

Assessment of the sprayer inspection results in Catalonia

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Abstract

The objective of the sprayer inspection is to reduce the risk for the environment and bystanders, since it is said that sprayers with malfunctions cause a reduction of the sprayer application efficiency. In order to know the condition of the sprayers before the inspection, the results of 11712 sprayers, inspected between 2014 and 2016 in Catalonia, were assessed. The average rate of unfavourable inspections was 38%

The most frequent defect found in the inspections was a wrong pressure gauge, mainly because its error was greater than the requirements of the inspection standard. Other common malfunctions were related with safety aspects, like missing or deteriorated guards in power transmission and other moving parts. In air-assisted sprayers, worn or clogged nozzles were also responsible for many unfavourable inspections, whereas in boom sprayers missing filters was a frequent cause for them.

Since an important number of faults and malfunctions are corrected during the inspection, it can be stated that the inspection of sprayers in use improve the efficiency of the spray application, both reducing the risk for the environment and allowing a good control of pests and diseases with the minimum pesticide input.

Key words: boom sprayer, air-assisted sprayer, inspection, Catalonia

1. Introduction

The 2009/128/CE directive for the sustainable use of pesticides makes the inspection of sprayers in use compulsory in all the member states. According to this directive, the reason for the compulsory inspection is the negative effects of pesticide application on the human health and the environment. The directive was incorporated into the Spanish law by and act in 2011. In this act it is established, among other things, what kind of sprayers have to be inspected. These are mobile application equipment for agricultural and other uses –horizontal boom sprayers, sprayers for bush and tree crops and dusters-, aerial application equipment and sprayers for greenhouses. Following the risk assessment requirements of the directive, handheld sprayers are excluded.

All the sprayers to be inspected –new or in use- have to be included in an official list since 2009, known as ROMA, for the Spanish acronym. This database has shown to be very useful for the implementation of the inspection programmes. It includes information about the kind of sprayer and its owner. In this way, the distribution of sprayers throughout the country can be known. To assure the accuracy of the list, if a sprayer is not included, the inspection workshop is not allowed to carry out the inspection.

As it is explained later, surprisingly there is an important number of sprayers included in the list, which have not passed the inspection yet. To tackle this issue, at the beginning of 2018, a field control of the sprayers was established in Catalonia. A working sprayer can be stopped to check if it has passed the inspection. If not, the owner can be fined.

2. Inspection workshops

As it is established in the Spanish law, inspections are carried out by the inspection workshops, which are authorised by the regions. At present, there are 18 authorised workshops in Catalonia to carry out sprayer inspections. Every inspection workshop has to be composed by at least one director and all the necessary inspectors and auxiliary workers for their inspection vehicles. The staff of the workshops has to pass a training course and have to have the required previous academic qualification, which is different for directors and inspectors.

The quality of the workshops activity is assured by the regional administration. In Catalonia, one control visit at the inspection site is scheduled to every 200 inspections or at least one every three months. In these controls, it is checked that the inspections are carried out according to the approved methodology and that the right inspection equipment is used.

3. The inspection programme in Catalonia

The Catalan inspection programme was set up to achieve the inspection of all the pesticide application equipment by the deadline established by the European directive. According to the number of sprayers included in the official list (ROMA) at the end of 2014 and taking into account their geographical distribution, a schedule for the inspection of the sprayers in a quarterly basis was prepared, starting at the second quarter of 2015. At the beginning of each quarter, communications were sent by post to the owners of the application equipment of the areas where the inspections were to be carried out. It was informed of the obligation of carrying out the inspection during the period and a list of the authorised inspection workshops was also included.

Figure 1 shows the comparison between the number of pesticide application equipment, which was planned to be inspected every term, and the number of inspections that were finally made. The amount of inspections carried out during the 4 quarters of the programme was lower than expected. However, it is noticed that at the beginning –third quarter of 2015- the number of inspections clearly increases. This must be triggered by the writing communications that were sent to the owners of the sprayers. Moreover, it can also be noticed that after the end of the programme, in the second quarter of 2016, inspections were also being carried out at a brisk pace. The inspections made before the beginning of the programme are related with a previous communication to sprayer owners in 2014.

The number of inspections carried out by the different workshops is depicted in figure 2, showing separately six of them, those who carried out most of the inspections. The trend in this figure is similar to that of the previous one, because the number of inspections of some of the workshops increases from the third quarter of 2015 on, when the inspection programme was started. The important differences in the number of inspections by some workshops in the same period of time, can be explained by the number of inspection vehicles used simultaneously by each workshop.

