VARIATION OF TRANSVERSAL DISTRIBUTION UNIFORMITY FOR EEP-600 ME IN CORELATION WITH BOOM STABILITY

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Abstract. *The practice of sustainable agriculture demands the best qualitative indexes for spraying machines and, especially, better distribution uniformity on the working width of these machines. Due to the importance of the spraying machines, the European Norms in the field have elaborated directives, rules or recommendations in order to contribute to the safety of users (EN 907) and to limit the negative impact upon the environment (EN 12762; EN 13700). The modernization of the spraying machines and a good know-how are the main factor which influence mostly not only the uniform distribution of the substance, but also assures the precise quantity of solution per hectare. This finally leads to the reduction of the pollution. This modernizations of the spraying machines are the implementations of new additionally and essential equipments and systems in order to apply the substance correctly and to comply with the European Standards. As a result of collaboration between USAMV Cluj Napoca and SC Tehnofavorit SA, Bontida, a spraying machine (EEP-600 ME) was designed and developed which is in accordance with the EU rules. The experimental trials in labaratory conditions were made for EEP-600ME mounted spraying machine by using the HERBST TEST 1000 testing equipment for measuring the cross-cut distribution uniformity, which showed the fact that the boom inclination angle has a great influence on distribution. Rise of boom inclination angle over 2 º leads to decreasing of distribution uniformity. At boom inclination angle only by 5º, the variation coefficient of distribution uniformity is over 37%, value that exceeds the allowable limit by four times over. At boom inclination angle only by 7º, the variation coefficient of distribution uniformity to get 29%. In order to maintain the qualitative indexes in sloped areas there is a demand to use spraying machines that are equipped with devices for boom leveling.*

Keywords: *spraying machine, boom inclination angle, variation coefficient for distribution uniformity.*

INTRODUCTION

The sustainable agriculture, as a altenative to conventional agriculture, demands technologies that must comply with human needs, without discredit the demands and options of future generations and in the same time must not lead implacable debase of natural environment.

The present studies and researches regarding the methods and equipments for fitosanitary crop treatment are in line with present tendency for sustanable agriculture promotion, being known that fitosanitary protection is one the of the main sources for environment pollution with chemicals.

In order to reduce the environmental impact are two ways:

- to use biodegradable agrochemicals in small amount;
- to assure a better distribution uniformity nd to maintain a precise rate applied on surface.

These methods implies the use of high tech spraying machines, that have a equipment for automated adjustment of aplication rate and a equipment for boom stability.

The mounted spraying machines which do not have a way for adjustment of boom palallelism with ground surface, when it works on hilly areas, can not reach to required distribution uniformity which leads to uneven liquid distribution over treated areas. This means

poor quality agrochemicals application and environment pollution.

The way how the agrochemical solutions are divided on the working width of the spraying machine, in the case when the boom in not parallel to ground surface, is less studied and we think that is a actual study can show the drawbacks of agrochemicals application in these terms.

Uniformity of distribution of the spraying machines is an important qualitative indication. It can influence the quality of treatment and also cause environmental pollution.

Among the factors influencing the uniformity of distribution the working width one can enumerate the following: working height between nozzle and the surface, the nozzle type and characteristics, working pressure and boom stability.

Within this paper there was studied how the vertical boom stability and position affects the uniformity of distribution.

MATERIAL AND METHODS

For determination of distribution uniformity on the working width of the spraying machine was used a HERBST TEST 1000 equipment, available at Department of Agricultural Engineering , and a mounted spraying machine EEP-600ME, developed at mentioned department, in a framework of a research project in cooperation with TEHNOFAVORIT manufacturer.

By the help of the mentioned equipment is possible to get the variation chart of distribution uniformity on the working width of the spraying machine and the variation coefficient of crosscut distribution uniformity.

The spraying machined is equipped with electronic devices for adjustment of liquid flow and working pressure. The machine, with working width by 70 cm, was equipped with IDK-120-04 nozzle type and boom tilt was adjusted by the help of adjustable bearing.

