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DETERMINATION OF DISTRIBUTION UNIFORMITY FOR EEP-600 SPRAYER EQUIPED WITH IDK 120-02 NOZZLE

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Abstract

Nowadays, when Romania is a full member of the European Community, it is necessary to implement a system for testing and diagnose the spraying machines. In order to do this, there are special equipments that can tell to operator what is fault in a spraying machine. The parameters that the test stand can measure are: distribution uniformity which is tested for the whole width of the machine; the nozzle flow and all the correlations between the nozzles; the pump nominal pressure and flow. Using this state of the art equipment was possible to study the uniformity distribution for EEP-600 mounted sprayer, equipped with IDK 120-02 nozzle, for different working pressures and boom heights.

INTRODUCTION

The sustainable agriculture concept, in which the main condition represents the resource optimum management, promotes the rational use of agrochemicals in order to reduce the environmental impact together with optimum crop production.
The analysis of different crop technologies shows that chemical method for pest and weed control is the most used because of its efficiency, but with a high environmental impact.

The use of systemic herbicides with low product residues in crop is a step forward to environment protection. The optimum treatment is obtained only if is assured a good distribution uniformity of agrochemicals, applied in the right moment depending on specific conditions and by using the minimum needed quantities.

The tools for herbicides application must realize good distribution uniformity on the boom working width, to obtain the droplet optimum dimensions for a better adhesion to plants and to reduce the liquid volume used on surface unit.

The herbicide application efficiency is influenced mainly by distribution uniformity on the working width of the sprayer. Following this we considered that it is important to analyze the main factors that have influence on distribution uniformity on the working width of the sprayer by using a certain nozzle type.
The main variable factors that were considered for determination of distribution uniformity are:

- working pressure;
- boom height measured from target surface.

MATERIAL AND METHODS

For experiments was used a state of the art equipment, namely HERBST TEST 1000, which is developed for determination of distribution uniformity for spraying machines and it needs a PC with installed OWFB 1.0 software.

This testing equipment has the following main parts: movement frame (aluminum rails), mobile measuring system with ten glasses, a sloped platform for substance, a wireless system for PC real time communication, a plastic collector.

The main parts of HERBST TEST 1000 equipment are showed in figure 1.

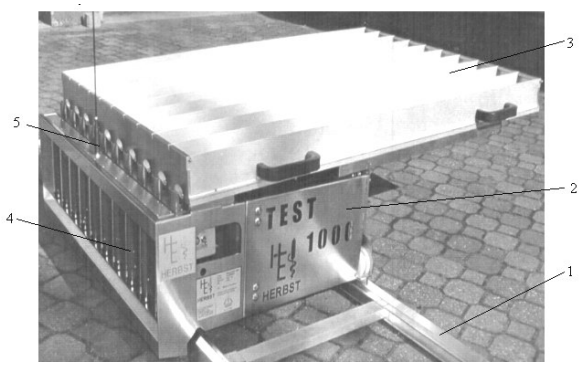

Fig. 1. The main parts of HERBST TEST 1000 equipment
1-movement frame; 2-mobile measuring system; 3-sloped platform for substance; 4-measuring glasses; 5-wireless communication system

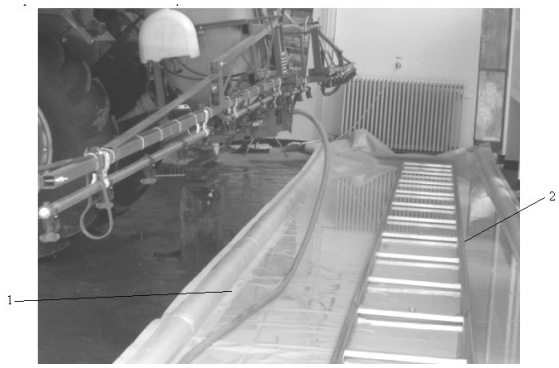

Fig. 2. The plastic collector (1) and the movement frame (2)

The main principle of HERBST TEST 1000 testing equipments is based on collection of test solution for each meter from the working width of the machine. This is made by the mobile measuring system, which starts to move from a chosen reference point with one meter at a time, until it reaches the chosen limit point depending on the working width of the sprayer.

After a complete measure, on the working width of the sprayer, the mobile measuring system returns automatically to the reference point.

The liquid is collected in glasses that have ultrasonic sensors used for liquid level measure. This value is then converted by the provided software (OWFB) in volume units. The measured data is sent via wireless communication system to a PC, which calculated the data needed for further analysis.

For the experiments, in laboratory conditions, we used the EEP-600 mounted sprayer equipped with IDK 120-02 nozzle type. Also, we adjusted the liquid pressure at 2 bar, 3.5 bar and 5 bar. The working height of the boom was adjusted at 30 cm, 50 cm and 70 cm.

The evaluation of distribution uniformity on the working width of the sprayer from statistical point of view is made by using the variation coefficient vk:

$$vk = \frac{S}{x} \cdot 100$$

where: S is standard deviation;

x – medium liquid volume in glass cylinders.

