
Session 1: Present experiences and challenges in inspections activities

Present experiences and challenges in inspections activities in Serbia

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Summary

During 2016, after 3 years, activities which were focused on establishing a system for control testing of sprayer and air assisted sprayers on the territory of the Republic of Serbia the whole system was established on a 31 station for control testing of PAE and 2 bodies who are responsible for control and system organization.

Thanks to the activities carried out through the IPA Twinning Project SR12 / IB / AG / 01 in December 2014, the equipment supplied to all stations by its basic activity of agricultural schools, agricultural extension services, professional high schools, agricultural institutes. Stations are equipped with all necessary equipment. The equipment is at each station entrusted to graduate agricultural engineer who have full-time job and they were trained in two basic courses.

Plan was that during 2017. Serbia get new "Law of plant protection products", which include parts of mandatory control testing PAE but we still in anticipation of this new legislation. During these anticipations, Faculty of Agriculture, University of Novi Sad organized many workshops with agricultural producers. Aim of this workshops is to introduce agricultural producers with important and benefit of sprayer inspection and calibration. These workshops were supported by Vojvodina's government. Also many of established station start with training of agricultural producers in their area with support of municipality or other state local body.

Agricultural producers make good response on this activity, so experts from Faculty of Agriculture Novi Sad, provide also to agricultural producers training in their "Education Developmental Center for Pesticide Application Equipment" (ERTAP). We call it "ERTAP open days". So, during season of spraying they can call us or visit our Center and we help them to be more effective and environmental friendly in pesticide application.

Still, the biggest problem is that we do not have new legislation. Like two years ago, also now for implantation of control testing in Serbia we needed an urgent adoption of a new law as well as supporting acts, with emphasis Rules on control testing, in order to implement the system in practice.

Key words: inspection, activities, educational workshop, new law, Serbia

Introduction

The importance of inspections of pesticide application equipment is reflected in the pesticide application efficiency. For pesticide efficiency, applications are a key nozzles and operating pressure. For their proper functioning, it is necessary:

- There is no pressure drop (leaks and dropping);
- The pump achieves the declared flow and operating pressure;
- Controlling via the control group (setting and controlling the pressure, switching on and off);
- set appropriate nozzles are installed;
- the wings are horizontally and vertically flat;

The mentioned factors have a final impact on the uniform application of pesticides. In addition to internal factors (element and sprayer circuits), there are external factors that influence the uniformity of the pesticide application. External factors include:

- Air temperature;
- Air humidity;
- Speed of movement;
- condition of crop;

Changing the pressure causes a change in the droplet size. By increasing pressure, a more uniform application of pesticides will be obtained (Višacki et al., 2016). Different nozzles have a different effect on the uniformity of the application. Injector nozzles will have a better distribution of the working fluid from the spray nozzle. Reflective sprayers will have a poorer distribution than all nozzles. The reason is in the type of nozzle because of the change in pressure, there is also a change in the size of the drops and the method of disintegration of the working fluid. Accordingly, lower pressures will affect the formation of larger droplets and higher pressures on the formation of smaller droplets. The effect will be different for a flat jet nozzles or injector type nozzles (Nuyttens et al., 2007). Therefore, at the same time, the uniformity of distribution of the sprayer will be different. In general, according to Sehsah and Klesinger (2011), it is noted that the pressure has an impact on the uniformity of the distribution of the sprayer. The same author proves that in wind conditions there are changes in the uniformity of the application of pesticides due to the change in the coefficient of variation. Similarly, Subr et al. (2017) where it adds that the wear nozzles additionally changes the coefficient of variation to higher values. The higher value of the coefficient of variation indicates an uneven application of pesticides. All of these factors will affect the efficiency of the pesticide application. The occurrence of drift is the first problem faced by a farmer. In addition to drifting winds that are almost constantly present, evaporative drift is increasingly more frequent (Heidary et al., 2015). This is confirmed in an open field where the type of nozzles, working pressure, drift and droplet size play a decisive role in the amount of deposits on the plant or the target surface. Olivet et al. (2017), Reynaldo and Machado (2017), Ozkan et al. (2012), Mesterhazy et al (2011) confirm the advantage of using an injector nozzles as a good solution in case of drifting. They state that a larger amount of deposits is achieved using a two-jet nozzles.

All of these facts are in fact a problem in Serbia in the application of pesticides. The importance of implementing the plant protection inspection procedure itself does not represent the completion of a task related to the efficient application of pesticides. The next step is farmer education. Although the law has not yet been adopted, the Educational Development Center for Pesticide Application first identified the critical points of the pesticide application, and then formed a team of people who first write a training literature and carried out dozens of different types of training both at the Faculty and throughout the territory of Serbia and Vojvodina province.