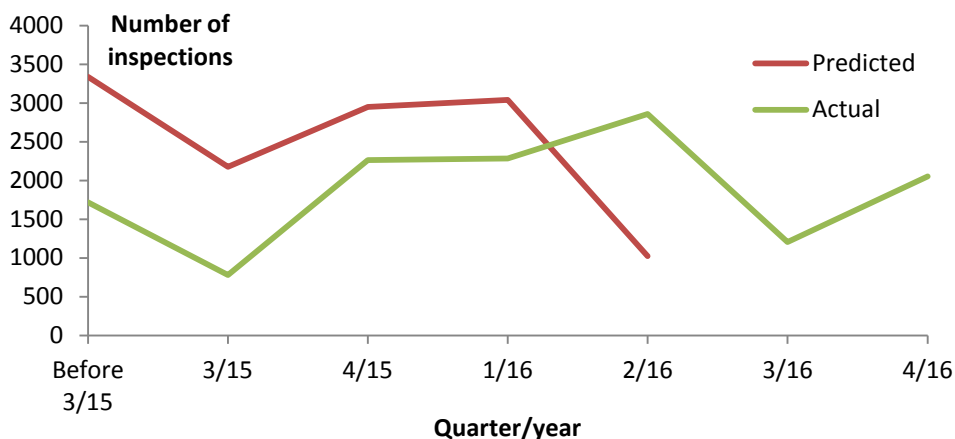


Figure 1. Quarterly evolution of the inspections predicted in the programme and the actual inspections

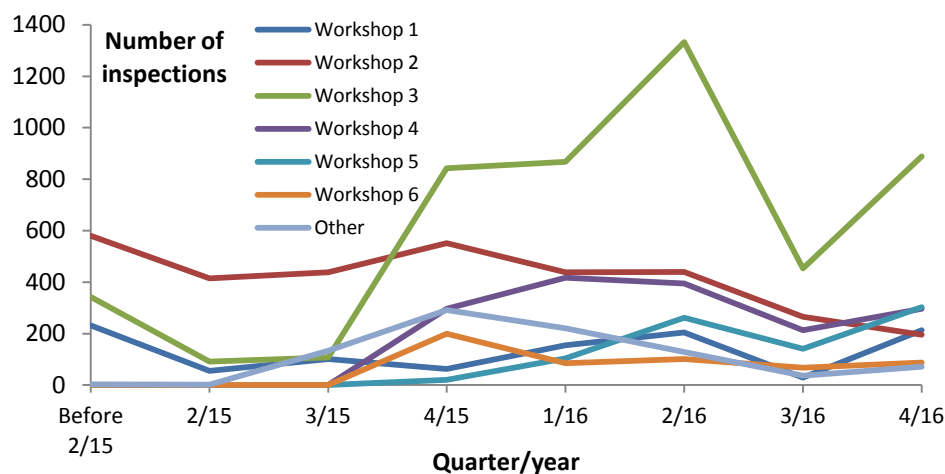


Figure 2. Quarterly evolution of the inspections carried out by the different workshops

The inspections used for this assessment were carried out according to the methodology established in the guidelines for the inspection of sprayers in use, available at the webpage of the Spanish Ministry. These guidelines were based on the EN standard 13790:2003, and they were intended for the inspections of boom and air-assisted sprayers, dusters and handheld spray guns and lances.

A software was also provided by the Ministry to the inspection workshops. By means of this software, it is possible to enter the information and measured values during the inspection and, at the end, it is possible to get a print out of the inspection report, which can be delivered to the sprayer operator. A text code, made up of 250 characters, is also automatically created for each inspection. It includes the sprayer identification, the date and the result of the inspection. Should the sprayer fail the inspection, information about the malfunction will also be recorded. All these codes have to be sent to the regulatory body, which keeps them in a database.

4. Assessment of the inspection results

A text file composed by all the codes of each inspection was analysed using the R software (The R Foundation). The objective was to get information about the development of the inspection programme and to assess the influence of the inspection of the sprayers in use in the improvement of the pesticide application equipment.

A pool of 11712 inspections carried out in Catalonia from 2014 to 2016 were used for the assessment. 4488 (38%) of them were reported as unfavourable inspections. Nevertheless, almost all passed a second inspection, after the malfunction had been repaired. The percentage of failed inspections provided by the different inspection workshops is similar, ranging from 35% to 45%. However, in some of them it doesn't reach 25%.

It has to be taken into account that many sprayers were already checked before the inspection. If some visual defects were spotted, it is thought that they were fixed before carrying out the inspection. Therefore, the actual percentage of non-compliant sprayers is likely to be higher than the one that is obtained from the inspection results. It is also possible that some sprayers with minor defects were not reported as unfavourable at the end of the inspection, because they were fixed in the same moment, instead of waiting for a second inspection.

