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RESEARCH ON THE WEAR AND RELIABILITY OF MACHINES FOR COMBATING DISEASES AND PESTS IN VINEYARDS

CERCETĂRI PRIVIND UZURA ŞI FIABILITATEA MAŞINILOR PENTRU COMBATEREA BOLILOR ŞI DĂUNĂTORILOR DIN PLANTAȚIILE VITICOLE

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Abstract. *The HERBST ED-900 stand functioning is based on the liquid collection on each nozzle of the herbicide sprayer in vineyards and orchards by means of collectors that are mounted on each nozzle of the machine. Using this stand one can test sprayers for vineyards and orchards with 10 nozzles each, on a ramp. After the measurements made on the herbicide sprayer in vineyards and orchards, the liquid quantities collected in each cylinder are partially transmitted to the computer through the wireless system and are stored in a data basis. From here they may be either accessed as absolute values and sent in a text file, or a graph of the distribution variation may immediatelly be visualized.*
Key words: nozzle, herbicide sprayer, vineyards and orchards

Rezumat. *Funcționarea standului HERBST ED-900 se bazează pe colectarea lichidului pe fiecare duză a maşinii de erbicidat în vii şi livezi prin intermediul unor captatoare care se montează pe fiecare duză a maşinii. Cu acest stand se pot testa maşini de stropit în vii şi livezi cu câte 10 duze pe o rampă. În urma măsurătorilor efectuate pe maşina de erbicidat în vii şi livezi, cantitățile de lichid recoltate în fiecare cilindru în parte sunt transmise la calculator prin sistemul wireless şi sunt stocate într-o bază de date. De aici pot fi accesate fie sub formă de valori absolute şi exportate într-un fişier text sau se poate vizualiza imediat graficul de variație a distribuției.*
Cuvinte cheie: duză, maşină de erbicidat, vii şi livezi

INTRODUCTION

The test and experimental ensemble is made up of a portable spraying machine, **ATOM-300**, produced by S.C. TEHNOFAVORIT S.A. Bonțida-Cluj and a Stand for testing the distribution uniformity of the spayers in vineyards and orchards, **Herbst ED 20-900**, produced by Ernst Herbst Prüftechnik e. K. Hirschbach-Germany. The HERBST ED-900 stand functioning is based on the liquid collection on each nozzle of the herbicide sprayer in vineyards and orchards

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by means of collectors that are mounted on each nozzle of the machine. Using this stand one can test sprayers for vineyards and orchards with 10 nozzles each, on a ramp (in the case of the measurements made, 12 nozzles) (Tenu *et al*., 2004; Tenu *et al.,* 2015).

MATERIAL AND METHOD

The stand (fig. 1) is provided with ultrasonic sensors for level measurement in glasses and a 12 V battery.

Fig. 1 Stand for testing the distribution uniformity of the spayers, Herbst ED 20-900

1 – framework; 2 – water collection basin during the measurements; 3 – supports for collector installing; 4 – collectors that are mounted on the nozzles of the sprayer to measure the flow; 5 – wireless transmission device for the data measured on the stand; 6 – collector graduated cylinders for flow measurement ; 7 – the liquid transfer tubes from the nozzles to the collector graduated cylinders.

The solution thus collected from each nozzle will get to the collector cylinders. Each cylinder is equipped with an ultrasonic sensor by means of which the level of the collected liquid is determined, and by means of the soft delivered with the stand, the liquid level in the cylinders is converted into a volume of liquid (fig. 2).

After the measurements made on the herbicide sprayer in vineyards and orchards, the liquid quantities collected in each cylinder (fig. 3) are partially transmitted to the computer through the wireless system and are stored in a data basis. From here they may be either accessed as absolute values and sent in a text file, or a graph of the distribution variation may immediatelly be visualized.

