Research Regarding the Flow Rate and Pressure Variation for the Nozzles Mounted on the Eep-600m Spraying Machine

Ioan DROCAŞ, Ovidiu MARIAN, Ovidiu RANTA, Sorin STĂNILĂ, Mircea MUNTEAN, Adrian MOLNAR

University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca
drocas_i@yahoo.fr

Abstract. Reduced environmental pollution and ensuring fair treatment in crops can be achieved through constructive and functional upgrading of spraying machines. The paper studies the variation of the nozzle flow, liquid pressure and uniformity of distribution for the EEP-600M machine. The experimental results have shown changes in the functional parameters of the nozzle (flow and pressure) depending on the nozzle position on the ramp section. The way of connecting the hoses leading the solution to the ramp and the number of nozzles per segment can influence the uniformity of distribution of the solution.

Keywords: nozzles pressure, nozzle flow rate, transversal distribution.

INTRODUCTION

Due to limitation of the cultivated area and the world's population growth is necessary to increase agricultural production. Pest and weed control of agricultural crops is one of the main ways that can provide significant increases in production. But pesticide usage has negative effects on the environment, contributing to soil pollution by adhering to particles of soil, pollution of surface and ground water and air pollution by means of active substance evaporation.

Reduction of environmental pollution when using pesticides can be achieved by the use of active substances with low persistence, biodegradable and by modernizing the application methods.

It is therefore necessary to modernize machinery and pesticide application equipment, ensuring a proper spray and better distribution uniformity.

The combination of three elements: substance, machinery and optimum time of application, depending on specific conditions, is the key to the application of minimum quantities of chemicals, with maximum efficiency and at the same time reducing environmental pollution.

On this line falls the research on EEP-600M machine, in order to determine how the variation of nozzles pressure and flow rate placed on the three boom sections influences the uniformity of distribution.
MATERIALS AND METHODS

For experimental trials we used the EEP-600M spraying machine that is in accordance with the constructive European standards [1]. It is equipped with a ramp consists of three sections. Side sections, which folds have a total of 10 nozzles each, and the central section have only four nozzles.

Solution that supply the nozzles of the sections is carried out at the end of section, not the middle as it would be advisable in order to have a better distribution of pressure.

Pressure and flow measurement was made using the nozzles testing equipment, that is a part of the TEST-1000 stand, manufactured by Herbst [2]. The equipment consists of the following main elements (fig. 1): computer process, flow meter, pressure sensor, nozzle mounting device and computer support device.

On the display one can read in real time, the pressure, flow and tested nozzle number. Data is stored in the computer and then transmitted by radio data to the acquisition computer.

Uniformity of distribution was determined using the test trolley [2] that is a part of the TEST-1000 stand.

The nozzles used were AGROTOP 110-04, new nozzles and to remove any calibration error, we used a single nozzle, which was moved on the boom in all 24 nozzle supports on the ramp. Pressure and flow in each place was determined simultaneously using the Y connector accessory for. Flow and pressure in each position was determined in three repetitions and the average was calculated.

RESULTS AND DISCUSSIONS

The results regarding the flow rate and pressure for the AGROTOP 110-04 are presented in figures 2 – 4. The transversal distribution is presented in figure 5.
Fig. 2. Average flow rate variation

Fig. 3. Average pressure variation

Fig. 4. Average nozzle differences in flow rate to the manufacturer data
Graphic analysis of variation in the flow nozzle (Fig. 2) shows that the average flow nozzles central section is greater than the two side sections, ranging between 1.69 and 1.72 l/min. Onto the side sections, the flow of the nozzle decreases from the center to the extremities, being comprised between 1.59 l/min to nozzles located closer to the central section and 1.55 l/min from nozzles on the wings.

Average pressure nozzles (Fig. 3) is amended also on the ramp width, with values between 2.77 and 2.37 bar onto the central section and on side sections between 2.27 and 2.20 bar. Of the two graphs can be seen that the curves of variation of flow and pressure are interrelated and that the loss of pressure and flow to the extremities of the ramps are higher.

The explanation for this type of variation is the way the hoses are connected to the three sections of the ramps.

To ensure greater uniformity of pressure and flow in the nozzle, it is necessary to connect the pressure hoses leading solution from solenoid valves to sections, to the center of the section and the number of nozzles to be equal to the three sections. Analyzing the variation of average nozzle differences against the flow rate given by the manufacturer (Fig. 4), one can find large differences in addition to the four nozzles from the central section to differences nozzles placed at the extreme side sections.

It should be noted however, that differences do not exceed 10%, the allowable limit set by the European standards as the difference between the nozzle flows.

Determining the distribution uniformity of the machine along the working width (Fig. 5), using the same type of nozzles (Agrotop 110-04), one can see that there are five points where the flow exceeds the allowable limit (±15%), three on the central section that give extra liquid, and two on the side sections and give a smaller quantity than the amount allowed.

The coefficient of variation for the uniformity of distribution is 6.89, which shows that the distribution uniformity is good.

CONCLUSIONS

1. Nozzle flow rate and pressure is influenced by the place where pressure hoses which delivers the solution are connected onto the section.
2. It is recommended that the number of nozzles on the sections to be equal, and to connect the pressure hoses to the middle of the section, fact that improves the uniformity of pressure and flow.
3. For EEP-600M sprayers, even if the hose connection is not in the middle of the section, the differences between the nozzles and uniformity of transversal distribution fall within the permissible limits.
4. Transversal uniformity and flow rate of the nozzles can be improved by proper connection of the pressure hoses that delivers the solution to the sections.

REFERENCES