4.1. Inspections according to the type of pesticide application equipment

Table 1 shows the number of the different types of inspected pesticide application equipment and, for each one, the percentage of unfavourable inspections is also depicted. It can be noticed that most of the inspections were made on boom and air-assisted sprayers, since they are the most used kinds of sprayers. Besides, the total numbers for both type of sprayers are very similar, as they are the corresponding percentages of unfavourable inspections. The third group by number of inspections is made up by the dusters, which are mainly used in vineyards. However the quantity of this kind of application equipment is low compared with the two previous groups. There is also a clear difference in the percentage of unfavourable inspections. In the case of dusters the percentage is around half of that of the sprayers. Some pneumatic sprayers, which are also mainly used in the vineyards, were also inspected. And just as an oddity, there is one reported inspection of a centrifugal sprayer and two of electrostatic sprayers.

Table 1. Number of inspected equipment and the corresponding percentage of unfavourable inspections

Type of pesticide application equipment	Number of inspected equipment	Percentage of unfavourable inspections
Boom sprayers	5291	39,6
Air-assisted sprayers	5671	39,4
Pneumatic sprayers	70	20,0
Centrifugal sprayers	1	0
Electrostatic sprayers	2	0
Dusters	677	20,2

4.2. Pesticide application equipment malfunction

Figure 3 shows the sprayer defect occurrence, which is reported in the unfavourable inspections. The most frequent malfunction is related with the measurements systems of the equipment, mainly faulty pressure gauges, which are not compliant with the requirements of the inspection standard. For instance, the scale of the pressure indicator can be inadequate –more than 0.2 bar in horizontal boom sprayers and more than 1.0 bar in sprayers for bush and tree crops. It is also frequently reported that the accuracy of the machine pressure gauge, which is measured during the inspection, is worse than required. Whatever the malfunction of the manometer, it has to be replaced by a new one.

The second group of defects spotted during the inspection is related with the protection of the operator. They are mainly related with the guards of the moving parts of the machine. These elements can be deteriorated or, in some cases, they are missing. The guard of the power take-off drive shaft, between the tractor and the machines, is usually deteriorated with the use. In many cases, however, it had been replaced before the inspection. Therefore, the faults that are more likely to be reported during the inspection are related with the guards of other power transmission parts. For instance, the power input connection before the sprayer pump and the fan power transmission. Other faulty safety devices are also reported in the sprayer fan itself, if guards to prevent the access are non-compliant.

Another important group of defects has to do with the filters. According with the inspection standard requirements, there shall be at least one filter on the discharge side of the pump –pressure section of the sprayer manifold, between the pump and the nozzles- and one filter on the suction side, if the sprayer is equipped with positive displacement pumps. Many small boom sprayers used for band spray applications in tree and bush crops, or equipped with guns and lances, don't have filters in the required position. It is also thought that, sometimes, the missing filters were mounted on the sprayers before the inspection and, therefore, the reported defects during the inspection are not an accurate indicator of the actual condition of the sprayers in use.

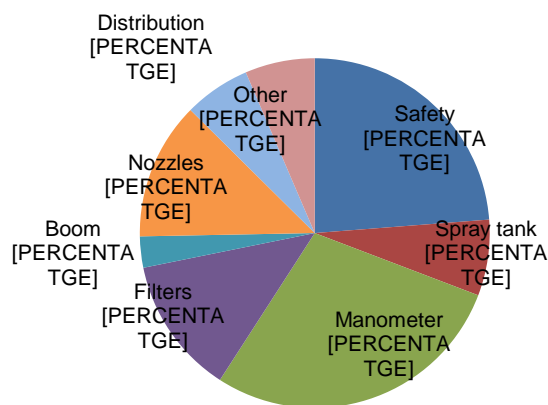


Figure 3. Percentage of defects found during the inspection of all types of pesticide application equipment

Nozzle malfunction reported during the inspections is mainly caused by the excessive deviation between the measured and the nominal nozzle flow rate. If the nominal flow rate is not known, the deviation is computed in relation to the average flow rate of all the nozzles of same type mounted on the sprayer. The cause of this excessive deviation can be either nozzle wear or clogging, depending if the measured values are higher or lower than expected. In case of excessive wear, the sprayer nozzles have to be replaced by new ones. Old hollow cone nozzles, with an adjustable spray jet width, are usually non-compliant with the flow rate deviation requirements of the inspection standard, since the flow rate depends on the jet width. In this case, it is recommended to replace these nozzles by new hollow cone models.