The determination of distribution uniformity was made when the boom was horizontally and tilted by 2°, 5° and 7°.

A snapshot of experimental trials is showed in fig.1.

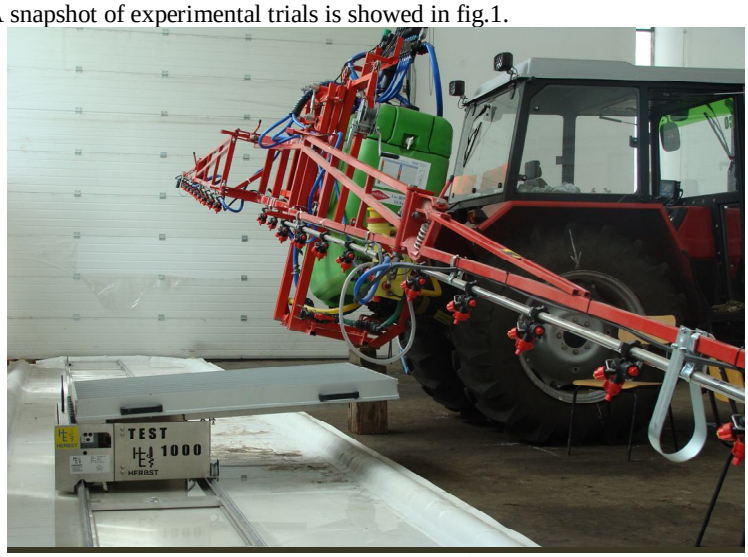

Figure 1. Snapshot with equipments used for experimental trials

RESULTS AND DISCUSSIONS

Following the experimental trials were obtained the distribution uniformity graphs on the working width of the machine and the variation coefficient of the working width of the machine.

For the case when the boom was horizontal (fig.2) the distribution uniformity was good the variation coefficient being 5,54 % (less than 7 %).

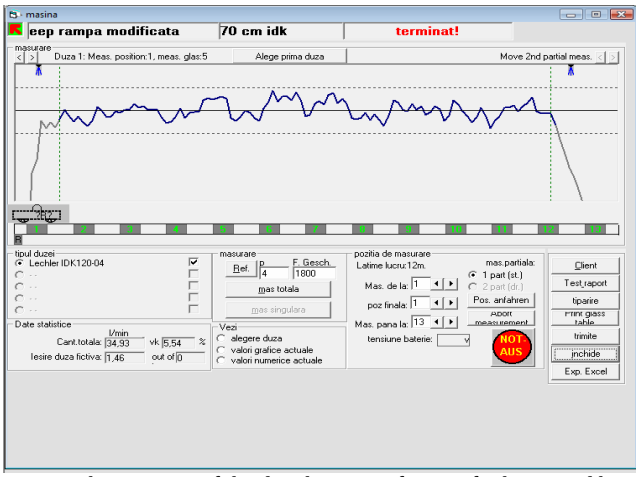

Figure 2. The variation of the distribution uniformity for horizontal boom

The adjustment of boom tilt angle at 2° leads to alteration of distribution uniformity, the variation coefficient is increasing to 6,78 %, lower than 7 %, which gets to a good distribution uniformity. From the graph analysis (fig.3) it is possible to see that exists only two points which exceeds the required ± 15 %, which are located at boom section that is close to ground surface. So, at a tilt angle by 2° does not imply a significant alteration of uniformity.

