Tarım Makinaları Bilimi Dergisi (Journal of Agricultural Machinery Science)
2017, 13 (3),171-175

A Study on Inspection of Sprayers in Use in Izmir and Manisa (Turkey)*

Erkan URKAN[1], Huseyin GULER[1], Goksel Fatih PEKITKAN[2], Mujdat TOZAN[1]
[1]Ege University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies of Engineering, Izmir/TURKEY
[2]Dicle University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies of Engineering, Diyarbakir/TURKEY
Corresponding author: erkan.urkan@ege.edu.tr

Geliş Tarihi (Received): 22.06.2017 Kabul Tarihi (Accepted): 21.09.2017

Abstract: Pesticides should be applied as accurately as possible for environmental concern. For this aim, not only the quality of plant protection products, but also the application equipment is very important. The technical condition of the sprayer is one of the important elements of successful application. By the time, some parts of the sprayers get worn out. These parts are nozzles, filters, pipes, connections, etc. Unless sprayers are checked periodically, these defects cannot be corrected.
In the European Union (EU) there are already valid standards for testing sprayers in use. In September 2015, EN ISO 13790 was replaced with new standards. These are; EN ISO 16122-1:2015-Agricultural and forestry machinery - Inspection of sprayers in use, Part 2: Horizontal Boom Sprayers and Part 3: Sprayers for Bush and Tree Crops. According to these standards the sprayers in use are tested periodically in the EU. These controls are fulfilled by the registered test centers which can be mobile or stationary all around Europe. In Turkey there are more than 300.000 pieces PTO driven sprayers in use. These sprayers are not inspected by any authority. Izmir and its region play an important role in Turkish Agriculture. In the study, a total of 30 used sprayers were investigated which were produced by 8 different manufacturers and located in Izmir and Manisa. Sprayers in use around Izmir had many problems which threatened the environment and public health and should be inspected immediately with the force of legal authorities.
In this study, according to standards EN ISO 13790-Parts 1-2 and EN ISO 16122-Parts 1-2-3, mounted or trailed orchard and field sprayers were inspected and the defects of these sprayers were evaluated. As a result of this study all inspected sprayers should be banned according to current evaluation criteria. For this reason, further studies should be done on different areas for determining the conditions of the sprayers and accordingly proper steps should be taken.
Key words: Periodic test, used sprayers, application technique, EN ISO 13790, EN ISO 16122.

INTRODUCTION

Many problems may occur on the sprayers which are not checked periodically. Some of these problems can be important ones such as the decrease of pump performance, nozzle defects, filter defects, cracks and leakages on hoses, manometer malfunction.

Non-uniform spraying causes lower biological efficiency. Therefore, spraying is repeated causing more pesticide residue on the crops than the limits. All the produced or imported sprayers in our country are licensed by Directorate of Agricultural Equipment and Machinery Test Center (Ankara-Turkey) under Minister of Food, Agriculture and Livestock. Every license is valid for 5 years. The tests related to the periodical controls of sprayers in Europe have started many years ago. For example, field sprayers' mandatory tests have started in 1993 whilst vineyard sprayers' mandatory tests have started in 2002 in Germany (Ganzelmeier H. and Wehmann, 2004; Wehmann, 2009). These tests are held as mobile or stationary in test centers by authorities.

*This research was supported by Ege University Directorate of Scientific Research Projects (Project No: 2012-ZRF-010).

Celen and Demir (2005) has notified that the sprayers in randomly selected agriculture firms in Tekirdag were controlled and 79% of them were found to be in good condition and 28% of the nozzles had blockage.

Ozpinar et al. (2003), have researched the technical and working properties as well as set up and usage conditions of sprayers used in Canakkale-Turkey in 2001 and 2002. In the research, 12% of nozzle plates and 25% of filters were found rusty and defected. Additionally, the distances between the nozzles were not even and 56% of the tested sprayers' manometers were either broken or lack of accuracy.

In Cukurova University (Adana-Turkey), regarding the periodical controls of sprayers with the participation of university representatives, researchers who study on the subject and the representatives of Ministry of Agriculture was held a workshop in 2010. In the conclusion report of the workshop, it was stated that a mobile station at a pilot area was going to be set and the periodical controls were certainly going to be held by ministry authorities. But it wasn't stated in the report when these controls would be carried into action. For this reason, this type of practices should be started as soon as possible to be able to reveal the sprayers' conditions in our country.

