



## Problems Experienced By Agricultural Enterprises in Çumra Town of Konya Province in Utilization of Field Sprayers\*\*

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### ABSTRACT

The primary objective of the present study was to identify the problems experienced by agricultural enterprises in Çumra town of Konya province in utilization of PTO shaft-driven field sprayers. Data were gathered through face-to-face questionnaires applied to 119 agricultural enterprises selected by stratified randomized sampling procedure from the town. Present findings revealed that 50.4% of sprayers had a tank capacity of 600 L, 89.9% of tanks were made of plastic material and 26.9% of the sprayers had an operational width of 10 m. Cracks or fractures were reported on boom by 31.9% and on both boom and chassis by 46.2%. About 24.4% indicated that they replaced the nozzles in case of a plug, 52.1% indicated regulator problems on rod, 26% indicated pump problems on pump lid and 91.6% indicated that they replaced at least one part. It was concluded based on present findings that farmers should be trained about utilization of sprayers to change their routines on sprayers. They should perform sprayer maintenance and repairs in accordance with user manual.

### 1. Introduction

Agricultural commodities play a significant role in human nutrition. Agricultural practices should be performed consciously, and producers should be donated with sufficient knowledge and information. Pests, diseases and weeds most of the time reduce yields and hinder product quality and health. Chemicals are commonly used against these factors and sprayers are commonly used to apply chemicals for pests and diseases. These machines should be manufactured from good quality materials, used appropriately and their repair and maintenance practices should be performed on time. Failure in these issues may result in various problems. In such cases, then quality pulverization will not be possible.

There are 358 407 sprayers in Turkey in 2018 (TUIK 2019). The projection coefficient for the number of tractor PTO shaft driven sprayers of Central Anatolia Region until the year 2023 is 1.58%, the rate

increase in number of sprayers is 2.92% and number of sprayers is expected to reach 417 070 (Demir 2015).

There are limited number of studies available about the current status of sprayers. There are some researches about status of use of sprayers, their types and problems experienced in Tekirdağ province (Demir and Çelen, 2006), in greenhouses of Erdemli town of Mersin province (Demir and Öztürk 2009), in Çanakkale province (Ürkmez and Özpınar 2013) and Şanlıurfa province (Tobi and Sağlam 2013). General status of Turkish field sprayer manufacturers was identified by Bayat and İtmeç (2018).

In this study, characteristics, faults in boom and chassis, nozzle, regulator and pump and number of replaced parts were determined, and solutions were proposed for identified problems.

### 2. Materials and Methods

This study was conducted in Çumra town of Konya province. The agricultural enterprises registered in Farmer Registration System of Çumra town constituted the research population. The research site is composed of 42 settlement units. Based on mountainous nature,

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irrigation status, number of plots, plot sizes and land consolidation statuses, nine districts were selected with the aid of purposeful sampling procedure.

The enterprises with a land size less than 10 decares were removed from the population. Based on frequency distribution of the population, land sizes were assessed in three layers as of: 10-50 da, 51-250 and > 251 da. Number of enterprises to be selected from population and included into the sample was calculated by a stratified sampling procedure (Neyman method) with the aid of the following equation (Yamane 1967):

$$n = \frac{\sum (N_h \cdot S_h)^2}{N^2 \cdot D^2 + \sum (N_h \cdot S_h^2)} \quad (1)$$

$$D^2 = \frac{d^2}{z^2} \quad (2)$$

where;

n : Number of samples,

N : Number of enterprises in population,

N<sub>h</sub> : Number of enterprises in hth strata,

S<sub>h</sub> : Variance of hth strata,

d : Error from population mean,

z : “z” value from the standard normal distribution table based on error ratio.

Number of samples as to represent the population was identified as 119 at 5% error ratio and 95% confidence interval and sample enterprises were selected randomly. Questionnaires were applied to selected enterprises through face-to-face interviews. Data were gathered about characteristics of filed sprayers and the problems experienced. Resultant data were also supported by observations. SPSS software was used for statistical analyses of the experimental data.

### 3. Results and Discussion

Questionnaires applied in Çumra town revealed that ages of enterprise owners varied between 20 -78 years with an average value of 45.7 years. The ratio of uneducated enterprise owners was 4.2%, ratio of primary school graduates was 56.3%, secondary school graduates was 10.1%, high school graduates was 18.5% and university graduates was 10.9%. Such a high university graduates for a town pointed out open-minded fashion of enterprise owners for new technologies and practices.

Tank capacity, material of manufacture, current status and nozzle type of sprayers are provided in Table 1. Sprayer tank capacities varied between 400 – 1000 L and 50.4% of the present enterprises had a tank capacity of 600 L.