Material and method

The identified problems are in fact the result of non-compliance with several international standards. Requirements prescribed by international standards are a starting point for all educational workshops conducted by the Educational Development Center for Pesticide Application. Requirements of the following standards have been observed:

- [1] [ISO 5682-1:2017](#): Equipment for crop protection -- Spraying equipment -- Part 1: Test methods for sprayer nozzles
- [2] [ISO 5682-2:2017](#): Equipment for crop protection -- Spraying equipment -- Part 2: Test methods to assess the horizontal transverse distribution for hydraulic sprayers

- [3] [ISO 6686:1995](#): Equipment for crop protection -- Antidrip devices -- Determination of performance
- [4] [ISO 8169:1984](#): Equipment for crop protection -- Sprayers -- Connecting dimensions for nozzles and manometers
- [5] [ISO 16122-1:2015](#): Agricultural and forestry machinery -- Inspection of sprayers in use -- Part 1: General
- [6] [ISO 16122-2:2015](#): Agricultural and forestry machinery -- Inspection of sprayers in use -- Part 2: Horizontal boom sprayers
- [7] [ISO 19732:2007](#): Equipment for crop protection -- Sprayer filters -- Color coding for identification
- [8] [ISO 22369-1:2006](#): Crop protection equipment -- Drift classification of spraying equipment -- Part 1: Classes
- [9] [ISO 22369-2:2010](#): Crop protection equipment -- Drift classification of spraying equipment -- Part 2: Classification of field crop sprayers by field measurements
- [10] [ISO 22401:2015](#): Equipment for crop protection -- Method for measurement of potential spray drift from horizontal boom sprayers by the use of a test bench
- [11] [ISO 10625:2018](#): Equipment for crop protection -- Sprayer nozzles -- Color coding for identification

Accordingly, three groups of problems have been identified. In first group is the problem that farmers faces:

- Age of sprayers since many sprayers were acquired thirty years ago while the domestic economy functioned;
- The problem with new sprayers that appeared as non-compliance with applicable standards;
- Spray nozzles in terms of weariness;
- Inappropriate sprayer nozzles do not comply with field requirements;
- Manometer does not meet scale standards;
- Problem with the speed of the shaft since the low speed does not generate sufficient flow;
- Poor membranes and valves on the pump as well as pressure in the air bell;
- Exploitation factors does not correspond to field conditions, operating pressure and traveling speed;
- Conditions on the field, drift and deposit on target.

The second group includes producers of cheap sprayers with the following problems identified:

- they do not know the requirements of international valid standards;
- Used nozzles are domestic production and do not meet international standards in terms of color coding, flow and distribution;
- Spray nozzles and nozzles carriers do not perform an adequate function;
- Filters do not have matching mesh; no threads are marked with a good color;
- Valves, ducts, manometers and command units in many cases do not work well since they leaking and do not stop the flow, they are very imprecise;
- Sprayer wings are neither vertical nor horizontal, nor have any automatic leveling systems.

The third group includes sprayers' manufacturers, which are not manufacturers, but those who build new sprays by purchasing components most often from Italy, Slovenia or Germany. The main problem identified is that they do not deal with the principles of effective pesticide application. Accordingly, sprayers are delivered with equipment that does not ensure that the operator performs an efficient pesticide application. Additionally, they train them for basic things about spraying, and not about the principles of good agricultural practice and real possibilities of a very high price machine for our market.

Another problem identified during the previous and this year is that farmers buy different machines without knowing what the ability of sprayer. They also do not know their exploitation factors and often buy oversized machines for their farms. This is an increasingly frequent problem because the state allocates huge incentives for the purchase of new agricultural machinery. The machines are imported without any control and no compliance with the standards of the European Union is checked, which is, for example, a problem with machines coming from Russia and Turkey.

Results and discussion

The solution of the problems identified is in the continuous and all time education of farmers. Dozens of educational workshops were conducted mainly in the territory of the autonomous province of Vojvodina. These workshops were divided into 4 segments. The first segment concerned general information related to the application of pesticides, diseases and pests and machinery for plant protection, the other part related to the choice of nozzles, norms and other exploitation parameters. The third part covered the personal protective equipment of the users of plant protection products. In the end, all three parts were covered and through the fourth part of the course participants could see this practically with a special emphasis on the inspection of pesticide application equipment.