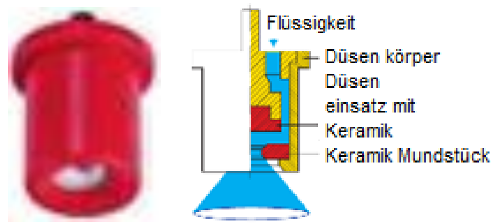
Fig.2 Measuring ramp in the liquid leak position

Fig.3 Ramp with the liquid collector cylinders

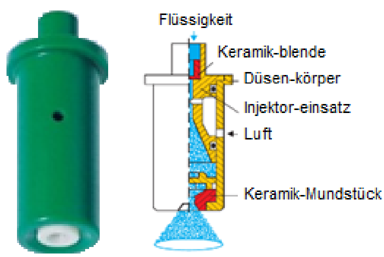
The measurements were made as following: on both ramps of the sprayer 12 identical nozzles were mounted; the sprayer was coupled to the stand for testing the distribution uniformity; the tank of the sprayer was filled with clean tap water; calgon was administered in water; the working pressure was adjusted; the electromotor was coupled, putting the sprayer into operation; the tightness of collectors was checked; after a period of leakage uniformity, the first basic measurement was made; then, periodically, every 12 hours, the measurements were repeated, making 3 measurements each time, in order to check the accuracy of the measurements; the measurement period of a nozzle set lasted from 2 to 2 weeks, generating a period of exploitation, equivalent to a working campaign; periodically, the water quality was checked and the tank water level was completed with clean water; after each measurement, the results were recorded and stored in the computer memory, creating the data basis for processing and interpreation.

The nozzles used during the measurements were:ceramic nozzles made by Lechler-Germany, LC 1,0 and LC 1,2 from the series equipment (fig. 4), nozzles TR 80-030 made by Lechler – Germany (fig. 5) and Nozzles ITR 80-015 made by Lechler – Germany (fig. 6) (Diaconu *et al.*, 2015; Diaconu *et al.*, 2016; Naghiu L., 2009;).

Fig.4 Construction of the LC nozzle:
1 – screw cap; 2 – ceramic nozzle;
3 – swirling device; 4 – gasket; 5 – sieve.



a. **b.**
Fig.5 Nozzles TR 80-030
a. nozzle construction;
b. functional scheme.



a. **b.**
Fig.6 Nozzles ITR 80-015
a. nozzle construction; b. functional scheme.

RESULTS AND DISCUSSIONS

The flow constancy of the LC12 S1/D1-S6/D6 nozzles is variable depending on the position to the product supply source (fig. 7). LC12 S6/D6 nozzle has the most constant flow being also a supplying line end, with the best grouped values reported to the normal curve. Despite all these, the flow variation, reported to the confidence interval of 95% is of ± 0.15 L/min, phenomenon to be seen at the LC12 S2/D2 and LC12 S5/D5 nozzles too. The LC12 S1/D1 and S4/D4 nozzles have flows with variations of 0.2 L/min, generally situated above the normal curve, while the LC12 S3/D3 nozzles have a position predominantly below it. The temporal dynamics of the flows, irrespective of the position on the machine ramp, indicates an upward curve of the flow, with lower variations on the measurement interval 10-30 (50 – 150 hours) and 40-55 (200 – 275 hours) (fig. 8).

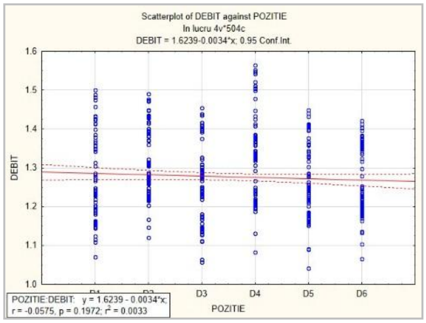


Fig. 7 Influence of the position on the ramp on the average flow S/D

On the measurement interval of 30-40 (150 – hours), the flow is generally below the normal level, which is due to narrowing modifications of the nozzle holes as a consequence of the wear. After this time slot, the nozzles enlarge their holes, but the deformation keeps the flow constantly upward.

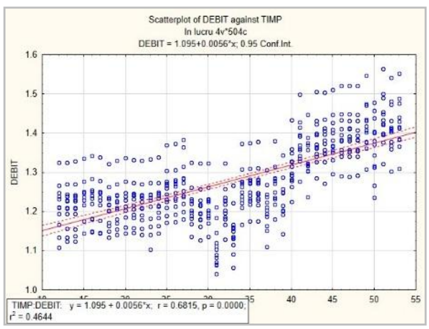


Fig. 8 Influence of the time of use on the average flow S/D

At a global level (fig. 9), the flow changes are due both to the position on the ramp and mostly to the time of use.