Sprayer tank material was mostly plastic (89.1%), but 7.6% was made of polyester and 3.4% was made of galvanized metal. Sprayer tanks were mostly durable (73.9%), but 10.1% had leakages and 16% had deformations at outer surfaces. The leakages in 12 sprayers were mostly coming from the hose gaskets at inlet and outlets of the tank. The deformations over the outer

surfaces were mostly because of storage of the sprayer at open spaces directly under atmospheric conditions.

Table 1

Properties of sprayers	
Properties	General
<u>Tank capacity (L)</u>	
400	9.2%
500	9.2%
600	50.4%
800	28.6%
1 000	2.5%
<u>Tank material</u>	
Plastic	89.15
Polyester	7.6%
Galvanized metal	3.4%
<u>Status of tank</u>	
Highly durable	73.95%
There is a leakage	10.1%
There are deformations at outer surface	16.0%
<u>Nozzle type</u>	
Flat-fan	39.5%
Hollow cone	42.9%
No idea	17.6%

Of the investigated sprayers, 39.5% had flat-fan nozzles, 42.9% had hollow cone nozzles and 17.6% of participant enterprises indicated that they had no idea about the type of nozzle. The nozzle material was mostly brass, but 55 was made of plastic.

Operating width of the sprayers varied between 6 – 24 m and the ratio of sprayers with an operational width of 10 m was 26.9% (Figure 1).

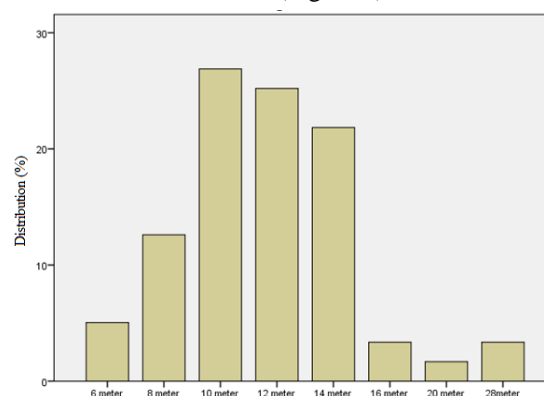


Figure 1  
Operational width of sprayers

Questionnaire results revealed that there were not any cracks and fractures on spray boom and chassis of 21.8% of the sprayers (Figure 2). However, there were cracks on spray boom of 31.9% of the enterprises and there were cracks or fractures both on spray boom and chassis of 46.2% of the enterprises. Ürkmez and Özpınar (2013) conducted a study in Çanakkale province and reported fractures on spray boom of sprayers in 22.6% of the enterprises. Bayat and İtmeç (2018) reported cracks or fractures on spray boom of 36.84 of the enterprises and on sprayer chassis of 78.95% of the enterprises. Such a high rate of fractures was mostly

because of undulated nature of the field, high operational speeds and reckless use of open spray boom during maneuvers.

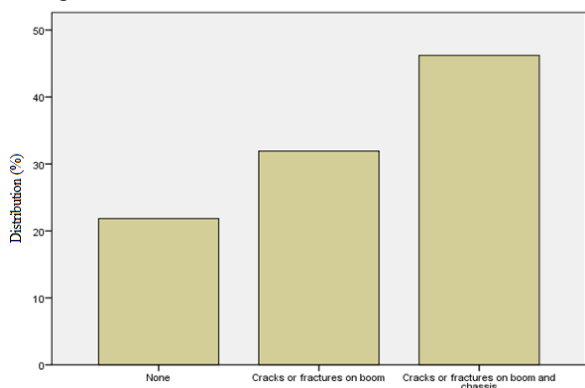


Figure 2

#### Repair of sprayer booms and chassis

Information about replacement of spray nozzles are provided in Table 2. In general, 5% of enterprises indicated that they haven't replaced nozzles, 22.7% indicated that they replaced on purpose, 24.45 indicated that they replaced nozzles in case of clogging, 23.55 indicated that they replaced the nozzles in case of clogging and flow offs, 8.4% indicated that they replaced only the screens of the nozzles and 8.4% indicated that they replaced the nozzles in case of irregular sprays. Similarly, Ürkmez and Özpınar (2013) indicated that 56.9% of pto shaft-driven sprayers in Çanakkale province experienced frequent clogging. Bayat and İtmeç (2018) indicated that 36.84% of sprayer manufacturers experienced abrasion problems in nozzles. Tobi and Sağlam (2013) indicated that 28.30% of the agricultural enterprises of Şanlıurfa province did not have screens in nozzles or experienced problems in screens. Such problems were mostly attributed to brass material and thus easy abrasion of the nozzles, abrasive effects of agro-chemicals and pollution of sprayer water. Therefore, filter maintenance should be performed regularly, and nozzles should be replaced on time.