MATERIAL and METHODS

In the study, the firms in Izmir (Turkey) and Manisa (Turkey) which have sprayers were determined. Researches and controls were made on these sprayers based on the standards of TS EN ISO 16122 Agriculture and forest sprayers – Control of the Sprayer in use – Section 2 and 3 and TS EN 13790 Section 1 and 2 which is no longer in active since 2015. According to the standards measurements were done by eye, inspections and functional tests. During these measurements nozzle flow rate meter, manometer calibration device, tachometer, test standards, check lists, tape measure, measurement cylinders and various hand tools were used.

In the study, a total of 30 used sprayers were investigated which were produced by 8 different manufacturers and located in Izmir and Manisa (Table 1). These sprayers are in use in the units of Ege University (Izmir-Turkey), Bornova Olive Research Institute (İzmir-Turkey), sprayer services and private farms.

Table 1. Producer and numbers of the sprayers that tested during the inspections

Producer	Place of Production	Number of checked
Agrotek	Manisa	11
Holsan	Kocaeli	1
Maxcharge	Watkinsville-ABD	1
Ontar	Konya	2
Parlayan	Manisa	3
Taral	Istanbul	5
Tarmak	Manisa	4
Zirmak	Bursa	3
	Total	30

During the inspections, various numbers of orchard sprayers, spray guns, field sprayers, and electrostatic sprayer were investigated and numbers of each are specified in Table 2 below.

Table 2. Type and number of sprayers inspected that during the tests

Type of Sprayer	Number
Field sprayer	4
Air-assisted sprayer	21
Field sprayer with spray gun	4
Electrostatic	1
Total	30

RESULTS and DISCUSSION

The sprayers investigated in the research were produced between 1986 and 2013 and the average production year was determined to be 2005 (Figure 1).

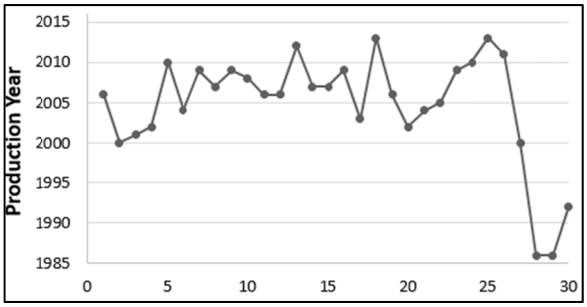

Figure 1. The production years of the sprayers that inspected during the tests

The numbers of the sprayers per production year can be seen in this figure. The ages of the sprayers were seen in Figure 2. During the inspections, 11 of the sprayers are the range of 6-10 years old, 10 of them are

in the range of 11-15 years old. Only 3 of them is younger than 5 years old and 6 of them is older than 20 years.

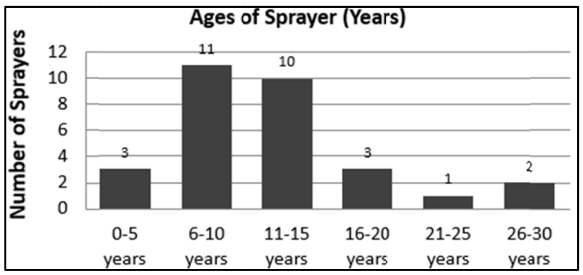

Figure 2. Ages of the sprayers that inspected during the tests

When the tank capacities were evaluated, half of the sprayers had 400 L capacity, and 7 of them had the capacity from 1200 to 2000 L (Figure 3).

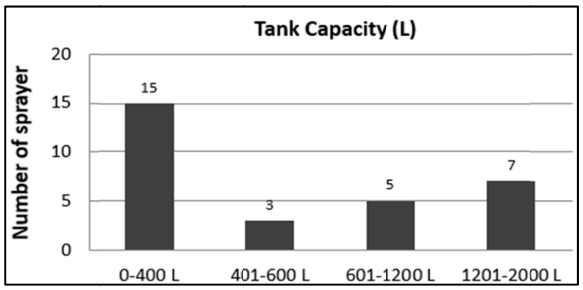

Figure 3. Tank capacity of the sprayers inspected during the tests

The inspected sprayers had 2 types of connection style to the tractors. 20 of them were connected to the tractor with the help of three-point hitch system, and the 10 of them were trailed type of sprayers (Figure 4).