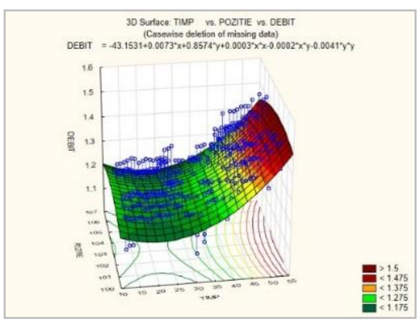


Fig. 9 Influence of the time of use and of the position on the ramp on the average flow

In the measurement interval of 15-25 (75 – 125 hours of working), the flow is lower compared to the initial one due to a slight nozzle deformation, after this time slot the wear being more evident and with an upward trend, until reaching a flow of more than 1.5 L/min, faster in the nozzles placed in the middle of the ramp than in those placed on the exterior side.

Compared to LC1,2 type, in the case of LC1 nozzles, the flow has a rising curve much more evident on short periods of time, with initial flows bigger at the ramp extremities (S1/D1 and S6/D6). An interesting phenomenon is the radial distribution of the flow and the moderate decrease of this parameter at the extremities during the use, concomitantly with a slight rise in the inside of the ramp. Overall, one can say that at a working duration of 117 hours, the pressure exercised by the treatment solution will balance the way of using nozzles and will normalize the way of the ramp working.

The placement of the nozzles on the ramp is determinant in the flow recorded in the whole treatment machine. The flow curve is downward, which indicates a flow decrease as the nozzle moves away from the supply source. The most constant nozzles are ITR80-015 S2/D2 and ITR80-015 S6/D6, with flows having fluctuations more reduced in time and more homogeneous as a distribution. The highest flow rates are recorded at the ITR80-015 S1/D1 nozzles, most of the determinations being above the normal curve.

The flow distribution in time indicates a reduced number of determinations placed within the limits of the confidence interval of 95% (fig. 10).

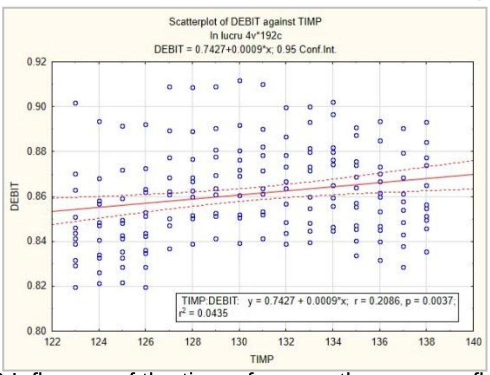


Fig. 10 Influence of the time of use on the average flow S/D

The position of the nozzles on the ramp strongly influences the studied flow (fig. 11), at all the nozzles being observed a slightly upward curve of the flow in the first half of the time of use, than a slightly downward curve in the second half of the interval. The ITR80-015 S1/D1 and ITR80-015 S2/D2 nozzles reach the maximum flows at the level of the whole treatment machine, while the

ITR80-015 S4/D4 and ITR80-015 S5/D5 nozzles maintain the flow below the level of 0.85 L/min on the whole time of use.

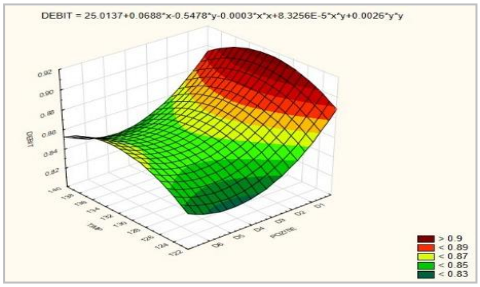


Fig. 11 Influence of the time of use and of the position on the ramp on the average flow

CONCLUSIONS

The most stable nozzles are S3/D3 and S5/D5, but in these two cases it is possible to have at a certain time a flow with 0.15 L/min higher or lower than the values of the flow distribution normal curve. An interesting aspect is the approach of the minimum flows registered at the S2/D2-S5/D5 nozzles to the normal curve which indicates a lower risk of not applying a sufficient quantity of products.

At the TR80-030 S3/D3 and TR80-030 S4/D4 nozzles one can observe the most combined flows indicating a better stability of this parameter on the arched curves of the sprayer ramp. The flow regression starts from a value of 0.7499, with a coefficient of -0.0195, but without statistical insurance.

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