If variation coefficient vk is less than 7% the distribution uniformity is good, if it's between 7-9% the distribution uniformity is acceptable and if it's higher than 10% is not acceptable.

RESULTS AND DISCUSSION

First we consider the case in which the boom height is 30 cm and the three values for liquid pressure: 2 bar, 3.5 bar and 5 bar.

The results are shown in the graphs from figures 1, 2 and 3, in which is showed the distribution uniformity on the working width of the EEP-600 sprayer and also the variation coefficient for each situation (see statistic data, with symbol vk).

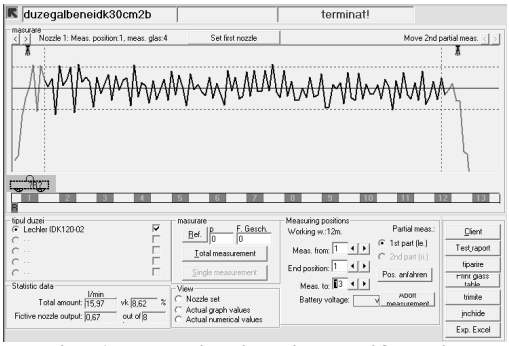

Fig. 1. The distribution uniformity graph for boom height by 30 cm and liquid pressure by 2 bar

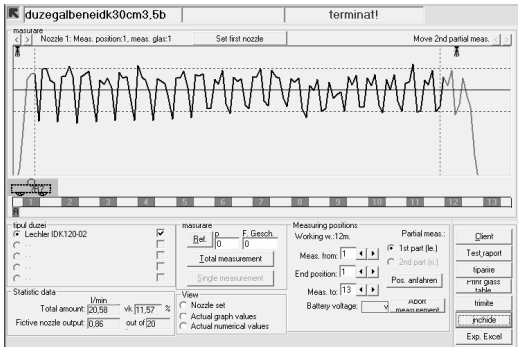

Fig. 2. The distribution uniformity graph for boom height by 30 cm and liquid pressure by 3,5 bar

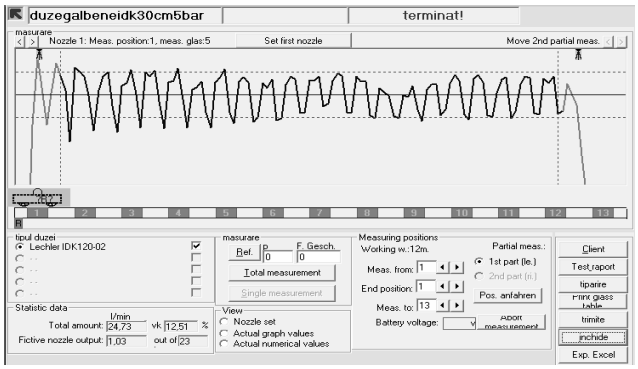

Fig. 3. The distribution uniformity graph for boom height by 30 cm and liquid pressure by 5 bar

From the showed graphs (figure1, figure 2 and figure 3) we can see that at a boom working height by 30 cm the optimum liquid pressure is 2 bar, case in which the variation coefficient for distribution uniformity is 8.62% (should be between 7-9%), which is acceptable for herbicide applications.

The second case that we consider is for the boom height by 50 cm for liquid pressure by 2 bar, 3.5 bar and 5 bar.

The results are shown in the graphs from figures 4, 5 and 6, in which is showed the distribution uniformity on the working width of the EEP-600 sprayer and also the variation coefficient for each situation (see statistic data, with symbol vk).

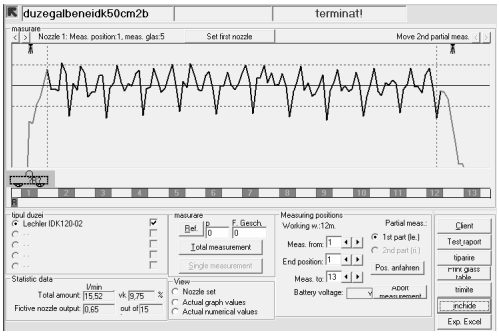

Fig. 4. The distribution uniformity graph for boom height by 50 cm and liquid pressure by 2 bar

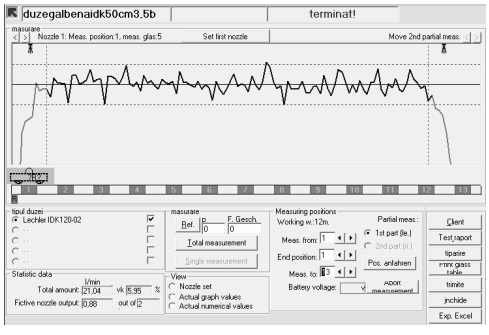

Fig. 5. The distribution uniformity graph for boom height by 50 cm and liquid pressure by 3,5 bar