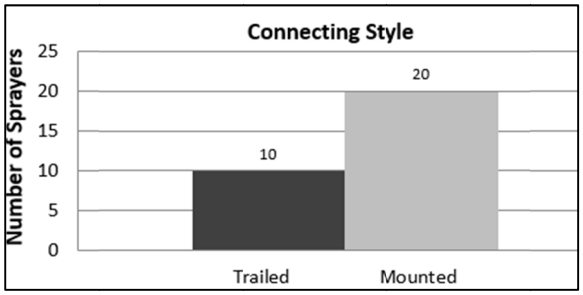

Figure 4. Connection style of the sprayers to the tractor

Orchard sprayers had different fan sizes. The largest fan had 90 cm diameter and the smallest fan had 70 cm diameter (Figure 5). All of the fans were axial type and made of cast (fixed fan) and plastic (adjustable fan) raw material. 9 of the sprayers' blade angle could be changed by a transmission system in 2 stages. These stages were for high speed and low speed of fan. The rest of the sprayers had fixed blade angle.

Only one of the sprayer had a centrifugal pump (Electrostatic sprayer) and the rest had piston-membrane pumps. 25 of the pumps had 3 and 4 pistons and the others had 5 or 6 pistons.

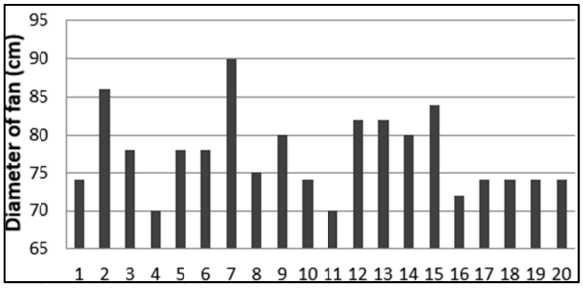

Figure 5. Diameter of fans on the orchard sprayers

During the inspections the nozzles and filters were cleaned. Although they were cleaned the horizontal distribution (for field sprayers) was not acceptable ranges. When the lid (basket) filter were checked 10 of the sprayers had no lid filter. The rest of them had and the condition of the filters were acceptable (Figure 6).

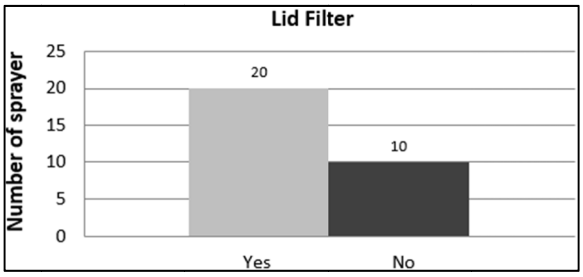

Figure 6. Condition of the lid filter on the sprayers

In the sprayers, tank level indicators were observed (Figure 7). Only 4 of the tank level indicators could be read while 2 of them could not be seen by the driver. The remaining 24 indicators could not be read.

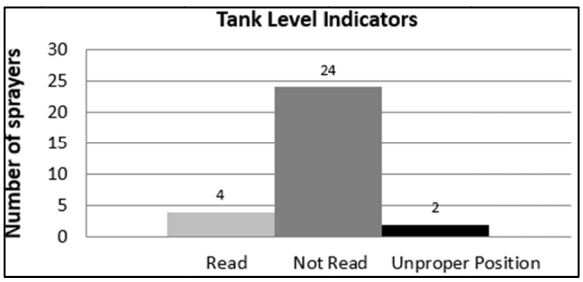

Figure 7. The conditions of the tank level indicators of the sprayers

Only 6 of the sprayers which were controlled in the research had shaft protectors and 7 of the sprayers had

PTO protectors. (Figure 8 and 9). 19 of the sprayers' pump had no label. The specifications of these pumps could not be read during the inspections (Figure 10).

