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Determination of the Field Sprayers and Their Problems in Thrace Region,Turkey

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ABSTRACT

Chemicals are widely used in crop protection around the world. Field sprayers commonly used to apply pesticides on the field crops. The area covers Tekirdag, Kirklareli, Edirne and the parts of Istanbul and Canakkale provinces which are in the European continent called Thrace region in Turkey. Since the main crops grown in Thrace are grains and industrial crops, field sprayers are the most common equipment for crop protection. Research is conducted in order to determine the field sprayer properties and the problems faced while operating them. A survey is carried out by interviewing 132 farmers with 22 questions. The results show that 97.7% of the farmers grow wheat and 92.4% of them grow sunflower. Farmers who have field sizes between 10-50 hectares are 46.2 % of the total participants. The most preferred sprayer brand is Parlayan Co. and commonly used spraying nozzles are domestic nozzles. The commonly used field sprayers have 800-1000 l tank capacity, 12 meter of boom width, and a manual boom folding mechanism. 23.5 % of the farmers have experienced cracks on the mainframe of the sprayer, 57.6 % of them have stated that the sprayer booms have been fractured by hitting the ground or an obstacle. 18.9 % of the farmers have complained about the pressure changes on the pump, 78.8 % of the sprayers have had nozzle clogging issues and 20.5 % of the farmers stated that they have seen cracks on the liquid tanks in time.

Keywords*—field sprayer; pesticide,Thrace, boom, nozzle, failure*

I. INTRODUCTION

Farmers have to handle the threats to crop health in order to get maximum yields from the field. Different methods are used to protect the crops from diseases or other factors that are potentially damaging. The most common and efficient method is chemical crop protection. Most of the fungal diseases, weeds, insects, and other microorganisms which are able to damage the crop and reduce the yield can be eliminated using proper chemical compounds.

Since the crop production increases in Turkey, new kinds of pests arise and the existing pests gain immunity to the active ingredient, pesticide use is increasing year by year, as well as all over the world. Annual pesticide usage in the world is 2 million tones and it is estimated to reach 3.5 million tones after 2020 [1]. According to data from the year 2018, 60000 tonespesticides were used in Turkey [2].

Pesticides are applied with a different type of equipment depending on the size of the field, type of the field, intended purpose, and plant species. The most common equipment used for pesticide application in Turkey is a field sprayer.

The area that covers Tekirdag, Kirklareli, Edirne provinces, and the parts which are in the European continent of Istanbul and Canakkale provinces is called the Thrace region. Thanks to the diversity of the climate in Thrace, crop diversity is great as well. Grain, industrial crops, feed crops, rice, sugar beet, olive, grape are commonly grown in that region. Since the field crops are widely spread over the

region, field sprayers are commonly used in Thrace. With the help of the humidity, temperature, and rain, field crops tend to be damaged by fungal diseases, pests, and weeds. Thus, Thrace farmers apply pesticides so often to protect their crops from diseases, which makes the field sprayers rather precious in their machinery.

As the field sprayers are crucial equipment in Thrace, the design characteristics have to be adapted to these conditions. Thus, sprayer manufacturers have tried to design sprayers that are easy to use, durable, and can be used for many years. Notwithstanding the strong and stable design of the sprayers, the defects and failures occur in field conditions that can be named as user experience which need to be taken into account by manufacturers.

Several researches are conducted about sprayers and their conditions in Turkey on both national and regional basis. Demir and Celenhave researched the problems and conditions of the sprayers in Tekirdag province [3]. The authors surveyed 718 farmers and investigated their sprayers. They concluded that 72.28 % of the sprayers were field sprayers. Moreover, 65 % of them have leakage and 28 % of them have nozzle clogging problems.

Baran and Durguthave investigated the agricultural mechanization of the West Marmara Region between 2004 and 2013. They stated that the number of sprayers increased by 19.75 % in ten years [4].

Bayat and Itmec have researched sprayer manufacturers. They interviewed 19 manufacturers from 9 different provinces and investigated the failures on the sprayers. Authors have stated that 78 % of the failures of the sprayers were pump based. Also, 78.95 % of the sprayers had boom defects and fractures, 36.84 % of them had defects on the chassis, 36.84 % of them had nozzle clogging. Furthermore, the sprayers have problems with the filter system, hoses, pipes, regulators, and valves [5].

Temel and Oztekin have investigated the crop protection equipment in terms of work safety. They have surveyed the farmers in Tokat province. The authors concluded that 76.8 % of the farmers had an intermediate level of knowledge on crop protection equipment, 42.8 % of them have never adjusted the parameters such as pressure, flow rate, and operation speed of the sprayers. Moreover, 42.1 % of the farmers have never made an adjustment or maintenance on the sprayers[6].

