holownicki, R.	43
Huyghebaert, B.	36, 74, 133

I

Iancu, T.	160
-----------	-----

J

Ježík, M.	137
-----------	-----

K

Knewitz, H.	91
Koch, H.	91
Kole, J.C.	34, 88
Kovács, L.	126
Kraggerud, A.G.	50

L

Lavčák, F.	137
Liberatori, S.	100
Limongelli, R.	100
Loga, J.	129

M

Marrucco, P.	60
Moeller, K.	19
Moreira, J.F.	139
Mostade, O.	74

N

Nagy, E.M.	140, 160
------------	----------

O

Oggero, G.	60, 82, 100
Oldenkamp, P.	21
Osteroth, H.J.	145

P

Pähnapuu, O.	157
--------------	-----

R		Stahli, W.	160
Rautmann, D.	78	Swiechowski, W.	43
S		T	
Sandström, M.	149	Tamagnone, M.	106
Schmit, J.F.	36	V	
Schorn, K.	11	Vladut, V.	140, 160
Sedlar, A.	118, 150	W	
Siim, J.	157	Wahlander, J.	149
Skuterud, M.	50	Wehmann, H.-J.	22
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Second European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe - SPISE 2 -

Nach der Durchführung des ersten europäischen Workshops vom 27. bis 29. April 2004 in Braunschweig, fand der zweite SPISE-Workshop vom 10. bis 12. April 2007 statt. Hierzu hat die Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA) / Fachgruppe Anwendungstechnik Fachleute für Pflanzenschutzgerätetechnik aus ganz Europa nach Straelen in das Informations- und Bildungszentrum für Gartenbau der Landwirtschaftskammer Nordrhein-Westfalen eingeladen. Mehr als 100 Fachleute aus 27 europäischen Ländern waren der Einladung gefolgt. Die Teilnehmer haben die europäische Initiative der BBA und der SPISE-Arbeitsgruppe sehr begrüßt und sich in einer Resolution für eine Fortsetzung der Harmonisierung im Bereich der Pflanzenschutzgerätetechnik ausgesprochen.

Ziel dieses Workshops war es, die Experten aus den Mitgliedstaaten über die von der Europäischen Kommission im Rahmen der Thematischen Strategie für einen nachhaltigen Einsatz von Pflanzenschutzmitteln beabsichtigte Einführung einer gesetzlichen Regelung für in Gebrauch befindliche Pflanzenschutzgeräte (Pflichtüberprüfung) zu informieren und über die weiteren erforderlichen technischen, organisatorischen und administrativen Regelungen in den Mitgliedstaaten zu beraten.

Second European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe - SPISE 2 -

After the first Workshop on the inspection of plant protection equipment in Europe from 27 - 29 April 2004 in Braunschweig, the second SPISE-Workshop took place from 10 - 12 April 2007, to which the Federal Biological Research Centre for Agriculture and Forestry (BBA) / Application Techniques Division invited experts on plant protection equipment technology from the whole of Europe to Straelen to the information and education centre for horticulture of the Chamber of Agriculture North Rhine-Westphalia. More than 100 experts from 27 European Countries came to Straelen. The participants did welcome this European initiative of BBA and the SPISE working group and emphasised their intention of continuing the work on harmonisation in the field of plant protection technique in a resolution.

The aim of this workshop was to inform the experts from the Member States on the planned introduction by the European Commission of a legal regulation, in the context of the Thematic Strategy for the sustainable use of plant protection products, for plant protection equipment already in use (obligatory inspection) and to discuss further necessary technical, organisational and administrative regulations in the Member States.