

## THE CURRENT STATE OF SPRAYER MANUFACTURERS IN TURKEY AND SOME STRATEGIES FOR THE FUTURE

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### Abstract

*In Turkey, crop sprayers are one of the most used plant protection machines. These crop sprayers have different tank volumes, work widths, nozzles, control units etc. In this study, a survey on mounted crop sprayers was conducted by interviewing nineteen different manufacturers, taking into consideration the factories which produced the most crop sprayers in nine different cities in Turkey and getting technical information about crop sprayers boom manufactured by the companies. Technical specs about companies and products for sprayer manufacturers, safety regulations, costs of steel components were asked and the data obtained were evaluated. According to the results obtained, 48% of the companies manufacture crop sprayers with 400 L tank capacity and 10 m sprayer boom width most commonly, 94.74% of the manufacturing companies stated that they produce in compliance with the Machinery Safety Directive and 35.46% of them are consumables as the highest cost in the production of the sprayer booms. Advices of decreasing manufacturing cost, machine safety regulations and suitability of related standards TS 4807 and TS 4808 were also made.*

**Key words:** crop sprayers, machinery safety directions, cost of field sprayer boom manufacturing.

### INTRODUCTION

In Turkey, there are 1,169 thousand sprayers that consist of approximately 416 thousand field, 117 thousand orchards, 628 thousand backpack sprayer and 18 thousand other types of sprayers in use. Total arable areas are approximately 24 million hectares and about 84 percent of these areas are used for field crop production, others are for orchard plants. Due to this production pattern, field crop boom sprayers are mostly used in Turkey.

Since pesticide spraying affects the yield and quality of the product, the application of the process as a uniform to all the plants in the area is the main aim of the pesticide treatment. Pesticide application machines and equipment are also designed and produced for this purpose. Locally made plant protection machines have replaced plant protection equipment, which entered into the agriculture of Turkey, by importation. Nowadays, numbers of high quality plant protection manufacturers are increasing. Beside these, plant protection equipment can be manufactured without engineering calculations. Because of that reason failure can occur during the working of the plant protection machines. There are

more than 150 sprayer manufacturing companies in Turkey.

Demir and Çelen (2005) conducted a survey on the situation and problems of field sprayer in 718 agricultural enterprises in Tekirdag province of Turkey. In the study, it was stated that the field sprayers which are subjected to the survey changed between 300-800 liters of tank capacity and about 69.7% of the field sprayers had a tank capacity of 400 liters. Also 43% of these field sprayer has 12 m boom width.

Yurtlu et al. (2012) found that farmers' level of education on safe machine use was low in their research on risk perceptions of agricultural machine use. The risk importance ratings of plant protection machines (sprayers, atomizers, dusters, fogging machines etc.) were determined in the study and it was stated that the plant protection machines took second place after agricultural transportation means within all agricultural machines with a total score of 356.8.

Demir (2015) was intended to determine the projection of plant protection machines in the Central Anatolia Region of Turkey. The use of tractor mounted field sprayer's number increased from 37.289 in 2004 to 43.278 in

2013. According these data as calculated foreseen projection of field sprayers' number will be 50.640 in 2023

The objective of this study was to determine the state of Turkish agricultural sprayer manufacturers via a survey, taking into some considerations such as; tank capacity, boom width, technical issues about companies and products for sprayer manufacturing; compliance machine safety regulations, costs of steel components of sprayers

## MATERIALS AND METHODS

In this study, a survey organized for the tractor mounted field sprayer manufacturers to search the spray arm widths, tractor power, storage capacity etc. issues in Turkey. Addition to this, manufacturers have been able to identify innovation considerations for field sprayer boom manufacturing, compliance with machine safety, maintenance. Face to face interviews were held with 19 tractor mounted field sprayer manufacturers from 9 provinces of Turkey (Adana, Aydın, Burdur, Bursa, Istanbul, Konya, Manisa, Mersin, Şanlıurfa) for this purpose.

## RESULTS AND DISCUSSIONS

The data obtained as a result of survey work are presented in the following subheadings.