This research is aimed to survey the farmers in the Thrace region of Turkey, where the field crops are commonly grown and field sprayers are mainly used. In order to advise and influence the sprayer manufacturers, the field sprayers are investigated from the farmers' aspect.

II. MATERIALS AND METHODS

A survey with 22 questions with 2 sections for the farmers from the Thrace region was created. 132 farmers are interviewed and asked to answer the survey questions. 49.2 % of the farmers have fields in Tekirdag province, 22.7 % of them are from Edirne Province, 18.2 % of them are from Kırklareli province, 5.3 % of them have fields in the European side of Istanbul and 4.5 % of them are from Canakkale. The reason why the number of farmers has fields in Tekirdag province is the crop diversity thanks to the climate and landscape characteristics.

In the first section of the survey, farmers' location, field size, crop types, tractor horsepower, the brand of the sprayer, tank capacity, age of the sprayers, working width, nozzle characteristics, folding mechanism are asked. In the second section, the problems and challenges experienced by farmers while they were using the sprayers and how to solve them are asked. Furthermore, farmers are asked whether they create tramlines while drilling, how the sprayer boom behaves while operating, and what they have been doing to prevent overlapping in geometrically uneven fields.

The survey consists of simple, understandable questions and terms in colloquial language. It is both published and shared on the internet and social media and directly asked the farmers by visiting randomly selected farms, villages, or cities.

III. RESULTS

The most common crop grown by farmers is wheat. 97.7 % of the farmers stated that they grow wheat. The second most common crop is the sunflower, which grew by 92.4 % of the farmers who participated in the research. As the Thrace region meets 80 % of the sunflower production in Turkey [7], that rate is not surprising. Also, 49.2 % of the participant farmers grow rapeseed, 53 % of them grow barley, 24.2 % of them grow corn and 12.9 % of them grow rice. In addition to these, there is one each farmer who grows oat, watermelon, birdseed, ryegrass, tomatoes, zucchini, pepper, grape, chickpea, and feed crops.

Regarding field size, 46.2 % of the farmers have a total production area between 10-50 hectares. 18.9 % of them have less than 10 hectares. The percentage of farmers who have a production area from 50 to 100 hectares is 16.7 %. Farmers who have 150 hectares and bigger area are 9.1 % of total participants. In addition, 62.9 % of them make tramlines while drilling, and the rest of them create tramlines in the first pesticide application after the germination of the crop.

The most preferred sprayer brand is Parlayan Co. 28 % of the farmers claimed that they use sprayers of that company. The other brands preferred are Onallar Co. as 13.6 %, Taral Co. as 12.9 %, and Zirmak Co. as 9.9 %. Also, 2.3 % of the farmers do not know the brand of their sprayers. All brands used by participant farmers are shown in Fig. 1.

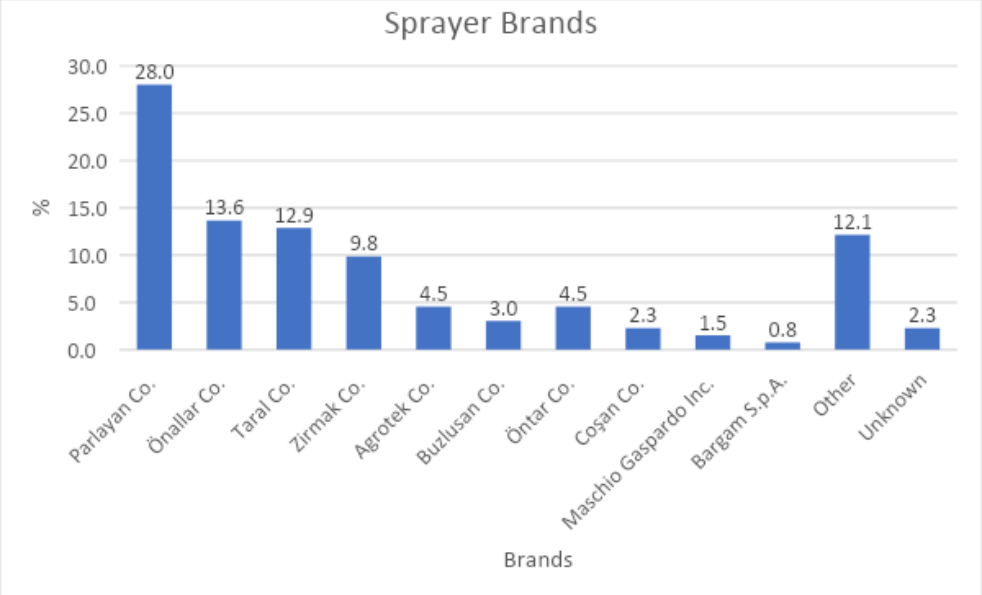

Fig. 1. Sprayer brands used by participant farmers

The engine power range of the farmers' tractor which is used with sprayers is asked. 32.6 % of them have answered that they use tractors with 100-110 HP range. 23.5 % of them are in the 90-100 HP range, 24.2 % of them are in the 70-90 HP range. The farmers who have a tractor with an engine power less than 70 HP are 11.4 % of total participants. 8.3 % of the farmers have answered that they attach their sprayers on the tractor with an engine power of more than 110 HP.