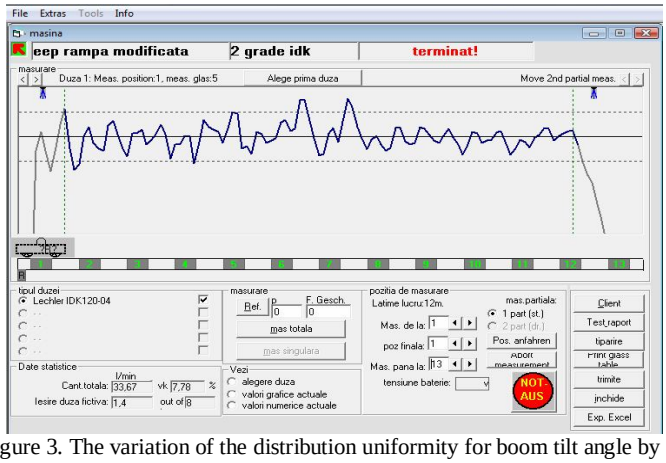

Figure 3. The variation of the distribution uniformity for boom tilt angle by 2°

The adjustment of boom tilt angle at 5° (fig.4) leads to significant alteration of distribution uniformity, the variation coefficient being 37,87 %, which is unacceptable, being higher than required limited by 9 %.

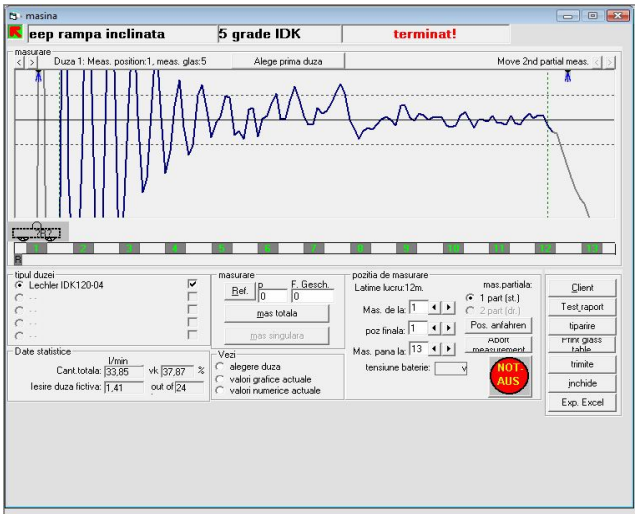

Figure 4. The variation of the distribution uniformity for boom tilt angle by 5°

Analyzing the graph (fig.4) it is possible to see that distribution uniformity exceeds the required limits in the boom section that is close to ground surface. In the opposite boom section (where boom is outstrip to ground surface) the distribution uniformity is much better.

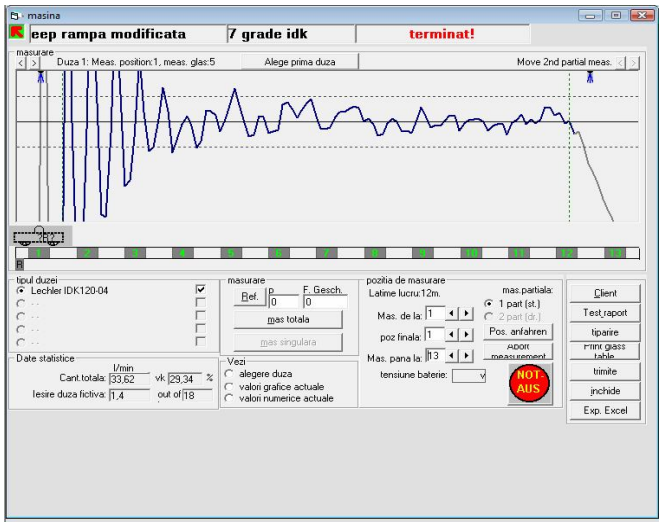

Figure 5. The variation of the distribution uniformity for boom til angle 7º

The variation of distribution uniformity at til angle 7º (fig.5) leads to poor distribution in boom section close to ground surface, fact that can be seen in the opposite boom section (where boom is outstrip to ground surface). The variation coefficient is 29 % being above the required limit.

In the boom center, where the nozzle remains in the same position, the distribution uniformity is good.

CONCLUSIONS

1. The distribution uniformity on the working width of the machine is influenced by boom position related to ground surface.
2. The increase of tilt angle over 2º leads to increasing of variation coefficient of the distribution uniformity on the working width of the machine over the required limit, as a consequence the machine will have poor qualitative indexes.
3. In order to maintain the boom position parallel to ground surface, when the spraying machine is working on hilly areas, it is necessary to use devices for vertical bomm stability.

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