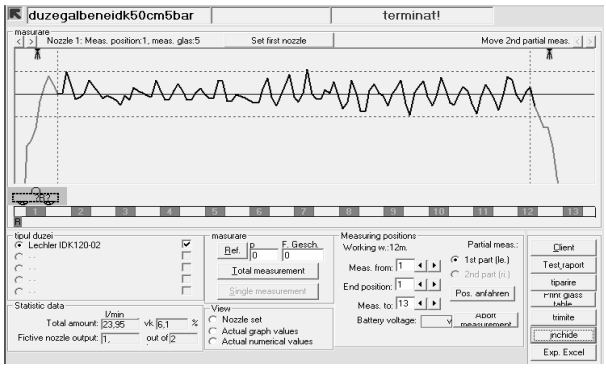

Fig. 6. The distribution uniformity graph for boom height by 50 cm and liquid pressure by 5 bar

From the showed graphs (figure 4, figure 5 and figure 6) we can see that at a boom working height by 50 cm the optimum liquid pressures are 3,5 bar and 5 bar, cases in which the variation coefficients for distribution uniformity are 5.95% and respectively 6.1%, situations in which the uniformity is very good, suitable for herbicide applications.

The third case that we consider is for the boom height by 70 cm for liquid pressure by 2 bar, 3.5 bar and 5 bar.

The results are shown in the graphs from figures 7, 8 and 9, in which is showed the distribution uniformity on the working width of the EEP-600 sprayer and also the variation coefficient for each situation (see statistic data, with symbol vk).

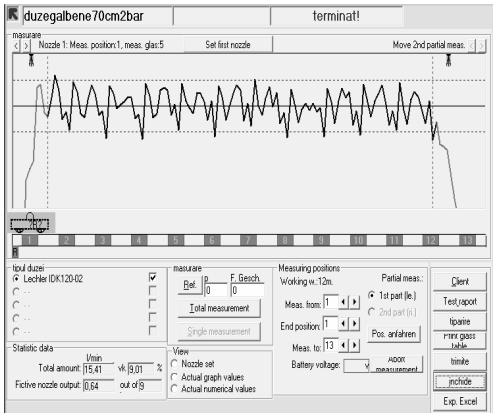

Fig. 7. The distribution uniformity graph for boom height by 70 cm and liquid pressure by 2 bar

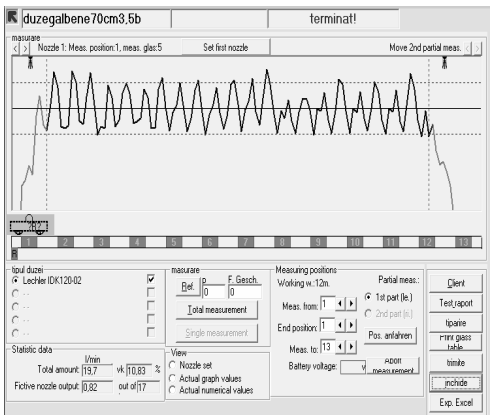

Fig. 8. The distribution uniformity graph for boom height by 70 cm and liquid pressure by 3,5 bar

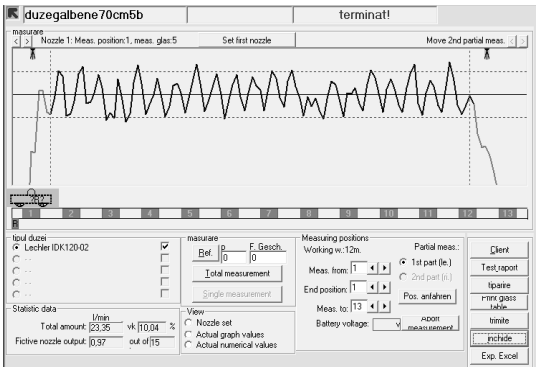

Fig. 9. The distribution uniformity graph for boom height by 70 cm and liquid pressure by 5 bar

From the showed graphs (figure 7, 8 and 9) we can see that at a boom working height by 70 cm the variation coefficients for distribution uniformity are higher than 9%, for each chosen liquid pressure, so this is a situation not suitable for herbicide applications.

CONCLUSIONS

1. From the analysis of data charts for distribution uniformity we can see that for a certain type of nozzle the distribution uniformity on the working width of the sprayer is influenced by the working pressure and by the boom working height (or boom distance regarded to target surface).
2. From the measured data we can conclude that for IDK 120-02 nozzle type, in order to get a good distribution uniformity it is necessary to adjust the boom height to 50 cm and liquid pressure by 3.5 bar and 5 bar, when the variation coefficient is 5.95 and respectively 6.1. For the boom working height by 30 cm and liquid pressure by 2 bar the distribution uniformity is acceptable, but in the other studied situations the distribution uniformity exceeds the required limits.

REFERENCES

1. Drocas I., 2005. *Norme Europene impuse maşinilor pentru tratamente fitosanitare*. Revista "Protecţia plantelor" nr. 58, ISSN-1453-2271.
2. Drocas I., A. Molnar, O. Ranta, S. Stanila, 2007. *Strategical objectives regarding rational use of agrochemicals.* International Conference "Agricultural and Food Sciences, Process and Technologies" with the theme "Agriculture And Food Industry Within The European Integration", Sibiu.
3. ***Notiţă tehnică stand TEST-1000.