Regarding the tank capacity of the sprayers investigated in the research, 32.6 % of them have 1000 lt capacity, 34.8 % of them have 800 lt capacity, 21.2 % of them have 600 lt capacity, 7.6 % of them have a capacity less than 400 lt and 3.8 % of them have capacity more than 1200 lt.

46.2 % of the sprayers have 12 meter booms, 39.4 % of the sprayers have 15 meter booms, 11.4 % of them have 10 meter booms and 1.6 % of them have booms wider than 18 meter. 1 farmer stated that he/she uses an orchard sprayer. Moreover, 52.3 % of the sprayers are 1-5 years old, 20.5 % of

them are 5-10 years old, 18.9 % of them are older than 10 and 8.3 % of them are bought one year ago or less.

The distribution of the tractor power range, tank capacity, boom width, and age of the sprayers are shown in Fig. 2.

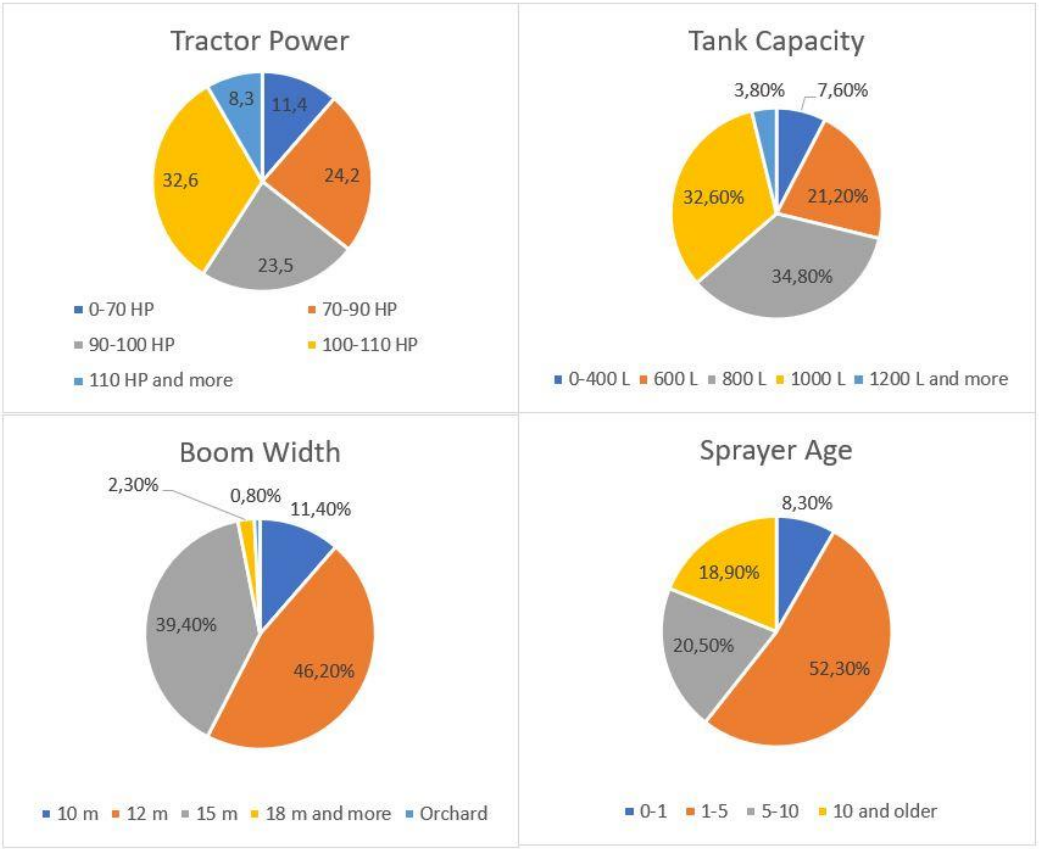

Fig. 2. The distribution of the tractor power range, tank capacity, boom width and sprayer age.

71.2 % of the sprayer have a manual boom folding mechanism and 27.3 % of them can be folded with the help of hydraulic power. One of the farmers stated that he/she had an electrical powered folding mechanism. Moreover, 87.1% of the sprayers fold horizontally and 12.9 % of them fold vertically.