Regulator problems of sprayers in investigated enterprises are provided in Table 3. Of the participant enterprises, 20.2% indicated that they experienced problems with the springs of the regulator, 12.6% with regulator gaskets, 15.1% with regulator pad and 52.1% with regulator rod because of gasket and spring. In Turkey, 21.05% of sprayer producers indicated that they experienced regulator-originated problems (Bayat and İtmeç, 2018). Manufacture of regulator rod from chrome nickel material and low quality of the other regulator materials trigger such problems.

Table 2

#### Replacement of sprayers

Replacement of sprayers	General
I don't replace	5.0%
Replace on purpose	22.7%
Replace in case of clogging	24.4%
Replace in case of abrasion or flow offs	23.5%
Replace the screen of the nozzles	16.0%
Replace in case of irregular spray	8.4%

Table 3

#### Regulator problems

Regulator problems	General
Spring was abraded / broken	20.25
Gasket was abraded	12.6%
Plastic pad was abraded	15.1%
Rod was deformed	52.1%

The problems experienced in piston-membrane pumps are provided in Table 4. In general, 26.1% of the participants indicated that they changed the valves, 20.2% indicated that pump block was cracked, 19.3% indicated membrane tear off, 26.1% indicated cracked pump lid and 8.4% indicated leakage from head pad of pump shaft. In Turkey, 78.95% of sprayer manufacturers indicated pump-originated problems (Bayat and İtmeç, 2018). In a previous study conducted in Çanakkale province, 11.7% indicated pump freeze at cold weather, 15.4% indicated leakage, 7.1% indicated pump failure in a short time (Ürkmez and Özpınar, 2013). When the desired or sufficient pressure was not supplied because of failures in any parts of the regulator during the operation of the sprayer, pump speed is increased. Increasing pump speeds then increase pump piston speeds and ultimately end up with various problems in pumps and especially tear membranes. Insufficient clean out of sprayers in winter season and leaving water in them result in cracks on pump rear lids and blocks and tears in pump membranes. Therefore, anti-freeze should be placed in pumps during the winter. Balanced rotation of shaft used in operation of sprayer and clumpy operation (in raising and lowering three points) result in deformation of head pad of pump shaft and destruction of crank bearing.

In general, 40.3% (48 enterprises) of the enterprises indicated that they checked the oil level of the sprayer and 59.7% (71 enterprises) indicated that they did not check the oil level. Of 48 enterprises, oil level check durations varied between 6 month (60.4%) and 1 year (39.6%). The oil added to pump varied between 100 – 900 ml with an average value of 268 ml, mostly (64.6%) 250 ml oil was added. About 75% of the enterprises were using 20W-50 motor oil and the rest (25%) were using different types of oil. Excessive oil addition result in oil extraction from the lid and excessive heat up of the pump. Different and off grade oils reduce pump performance and result in different failures.

Table 4

#### Pump problems

Pump problems	General
Pump valves were replaced	26.1%
Pump block cracked	20.2%
Membrane was torn	19.3%
Pump lid cracked	26.1%
Head pad of pump shaft is leaking	8.4%

Within the scope of this questionnaire study conducted in Çumra town, 8.4% of the enterprises indicated that they did not replace any parts of the sprayer (Figure 3). In other words, 91.6% of the enterprises

changed at least one part of the sprayer. It was reported in a previous study conducted in Çanakkale province that 82.3% of the enterprises experienced at least one problem with their sprayers and they indicated that they either eliminated the problem by repair or let the problem go on (Ürkmez and Özpinar, 2013). The ratio of the enterprises replacing at least one part in Çumra town was greater than those earlier ones.

Among the replaced parts, nozzles had the first place with a ratio of 31.1% and they were respectively fol-

lowed by sprayer valve, hose and filter (24.4%) and regulator and its parts (16.8%). For pumps, 8.4% replaced pump valves and membranes, 5% replaced pump pistons and membranes, 2.5% replaced pump block, 1.7% replaced block, piston and membrane together and 0.8% replaced oil filler plug and back pump lid. In pump repairs, replacement of membranes and valve O-rings were especially pointed out.