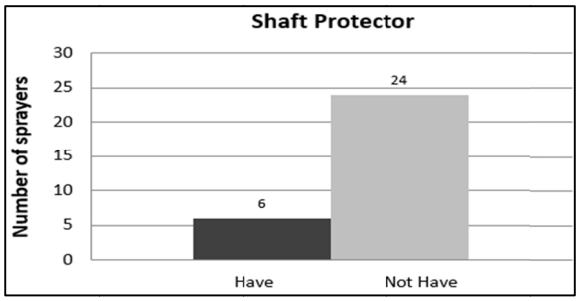

Figure 8. The conditions of the shaft protectors of the sprayers

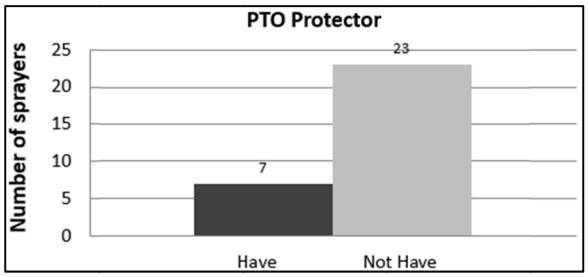

Figure 9. The existence of the PTO protectors of the sprayers

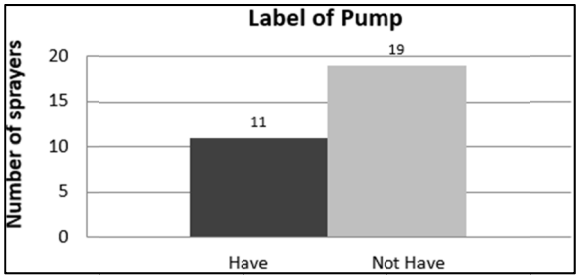

Figure 10. The condition of the pump's labels

Only 1 of the sprayers had steady hose protector whilst 7 of them had worn out or torn. 22 of them did not have any hose protector at all (Figure 11).

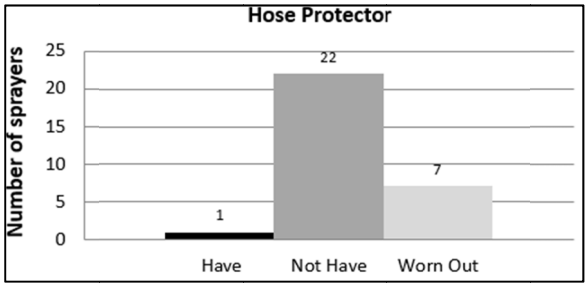

Figure 11. The existence of the hose protectors of the sprayers

Manometers with the diameter of 64 mm were used in all the sprayers. The scales of these manometers were observed to be the same both in field and orchard sprayers. Results of manometer calibration are given in Figure 12.

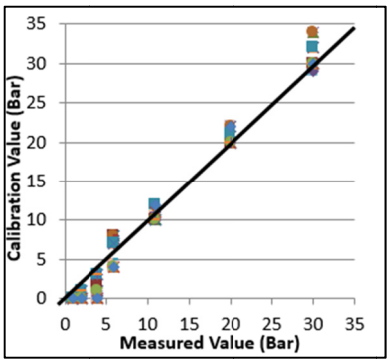

Figure 12. Manometer calibration results of the sprayers

Moreover, some manometers were observed to be affected by the sun and the sprayed chemicals. For this reason, 9 of the 30 manometers were determined as unreadable and 1 of them to be broken (Figure 13).

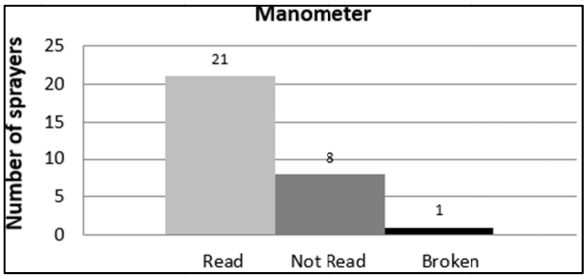

Figure 13. The conditions of the manometers of the sprayers

All the manometers which were tested with the help of manometer test stand had the difference more than 10% calibrated pressure (Figure 14).

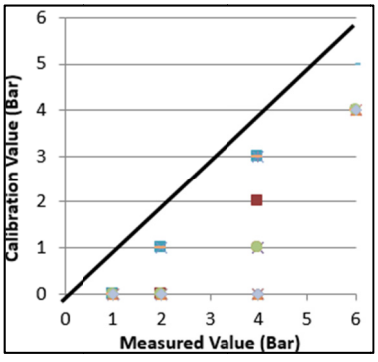

Figure 14. Calibration test of the manometers that inspected during the tests (up to 6 bar)

CONCLUSIONS

During the inspections, especially the field sprayers had different size nozzles on the spray boom. And many nozzles had no filter, broken or blocked. Un-proper condition and different sized nozzles effect cross distribution negatively. The owner of the sprayers or the staff of the services informed about the importance of the nozzles.