The reported faults related with the sprayer tank are mainly due to a bad condition of the tank contents indicator. It is very common that plastic sprayer tanks are equipped with a translucent band, through which the liquid level inside can be seen. With the use, this band becomes too dark to see through it. In this case, to pass the inspection it is necessary to mount another tank contents indicator, like a transparent plastic hose outside the tank, connected with the liquid inside.

Finally, the defects included in the distribution section are mainly caused by an excessive pressure loss between the measuring point, in the place where the sprayer manometer is mounted, and the position

of the nozzles. There can be many reasons for this, like for instance, an excessive pressure loss along the sprayer pipes and hoses, or a pressure loss in a point of the sprayer manifold, like an electro valve or a connection. If the cause cannot be found, the connection point of the manometer can be moved closer to the nozzles, so that the pressure loss will be reduced.

For a more detailed assessment of the defects and malfunctions reported during the inspections, figure 4 shows the differences found between horizontal boom and air-assisted sprayers. In relation with the filters, the percentage of defects is higher in boom sprayers. This may be caused, as it is said before, by the design of the small sprayers used for herbicide applications in tree and bush crops. On the other hand, air-assisted sprayer inspections report a higher number of nozzle defects than boom sprayers. For air-assisted sprayers, the malfunction of the blowing unit is also indicated, although the percentage is very low. This can be explained by the fact that defects in the blowing unit are mainly related with safety devices, which are already reported in the safety section.

In relation to the inspection of dusters, only defects related with the safety devices were reported, both in the power transmission and the blowing unit. Since these machines are designed for the application of pesticide dust, there are no pressure measuring devices, like the manometers of the sprayers. Besides, the flow rate of the application unit is not measured either. The compliance is checked by inspection and functional test.

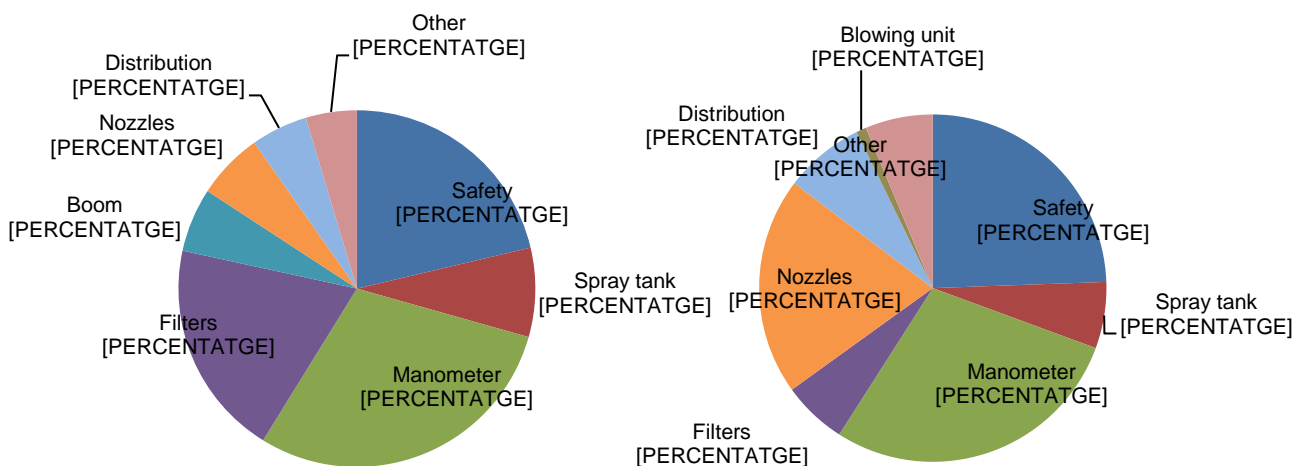


Figure 4. Percentage of defects found in the inspection of horizontal boom sprayers (left) and sprayers for bush and tree crops

5. Final comments

According to the 128/2009/CE directive, all pesticide application equipment should have been inspected by the end of 2016 in all member states. In Catalonia, as in other countries, there is still a significant number of sprayers that have not passed the compulsory inspection, but they are still used in crop protection.

As it has been shown in this paper, most of inspections were carried out in horizontal boom sprayers and in sprayers for bush and tree crops. In both types of machines, the percentage of unfavourable inspections was roughly 40%.

Therefore, the amount of defects and malfunctions that are corrected during the inspections is important. The improvement of the application equipment should have a clear positive effect on the quality of the pesticide applications, because of an improvement of the efficiency and a decrease of the risk on the human health and the environment.