The first segment included:

- Diseases and pests in crop production;
- Elements and assemblies of plant protection machines;
- Setting up a sprayer;
- Norm, dose and concentration;
- Maintenance and off-season storage of the machine;

The second segment concerned:

- Types and subtypes of nozzles;
- Drift;
- The size of the drops of the nozzles;
- Impact of pressure on the pesticide application efficiency;
- Efficient and economical application of pesticides;
- Use of a tracer and pesticide deposit;
- Exploitation parameters of labor.
- The third part of the course also had several areas:
- Packaging, instructions for use and manipulation with plant protection products;
- Spray filler, pouring and flushing process;
- Collection and destruction of packaging;
- Preservation and storage of plant protection products;
- Personal protective equipment;
- Measures of protection and caution when handling, storing, transporting plant protection products;

The fourth part was the most interesting course participants since it was related to the practical part. Thus, through this part of the course, an inspection of the sprayers was carried out by the owners of the course. Specifically, there are recommendations regarding nozzles, operating pressure and speed of movement in pesticide application, weather conditions and limitations.

The following photos show different segments of realized courses.



Fig. 1. The first part of the lecture is about personal protective equipment



Fig. 2. Practical presentation of the work of nozzles



Fig. 3. Selection of nozzles



Fig. 4. The accompanying publication is related to the course



Fig. 5. Types of nozzles for efficient pesticide application



Fig. 6. Personal protective equipment and nozzles



Fig. 7. Practical demonstration of inspections of pesticide application equipment



Fig. 8. Presentation of the Course at the annual conference

All equipped stations with equipment for inspection of pesticide application equipment have been realized equipment in the test run and performed the first tests. According to unofficial data, over 85% of pesticide application equipment do not comply with applicable standards. The most common problems are with nozzles, wings and pressure gauges. Leaking and dropping from parts is almost a regular occurrence. Nozzles have not been changed since the purchase of the sprayers. Not knowing the color coding and flow, setting the standard and influencing the pressure on the droplet size as a fat of efficiency is a daily occurrence. Although the inspection of the plant protection equipment is not mandatory, the stations have initiated self-financing of their activities from municipal funds or funds of the Provincial Secretariat for Agriculture or the Ministry of Agriculture of the Republic of Serbia.

Conclusion

By not adopting a new law of plant protection products, enormous damage to the environment and agricultural production is inflicted. Currently, the activities of the equipped stations are very useful and have brought very bad results in case of current stand of pesticide application equipment. This shows that the new law of plant protection products have included inspections of pesticide application equipment, which will be extremely useful for efficient and sustainable agricultural production. Courses related to the principles of efficient and economical agricultural production in the framework of sustainable agricultural production and sustainable management and land use as a natural non-renewable resource are currently of crucial importance for Serbia's agriculture.

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Literature

1. Višacki V, Sedlar A, Bugarin R, Turan J, Burg P. (2017). Effect of Pressure on the Uniformity of Nozzles Transverse Distribution and Mathematical Model Development. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 65(2): 563–568.
2. Nuyttens, D., K. Baetens, M. De Schamphelleire, and B. Sonck. (2007). Effect of nozzle type, size, and pressure on spray droplet characteristics. *Biosystems Eng.* 97(3): 333-345
3. Sehsah E. M. E. and Kleisinger S. (2011). Study of some parameters affecting spray distribution uniformity patternen *Misr J. Ag. Eng.*, 26(1): 69- 93

4. Subr A , Milanowski M , Parafiniuk S , Sawa J. (2017). Testing the uniformity of spray distribution under different application parameters. IX International Scientific Symposium "Farm Machinery and Processes Management in Sustainable Agriculture", Lublin, Poland, 2017 DOI: 10.24326/fmpmsa.2017.64 359
5. Étore F. Reynaldo¹ and Thiago M. Machado (2017). Performance of spray nozzles to control fusarium head blight and mycotoxin in the barley crop. Revista Brasileira de Engenharia Agrícola e Ambiental Campina Grande, PB, UAEA/UFCG, ISSN 1807-1929 v.21, n.3, p.209-213, 2017 DOI: <http://dx.doi.org/10.1590/1807-1929/agriambi.v21n3p209-213>
6. Ozkan H E, Paul P , Derksen R C, Zhu H. (2012). Influence of application equipment on deposition of spray droplets in wheat canopy. Aspects of Applied Biology 114, 2012 International Advances in Pesticide Application 317
7. Mesterházy A, Tóth B, Varga M, Bartók T, Szabó-Hevér A, Farády L, Lehoczki-Krsjak S. (2011). Role of Fungicides, Application of Nozzle Types, and the Resistance Level of Wheat Varieties in the Control of Fusarium Head Blight and Deoxynivalenol. Toxins, 2011(3), pp.1453-1483
8. [Juan J. Olivet](#), [Juana Villalba](#) and [Jorge Volpi](#). (2017). Evaluation of spray nozzles for fungicidal control of tan spot in wheat Crop and Pasture Science 68(7):591-598. 2017 <https://doi.org/10.1071/CP17171>