Inspection method for spray rate controllers in Flanders (Belgium)

Declercq, J.; Nuyttens, D.
Institute for Agricultural and Fisheries Research (ILVO), Technology & Food Science Unit - Agricultural Engineering – Burg. Van Gansberghelaan 115, bus 1 – B-9820 Merelbeke, Belgium
DOI 10.5073/jka.2012.439.016

Summary
In Belgium, the inspection of sprayers is performed by official and mobile teams ruled by two inspection authorities. The management of the inspection is done by the Federal Ministry for Consumer Protection, Public Health and the Environment (FAVV). In the Flemish region the inspection is delegated to the Institute for Agricultural and Fisheries Research (ILVO). In Belgium, the mandatory inspection of sprayers was started up in 1996 and the 6th inspection cycle (2011-2012-2013) is currently running.
In the past decade the number of sprayers equipped with a spray rate controller, increased significantly. In the first inspection cycle (1996-1997-1998), only 4.58% of the sprayers were equipped with a spray rate controller in Flanders. In the fifth inspection cycle (2008-2009-2010), this percentage increased significantly to 20.37%.
As the original inspection method for spray rate controllers showed some lacks and was time consuming, ILVO developed a simple and reliable method for testing rate controllers used on field and orchard sprayers.
Key words**:** sprayers, inspection, rate controller

Introduction
Since 1995 sprayer inspection is mandatory in Belgium which makes it one of the forerunners in Europe. The items that need to be inspected and the requirements are completely described in the Belgian legislation. This legislation also describes the inspection protocol for a limited number of items, but for most items there is no specific description on how to inspect them.
Consequently, inspection authorities need to develop procedures describing in detail how to perform the inspection. This is also one of the reasons why Belgian inspection authorities need to have an ISO 17020 accreditation so that inspection methods are traceable and transparent.
One of the items that must be inspected are spray rate controllers on sprayers.
Due to the increasing number of sprayers fitted with a rate controller ILVO felt the need to develop a new time saving and accurate inspection method for spray rate controllers.

Fig. 1. Inspection van with lift and test equipment (Flanders).

Belgian law : spray rate controllers inspection limits

The inspection of spray rate controllers is described as follows in the Belgian legislation:
"Mechanical and electronic regulation systems with a flow equal with the driving speed and the electronic indication from the sprayed volume per hectare are inspected (respectively D.P.A.m and D.P.A.e systems). The driving speed and the sprayed amount during a certain period are determined. The amount that is sprayed in reality is calculated and compared with the set values on the rate controller. When the difference between the amount that is sprayed in reality with the set value on the rate controller is more than 10% then the sprayer is rejected."
Hence, there is no description on how to inspect this item and as a consequence, inspection authorities need to set up an inspection protocol themselves.

Original inspection method for spray rate controllers (until 2009) .

To check application rate and sprayer speed, the following method was used till 2009:
Two marking points were placed with a distance of 100 m in between with at least 10 to 20 m of free "run in" track before the start of the 100 m track. Farmers/fruit-growers were asked to program their usual application rate and to start a first short run (e.g. about 20 m) at a constant speed. During this run, the rate controller could adjust the control valve to obtain the desired application rate. After this run in, the farmer was asked to stop spraying by shutting of the main valve and the inspector placed 3 spray test sacs underneath three nozzles (Fig. 2).

Fig. 2. Spraytest bags.

In a second run, the driver was asked to start driving again at constant speed and to open the main valve from the sprayer just after passing the first marking point and at the same moment the inspector started up the stopwatch. When finishing the 100 m track, spraying and stopwatch were stopped. The spraytest bags were removed and the contents of the bags were poured into a measuring cup with accurate scaling. The mean value was calculated and al the measured values were putted into the inspection software to calculate the actual spray rate and compare it with the value set in the spray rate controller.

Fig. 3. Screen shot from the spray rate calculation program.

As one can see this method has a lot of disadvantages and also entails some inaccuracies. Firstly, when re-opening the main valve at the first marking point the rate controller shall have to (re)regulate some meters to obtain the desired rate. Further on the driver needs to start and stop spraying at the moment of passing the marking points and, at the same moment, he has to pay full attention on maintaining the desired speed. Finally, there is also the inaccuracy of the inspector to start-stop the stopwatch, and read out the measuring cup. To compensate those inaccuracies, a long test track is used (100m+20m). With a consequence that it is difficult to find a suitable location to perform this test.

New inspection method for spray rate controllers in Flanders (from 2010).

To overcome the problems involved with the original inspection method using the spraytest bags and the stopwatch, a new testing device was developed at ILVO. Main goal was to reduce the length of the test track and to decrease test time while maintaining or even improving accuracy. Furthermore the test device needed to be easy to use even for a "non professional".
To obtain these objectives, ILVO developed an accurate and reliable method where an "on the go" measurement was possible. In this way, the main inaccuracy caused by reopening of the main valve at first marking point and rate (re)regulation first meters of the test strip is eliminated.
The measuring device consists of a flowmeter attached between a nozzle holder on the sprayer and a pre-measured nozzle (Fig. 4). As already mentioned, in Belgium nozzle flow is measured separately on a nozzle test bench during the inspection so the average nozzle flow of a nozzle set is known. The pre-measured nozzle is selected as a nozzle with a flow rate close to the average flow rate. So measuring the flow through this nozzle in combination with a speed measurement, makes it possible to determine the spray volume rate in an accurate way. The starting and stopping of the measurement is still done manually for a track length of 25-50 m but the start/stop of the time measurement is coupled with the start/stop of the volume rate measurement and is performed by the inspector.
Some preliminary tests were done in 2008-2009 with different types of flowmeters and read- out units and two different prototypes were made. Finally in 2010 five final versions were made, three for daily use (three inspection teams) and two spares .