Several nozzle brands are preferred among the farmers. Hence, 47.7 % of them claimed that they bought the nozzles made in Turkey. Also, 22.7 % of them use nozzles produced by Spraying Systems Co., 17.4 % of them use spraying nozzles of Lechler Co. 2.7 % of them use nozzles of AragSrl and 2.7 % of them use nozzles of Taral. 69.7 % of the nozzles have 3 mm orifice, 28% of them have 4 mm orifice. 15.9 % of them have 2 mm orifice and 3.8 % of them have 5 mm orifice. However, 11.4 % of the farmers do not know which spraying nozzles they use.

The failures on the sprayers experienced by the farmers during the pesticide applications are investigated on the main parts basis. Therefore, the problems on the boom, spray tank, mainframe, pump, and nozzles are determined.The participants stated that they have faced several failures on the sprayer frame. 23.5 % of the sprayers have cracks on the frame, %15.2 of the sprayers' frames were fractured due to the weight of the liquid tank and boom. Complaints regarding the overweight of the frame are also no ignorable. 20.5 % of the farmers stated the mainframe of their sprayers is rather heavy which puts too much load on the three-point linkage of the tractors.

The farmers are asked to claim the problems experienced with the sprayer booms. 57.6 % of them answered that booms are fractured due to the crash into the ground or an obstacle. Fracture on the

welding points is %18.2 and 6.1 % have fractures on the bolt joints. 22.7% of the sprayers have buckling and 18.9 % of them have fractures due to the vibration and uneven ground. 15.2 % of the farmers stated that booms are rather heavy and 10.6 % of the farmers claimed that the folding mechanism of the booms is not working properly. Moreover, 73.4% of the farmers complain about the vertical movement which causes uneven boom height.

The most common problem in the pump and filter systems of the sprayers are pressure changes. The percentage of farmers who have been challenged with pressure changes is 18.9%. Moreover, 16.7% of the sprayers have water leakage from the pumps 17.4% of the sprayers have oil leakage, 14.4% of the sprayers have defects on the diaphragm of the pumps, and 8.3 % of the sprayers have cracks on the body of their pump.

The percentage of the farmers who stated that the spraying nozzles of their sprayers clogged at least once is 78.8%. Besides, 17.4 % of the farmers claimed that the spray nozzles wear so often and 17.4 % of the farmers have experienced uneven spraying of the nozzles.

Cracks occurred on the liquid tanks during their operating time. 20.5 % of the farmers have complained about the cracks on the tanks. Also, 8.3% of the farmers were not satisfied with the filler cap. It is said that the place of the filler cap is nearly unreachable and has leakage when the tank is full.

The farmers have several solutions for those failures. While 49.2 % of the farmers take the sprayer to the nearest authorized service shop for repairment, 41.7 % of them repair the sprayers by themselves. The farmers' solution to the overlapping in the geometrically shapeless differs. While 71.2 % of them close the valves on the potentially overlapping side of the boom, 29.5 % of the farmers do nothing to prevent overlapping.

IV. CONCLUSION

In this research, Thrace region of Turkey is chosen and 132 farmers are interviewed with a survey consisting of 22 questions to determine their field size, tractor and sprayer properties, and the problems experienced during the spraying applications.

The majority of the farmers have crop production areas between 10-50 ha which is average in the Thrace region. The most common tractor power range is 100-110 HP. Since the percentage of the farmers who have a sprayer with 800 and 1000 l tank capacity is 67.4 %, it is not efficient to attach these sprayers to the tractors that have less engine power than 100-110 HP. Moreover, the most common boom width is 12 meter.

Since 60.6 % of the sprayers are between the age of 0 and 5, the majority of the sprayers can be considered new. Also, the most popular sprayer brand is Parlayan Co. The majority of the farmers prefer spraying nozzles made in Turkey. This can be related to the high exchange rates causing an increase in the price of the imported nozzles.

The farmers have faced several problems with the main parts of their sprayers. 23.5 % of the farmers have seen cracks on the mainframe, 57.6 % of them have reported that the booms are fractured by hitting on the ground or an obstacle, 18.9% of them have faced pressure changes during the application, 78.8 % of the farmers have had nozzle clogging and 20.5 % of them have seen cracks on the liquid tank.

While 49.2 % of the farmers have taken their sprayers to the nearest workshops to repair, 41.7% of them have solved the problems by themselves. This shows that the farmers know the maintenance, settings, and repair of their sprayers. However, 11.4 % of the farmers do not know the brand of the spraying nozzles on the sprayer and 2.3 % of them do not know the brand of their sprayers. The reason for that is misinformation about the nozzles and the sprayer while the farmer negotiates with the dealer and skips reading the manual of the sprayer.

To conclude, several problems can occur on the field sprayer in the progress of time. While some of them are design and manufacturing-based, problems can occur because of user error. Sprayer manufacturers need to determine those problems and develop durable and reliable sprayers to meet the farmers' expectations.

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