

## ESTIMATION OF THE CONCENTRATED ENDURANCES OCCURRING ON THE OUTER SURFACE OF THE SPRAYERS

TAMÁS SÁNDOR, BÉLA PÁLYI

University of Pannonia - Georgikon Faculty  
Department of Agricultural Mechanization  
Keszthely H-8360 Festetics Str. 7.  
[muzaki@georgikon.hu](mailto:muszaki@georgikon.hu)

### ABSTRACT

Unsatisfactory technical condition or insufficient adjusting of plant protection machines may cause considerable environmental pollution. During their maintenance and cleaning (mechanical errors) more or less concentrated plant protecting chemicals may get into living water and from these even into drink water. Naturally, during spraying the wind may drift the chemicals into natural waters. In 1999 the International Standardization Organization has established a working group to elaborate rules to decrease environment pollution by efficient cleaning of sprayers. As a result of their work, in March 2004 the ISO/DIS 22368 standard draft came into force, which describes in three chapters the inner cleaning of sprayers as well as the investigation of effectiveness of cleaning devices for outer and inner side of pesticide tank of sprayers. Our aim was to investigate the effectiveness of the cleaning devices, the contamination quantity and relation of chemicals on the sprayers and make proposals to improve directions of the standard.

**Keywords:** plant protection, maintenance and cleaning, international standards, measuring methods

### INTRODUCTION

Plant protection is one of the indispensable operations in agricultural production, as it influences the income of the farmers (high prices of pesticides, damages caused by insects, wild or other pathogens etc.). The bad technical state of plant protection machines, wrong adjusting, and the negligence of maintenance and cleaning can harm the income possibilities, and increase the endurance of the environment.

There have been important steps made to avoiding such problems on European level. As a result of it the DIN/EN 12761 standard (2001) has been created, which prescribes the providing of inner cleaning machines with a rinsing water reservoir in case of new sprayers. The connection of outer cleaning device is also possible, so the cleaning will be quick and water-saving (CSIZMAZIA, 2006). Besides the European Plant Protection Organization created the TOPPS program which together with the European Committee's Life program works out offers, presentations and prospects that serve the prevention of the point source pollution of the environment by training the staff involved in work with plant protecting appliances (EUROPEAN COMMISSION, 2008). In order to achieve this goal the International Organization of Standardization (ISO) created a work group managed by the Julius Kühn Institute of Plant Protection Application Technology. Their task is to work out measuring methods by which the pollution of the sprayers with pesticides and the efficiency of the cleaning equipment can be measured. The result of their work came the ISO/DIS 22368 standard draft to light, which consists of three parts. The first part deals with the complete inner cleaning of the plant protecting machine, the second part with the external washing of the machine, the third part deals with the internal rinsing of the liquid tank (HERBST AND GANZELMEIER, 2002; WEHMANN, 2008). The standard draft plan was recognized as international standard in July 2012 and nowadays the team is working on the determination of the achievement criteria.

Our department researches nowadays concentrate on the second chapter of the standard. We are looking for an answer about the quantity and relation of chemicals on the sprayer

by using different settings. We also give advice about the increasing of the efficiency of the measuring methods which were used according to the standard, as well as the reduction of expenses and the time consumption.

## MATERIAL AND METHOD

The subject of the measuring is a Berthoud ARBO 1000 plantation sprayer with axial ventilator which has 1000 l nominal volume and has adjustable deflectors too. The tests were made with Saphirex disk-core type circulation nozzles, which have wide spraying angle ( $65^{\circ}$ ), on high pressure (10, 15, i.e. 20 bar), with and by removing the deflectors (*Table 1.*).