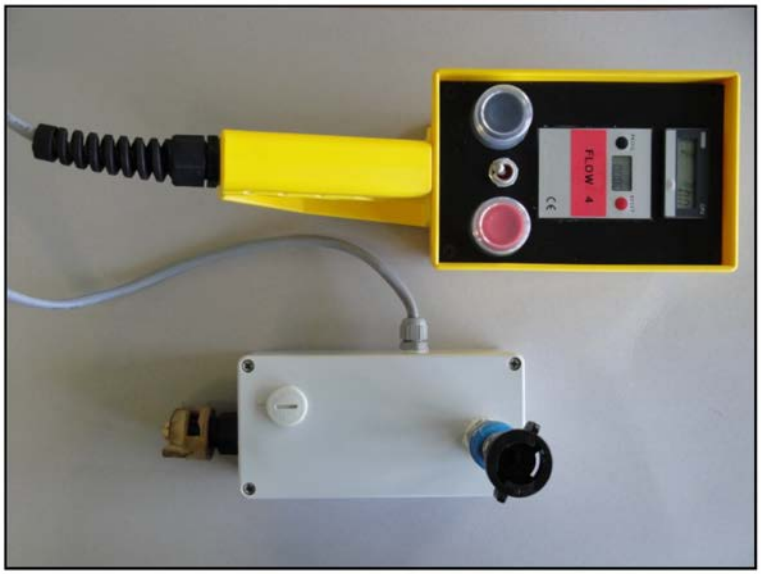

Fig. 4. Spray rate controller inspection eauipment.

As shown in Fig. 4 the testing equipment exists of a flowmeter that is built in into a polycarbonate housing with at the inlet of the flowmeter a universal festo adaptor and at the outlet of the flowmeter a standard TeeJet nozzle holder.
The flowmeter is wired to a spray rate/volume read out unit through a double pole toggle switch which can interrupt the pulses from the flowmeter and also commands the stopwatch. Stopwatch and read out unit are powered by a simple long lasting lithium-ion battery and are built into a watertight handheld unit. The wire between flowmeter and read out unit is about 10m long and watertight fixed to flowmeter housing and handheld unit. The flowmeter has a measuring range from 0.25 l/min to 5.5 l/min and is calibrated in the BELAC accredited Spray Tech Lab at a flowrate of 1.5 l/min with a calibration accuracy of at least +/- 0.5%. Accuracy at flows of minimum 0.75l/min and maximum 2l/min is still within a tolerance from +/- 1% (EN13790 asks +/- 1.5%).

Usage of the testing unit .

The test procedure consists of different steps:

1. At first two marking points are placed but instead of the 100 m that were placed with the original method, 50 m is sufficient and even distances of 25 m give satisfying results on condition that the "run in" of the test track is long enough to obtain a stable rate and speed.
2. The farmer/fruit-grower is asked to program a spray application rate that lies in the range of 0.75 l/min to 2l/min of the flowmeter (1.5 l/min nozzle flow rate is recommended).
3. The inspector mounts the flowmeter with the pre-measured nozzle on the spray boom and takes place in the tractor/sprayer cab with the handheld unit. The volume and the stopwatch on the handheld unit are set to zero and the farmer/fruit grower is asked to start spraying at a constant speed.
4. When passing the first marking point the measurement (stopwatch and volume) is started up "on the go" by switching on the toggle switch. During spraying the display can be changed between real time flow rate and total sprayed volume so a pre check is possible.
5. By passing the second marking point toggle switch is switched off and the farmer/fruit grower is asked to stop spraying.
6. Afterwards all measured and programmed values are putted into the inspection software and the real flow rate is calculated and compared with the desired flow rate.

Fig. 5. Testing in practice.

As one can see the complete inspection procedure has been shortened and the new method has a lot of advantages. The driver can completely concentrate on driving and maintaining a constant speed. There is also no need to stop and restart at the first marking point resulting in a more accurate measurement and saved time. Also important to mention is that while performing the test the real time flow rate can be read out so while driving the inspector can already determine if the spray rate controller works correct. Furthermore after testing, the volume can be read out directly with a known accuracy.
Moreover, the device can also be used to measure the real time nozzle flow rate of all nozzles on the sprayer, although originally it was not designed for this purpose.
However the equipment has some smaller disadvantages such as the limited measuring range due to the one point calibration (0.75l/min – 2l/min) and it also needs maintenance and validation on a regularly base.

Conclusions

After 2 years of daily use we can conclude that the testing equipment fulfils our needs and that the main goals are achieved. The test track is shortened and the procedure is less time consuming with the same or even a higher accuracy.

References

Braekman, P., Huyghebaert, B., Sonck, B., 2004: The Belgian way of organising a compulsory inspection of sprayers. I European Workshop, Standardized Procedure for Inspection of Sprayers in Europe/SPISE, Braunschweig– Germany 5 pp.

Huyghebaert, B., Mostade, O., Braekman, P., 2004: Overview of the Sprayer Inspection in Belgium. I European Workshop, Standardized Procedure for Inspection of Sprayers in Europe/SPISE, Braunschweig– Germany 5 pp.

Declercq, J., Huyghebaert, B., Nuyttens, D., 2009: An overview of the compulsory inspection of sprayers in Belgium. III European Workshop, Standardized Procedure for Inspection of Sprayers in Europe/SPISE, Brno, 1pp.

Declercq, J., Huyghebaert, B., Nuyttens, D., 2009: An overview of the defects on tested field sprayers in Belgium. III European Workshop, Standardized Procedure for Inspection of Sprayers in Europe/SPISE, Brno 7 pp.

ISO 17020, 2004: General criteria for the operation of various types of bodies performing inspection.