### Evaluation of sprayer tank capacities and boom width

According to survey results firstly, it is understood that all manufacturers are manufacturing the tractor mounted field sprayers with 400 l, 600 l, 800 l and 1000 l nominal tank capacity. Beside these 100 l, 200 l, 300 l, 500 l, 1200 l, and 1600 l are also manufactured but not used widely (Figure 1).

Despite the fact the field sprayer with 1200 and 1600 liter tank capacities are available in the manufacturers, according to the standard TS 4807 (current standard of Turkish Standard Institute about tractor mounted field sprayer) tractor mounted type field sprayers are not suitable for 1200 l and 1600 l tank capacities because of overturn of tractors.

However, manufacturers still offer these machines in the market, ignoring the relevant standard.

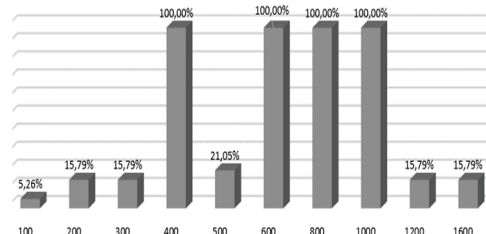


Figure 1. Manufacturing percentages of nominal tanks capacities in companies (liter)

As in Figure 1, mostly manufactured tanks' (400 l, 600 l, 800 l, 1000 l) relation with field sprayer boom width is searched. According to results, 48% of companies are manufacturing 400 l tank capacity with 10 m boom width, beside this 39.68% of companies are manufacturing 600 l tank capacity with 12 m boom width, 25.48% of companies are manufacturing 800 l tank capacity with 16 m boom width, 25.18% of companies are manufacturing 1000 l tank capacity with 16 m width. As known, big tank capacities have high chasis of crop sprayers. Whether the boom width increase, vibrations on the crop sprayer boom also increase. To prevent this, chassis and boom width must have relevance ratio which must increase both storage tank capacity and boom width as in relationship of prototype and model. This standardization will decrease failures in applications.

### Relevance of compliance machine safety regulations (European Machinery Directive 2006/42/EC) of tractor-mounted field sprayers

In survey, it was questioned that if the tractor mounted field sprayers are proper for CE document. For 94.74% of the companies, CE document is available. Then it was asked that if clean water is available for cleaning the field sprayer. As an answer, 94.74 of companies denote that there is cleaning water tank on the field sprayer. According to results, 73.68% of companies are using waterjets for cleaning the inside of the tanks. Beside this, sprayers in 57.98 % of companies had the system which sends the pesticide directly into storage tanks without hand touch. The tractor mounted field sprayers that manufactured in Turkey, as the ratio of 73.68 %, had the system prevents overturn when machine is parked. Also, 94.74% percentage of these field sprayers had the traffic signs on it. By the way, 68.42% of companies had the protection on electrical lines

in field sprayer which have the high storage capacity. Furthermore, the questions about, location of the signs and warnings are proper or not, the protection on hydraulic lines are available or not, cleaning water is available or not, for operator cleanness PTO cover is available or not, system of unloading the storage tank is safe or not, boom lock system during the traffic travel is available or not, are also asked. All the companies are answered these questions as affirmative.

In the work done, most firms stated that they had CE marking machines. It is learned that a large majority of companies have a clean water tank for machine washing purposes. It is important that there is enough water to clean the machine locally in any case. Jet system is required for washing inside the spraying tank. It is an important matter to dilute the residues in the tank with the pressurized water. It seems that this system exists in the great majority of companies. According to Turkish TS 4807 standard; there must be a discharge plug at the bottom of the pesticide tank to provide complete discharge of the tank. At this point, the liquid which can be prevented from being left in the tank can go out from the drain tap with its own. According to TS 4808 type of field sprayer standard, the tank filling system must supply water to the tank with the vacuum brought by the pump. The system which prevents the overturning in the park, is generally made by attaching 4 tires to the lower part of the field sprayer chassis. These wheels must also be supported with wedges. The designers must also determine the position of the center of gravity of the machine in the CAD program and position the wheels accordingly. The electrical cables must be in a housing, preventing easy access by uninformed people. It also prevents an external load from damaging the cables. However, most companies do not fulfill this requirement. When the field sprayer is taken to the field where it will work, it will definitely go to traffic. Therefore, it is necessary to make traffic markings on the machine.