**Table 1. Saphirex nozzle properties for Berthoud ARBO 1000 sprayer**

Saphirex 12/10°	Capacity (litre/min)			
	Working pressure	10 bar	15 bar	20 bar
1 nozzle		1.26	1.54	1.74
Without deflector (10 nozzle)		12.6	15.4	17.4
With deflector (14 nozzle)		17.64	21.56	24.30

Source: Berthoud ARBO Manual

The aim of the research is the measuring of the chemical sediment issued from the spraying on the outer surface of the plant protecting machines. It is also the checking of the accomplishment of the standard and making offers to increase the efficiency of the measurements, and eventually elucidate measurement errors. According to the standard we used Tartrazine 85% (E 102), a yellow food colouring. Its main characteristics are good solubility, good adhesiveness, it is easy washable, so is proved to be ideal for the measurements. The measurement begins with the filling up of the machine. We fill as much reference liquid into the machine as it is necessary for the spraying, according to the standard. Meanwhile the mixing equipment is working. Then, simulating a spraying process, we spray the liquid in a radius circle given in the standard (in case of an axial ventilator min.  $r = 10$  m), for 10 minutes clockwise, then backwards to compensate the wind effect (*Photo 1. and 2.*).



**Photo 1. Berthoud ARBO 1000 Sprayer**



**Photo 2. Measuring Area by ISO standard**

Then we let the technical rest out and we wash the wheels, so that they do not deform the concentration of the patterns. Then we put the sprayer in a catchment pool to clean the outer surface with a high pressure cleaner (*Photo 3. and 4.*).



**Photo 3. Catchment pool**



**Photo 4. Sprayer prepared for cleaning**

We collect the cleaned liquid and we take samples and then we repeat the process. After registering the concentration of the liquid samples it is possible to define the quantity of the chemicals sedimented on the sprayer according to the sprayed quantity with the help of spectrophotometry (ISO/DIS 22368-2:2004, 2004). Beside the conditions and the circumstances described by the standard we also examined the machine in real circumstances, which is in an orchard. We made the measurements, and then we also washed it and took samples.

## RESULTS

During the measurements by the survey of the machine, the plant protecting material appears in larger quantity on the boom, which is on the inlet and outlet openings on the axial fan. This can be explained by the fact that the fine spray is taken away with the suction effect of the ventilator, and that gets into the ventilator through the turbulent stream. Moreover the drift was also observed, which got the fine spray not only on the sprayer but also on the prime mover (*Photo 5. and 6.*).



**Photo 5. Turbulent stream by spraying**



**Photo 6. Drift effect by spraying**

This can be important from the point of view of work protection and environment protection. If it were a substance which could be absorbed by the skin the person working with the machine could even get a slight poisoning (*Photo 7. and 8.*).