Nearly all of the sprayers (26 sprayers) did not have proper filters. Some filters were blocked and they were cleaned but many sprayers' filters were not on their places.

Although anti-drip nozzles very important to protect environment only 9 of the sprayer had anti-drip nozzles.

Leakages were seen on many parts of the sprayers. Especially on the spray guns. And it is also important for the applicator's health.

Both field and orchard sprayers had the same diameter of manometers. Although the diameter of the manometers was acceptable according to the standard, the scale of them were not acceptable. Fields sprayers need lower pressures orchard sprayer need higher pressures. The sensitivity of the manometer should be different according to working pressure. But all the sprayers had the same manometer with the same scale.

The level of the spray liquid must be seen from the operators driving position. Unfortunately, 26 of the sprayers has not get tank level indicator. With these sprayers the operator cannot see the water level in the tank. It causes many problems on the application and safety of the application.

Agitation is very important for the mixing of the pesticide with water. Agitation control was made by eye inspection. 4 of the sprayers had no circulation in the tank and 3 of them had no agitation line. Without agitation line spraying is not possible.

The periodical control of the sprayers is very important for improving the efficiency of the application. Especially in Izmir and Manisa, the sun has negative effects on the sprayers. For instance, fractures on the hoses, cracks in the tanks, and worn out parts on the whole plastic component. For this reason, sprayers should be stored under the shelter. Especially defected manometers should be renewed. Nozzles on the same line with different sizes must be uniform. After the application, the sprayers were observed to not be washed with clean water. Serious amounts of pesticide residues were observed to be left in the tanks. Regular cleanings should be done in order not to cause corrosion because of these residual chemicals.

Especially in EU member countries, controls for sprayers that had been used for many years are being worked on. In our country, some meetings were held on this issue by the joining of Ministry, universities and producers but no further steps were taken. Bayat et al. (2008) stated that in order to confirm the standards, sprayers should go through serious maintenance and most parts should be renewed.

As a result of this study all inspected sprayers should be banned according to current evaluation criteria. For this reason, further studies should be done on different areas for determining the conditions of the sprayers and accordingly proper steps should be taken.

Acknowledge

This research was supported by Ege University Directorate of Scientific Research Projects (Project No: 2012-ZRF-010).

REFERENCES

Bayat A., Soysal A., Sen A., S., 2008. A Survey Study on Inspection of Field and Air-Assisted Orchard Sprayers in Use. Tarim Makinalari Bilimi Dergisi (Journal of Agricultural Machinery Science), 4 (2), 209-214.

Celen I., H., Demir C., 2005. Tekirdag Ilindeki Tarimsal Isletmelerdeki Pulverizatorlerin Durumu ve Sorunlari Uzerine Bir Arastirma. Tarim Bilimleri Dergisi 2006, 12 (1) 23-28, Ankara Universitesi Ziraat Fakultesi

Ozpinar S., Ozpinar A., Cay A., 2003. Canakkale Ili Tarim Isletmelerinde Kullanilan Pulverizatorlerin Teknik Ozelliklerinin Belirlenmesi. Tarimsal Mekanizasyon 21. Kongresi, 3-5 Eylül 2003, Konya. pp. 223-229.

Ganzelmeier H. and Wehmann H. J., 2004. First European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe – SPISE – 1, Braunschweig, Germany, April 27-29, 2004. ISBN 3-930037-13-0

Wehmann H. J, 2009. Third European Workshop on Standardised Procedure for the Inspection of Sprayers in Europe - SPISE - 3, 22 to 24 September 2009 – Brno, Czech Republic.

EN 13790-1: Agricultural machinery. Sprayers. Inspection of sprayers in use. Field crop sprayers

EN 13790-2: Agricultural machinery. Sprayers. Inspection of sprayers in use. Air-assisted sprayers for bush and tree crops

EN ISO 16122-1: Agricultural and forestry machinery - Inspection of sprayers in use.

EN ISO 16122-2: Agricultural and forestry machinery, Horizontal Boom Sprayers.

EN ISO 16122-3: Agricultural and forestry machinery, Sprayers for Bush and Tree Crops.