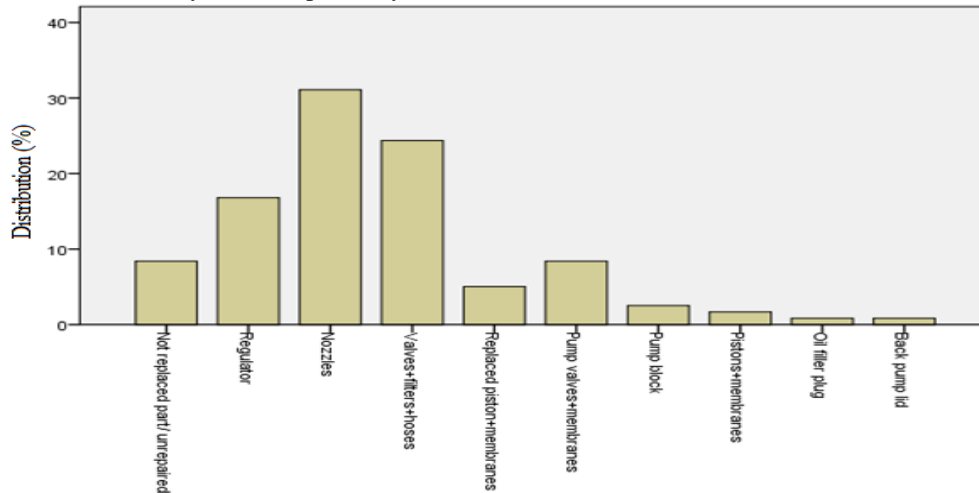


Figure 3  
Replaced parts of sprayers

Number of parts replaced in sprayers of the enterprises is presented in Figure 4. In general, 47.2% replaced two parts, 33.6% replaced one part, 10.1% replaced three parts and 0.8% replaced five parts.

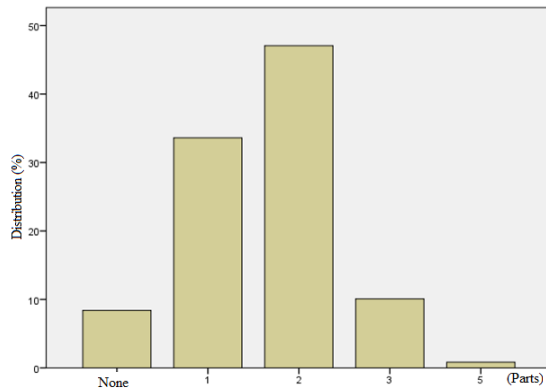


Figure 4  
Number of replaced or repaired parts

#### 4. Conclusion

Present findings revealed that educational level of the investigated enterprise owners was low. Thus, their routines on sprayers should be changed. They should perform sprayer maintenance and repair in accordance with the user manual. Trainings should be provided on this issue. Own manufacture or export of sprayer parts by manufacturers may lead to quality problems in sprayer parts. Competitive market conditions and low-cost manufacturing concerns also end up with quality

problems in sprayer parts. A price stability should be set in markets to eliminate such quality problems.

#### 5. References

- Bayat A, İtmeç M (2018). Türkiye'deki Tarla Pülverizatörü İmalatçılarında Genel Bir Bakış, Tarım Makinaları Bilimi Dergisi, 14 (3), 157-162.
- Demir B, Öztürk İ (2009). Mersin Erdemli İlçesindeki Sera İşletmelerinde kullanılan Pülverizatörlerin Durumu ve Sorunları, Alinteri Zirai Bilimler Dergisi, 17 (B), 1-6.
- Demir B (2015). İç Anadolu Bölgesinin Bitki Koruma Makineleri Projeksiyonu, Alinteri, 28 (B), 27-32.
- Demir C, Çelen İE (2006) Tekirdağ İlindeki Tarımsal İşletmelerdeki Pülverizatörlerin Durumu ve Sorunları Üzerine Bir Araştırma, Tarım Bilimleri Dergisi, 12 (1), 23-28.
- Tobi İ, Sağlam R (2013). Şanlıurfa İlinde Süne İlaçlamasında Kullanılan Tarla Pülverizatörlerinin Mevcut Durumunun Saptanması, Selçuk Tarım Bilimleri Dergisi, 27 (2), 74-83.
- TÜİK (2019). Türkiye İstatistik Kurumu verileri [Erişim tarihi: 01.07.2019]
- Ürkmez Ü, Özpinar S (2013). Bitki Koruma Makinalarının Uygulamadaki Sorunlarının Belirlenmesi: Çanakkale İli, 28. Ulusal Tarımsal Mekanizasyon Kongresi, Konya, 253-261.
- Yamane T (1967). Elementary Sampling Theory Prentice. Hall Inc. Englewood Cliffs, N. J., USA.