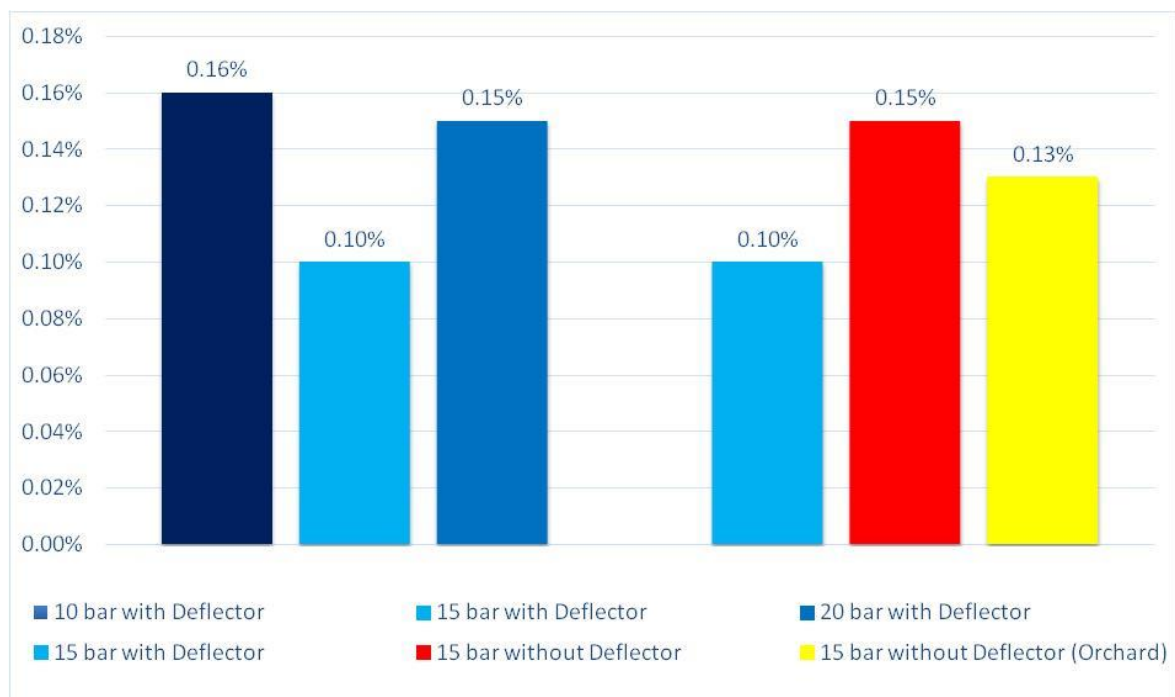


**Photo 7. Sprayer before cleaning**



**Photo 8. Contamination on the Sprayer (Modified Picture)**

If the machine were cleaned in the yard the chemical could get into the soil and pollute drinking water, too. The result of the measurements proved that while using the adjustable deflectors the degree of pollution at 15 bar working pressure was the smallest compared to the quantity of the sprayed chemicals (0.1%; 10 bar – 0.16%; 20 bar – 0.13%). At the measurements made without the deflectors there has been only a comparing test at a working pressure of 15 bars. Then the degree of pollution was slightly higher due to the lack of directing effect of the air (0.15%; +50 %). At the end, the measurements in the orchard, without deflectors, based on the test results are the degree of contamination, although not significantly, decreased (0.13%; -13%; *Figure 1*).



**Figure 1. Sedimentation on the sprayer in relation to the operating pressure**

Source: Based on measurement data. (2011-2012)

## CONCLUSIONS

The ISO/DIS standard gives good directions to the farmers and sprayer producers in all respect of sprayer maintenance and cleaning to achieve a cleaner environment and to get residue-free, healthier workplaces in the agriculture. The description of the process given in the standard is acceptable, though it is time and work consuming and it needs small adjustments (e.g. the gathering of the washed up liquid and sample taking from the catchment pool). The measuring results show, that the lowest contamination on the sprayer are on 15 bar operating pressure and the contamination rises when the deflector was removed.

Our investigations will be continued to improve the standard by using digital image processing technics to help the spraying producers for a better visual detection of contamination on the plant protection systems.

## ACKNOWLEDGMENTS

*“This article was made under the project TÁMOP-4.2.2/B-10/1-2010-0025. This project is supported by the European Union and co-financed by the European Social Fund.”*

## REFERENCES

- CSIZMAZIA, Z. (2006). A növényvédelem gépei (Machines of plant protection), Mezőgazda Kiadó, Budapest, p: 137-138, ISBN 963-286-150-7
- EUROPEAN COMMISSION – ENVIRONMENT (2008). TOPPS-Life program. [www.topps-life.org](http://www.topps-life.org)
- HERBST, A. AND GANZELMEIER H. (2002). International Standards and their Impact on Pesticide Application, Aspects of Applied Biology 66, January 2002. Warwick, UK. 2002.
- WEHMANN, H.J. 2008: Reinigung von Pflanzenschutzgeräten – ISO Norm und erste Ergebnisse (Cleaning of sprayers – ISO standard and first results), Nachrichtenblatt des deutschen Pflanzenschutzdienstes, 60 (3). pp 62 – 67, ISSN 0027-7479
- ISO/DIS 22368-2:2004 - Crop protection equipment – Test methods for the evaluation of cleaning systems – Part 2: External cleaning of sprayers (2004). Worksheet, International Organisation for Standardization