### Manufacturing costs of the field sprayer booms

In the field study, steel construction costs of the manufacturers were evaluated and it is understood that 5.26% of the companies did not

calculate the steel construction costs. As shown in Figure 2, 35.46% of the manufacturers consider that the consumables (sheet metal, profiles etc.) are the most expensive part of the manufacturing.

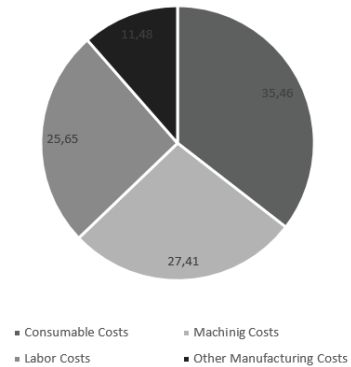


Figure 2. Manufacturing cost distribution of field sprayer boom according to manufacturers

Manufacturing costs (turning, milling, laser cutting etc. operations) are the second after consumables as the ratio of 27.41%. Labor cost have the ratio of 25.65% ratio which is higher than other manufacturing costs (electrical costs, water costs etc.) which have the ratio of 11.48%.

### Cost Reduction Studies of Sprayer Arms

As shown in Figure 3, 52.63% of the companies stated that they changed the design. 36.84% of companies change their raw material supplier and sell cheaper and quality products. For a better quality and economical sprayer, 31.58% of firms have stated that they try a different manufacturing method. For a better quality and economical sprayer, 31.58% of the firms stated that they tried a different mounting method.

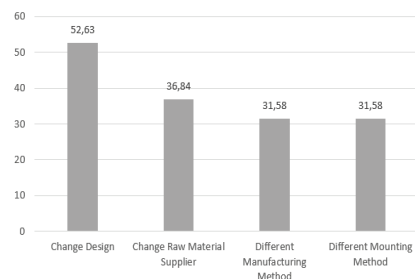


Figure 2. Studies done by companies in order to make their products better and more economical

In the study, some companies also aim to bring the user to a more efficient sprayer thanks to serious R&D activities. In these R&D studies, the software of low pressure electronic regulators is used, beside this aluminum material usage in sprayer booms, using nitrogen in the hydraulic piston to open and close the opening and closing hydraulic systems more slowly. Being close to the raw material and being located in large industrial sites allows manufacturers to purchase more suitable crop sprayer parts.

By using the technology adapted manufacturing method in production, better quality and economical products will be marketed. As can be seen in Figure 4, if the welding is done with a robot, better quality and faster welding can be done, thus labor costs can be reduced and more quality and economical products can be marketed.

Reducing the use of bolts and nuts in this phase, spreading sheet metal applications, welding rather than bolt-nut connections is effective in reducing sprayer installation costs.

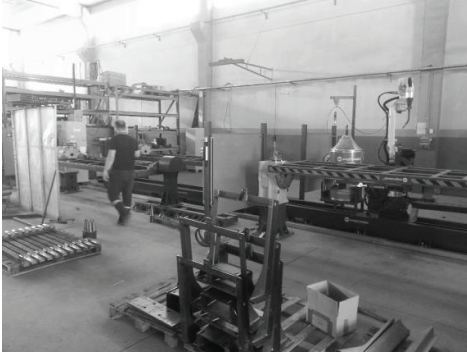


Figure 4. Robot welding used during welding of field sprayer chassis and booms

## CONCLUSIONS

Companies mostly manufacture 400 l storage tank capacity 10 m boom width with percentage of 48%.

In the study conducted, it is found out that most of the manufacturers are informed about machine safety, but their field sprayers do not fulfill some of these applications.

The agricultural sector is a sector where many accidents are experienced.

In order to prevent any accidents that may occur in the machines manufactured for this sector, the manuals should include warnings and markings on the machines, which will inform the user to avoid job accidents.

Beside these, there are some studies to decrease manufacturing costs which also will be reflected to product's price.

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