THE AIR FLOW INFLUENCE ON THE UNIFORMITY OF DISPERSION FOR A VINEYARD SPRAYING MACHINE

INFLUENŢA DEBITULUI DE AER ASUPRA UNIFORMITĂŢII DE DISPERSIE PENTRU O MAŞINĂ DE STROPIT ÎN PLANTAŢII DE VIŢĂ DE VIE

DIACONU Andreea[1], ŢENU I.[1], CÂRLESCU P.[1], VLAHIDIS V.[1]
e-mail: andreea_diaconu_a@yahoo.com

Abstract. *Control of diseases and pests from vineyards is one of the most important technological links, because it makes the health of the culture, i.e. production of grapes. These treatments are applied with special machines, equipped with fans that can control drift droplets of phytosanitary substance, transporting them on target. For this reason, the determination of dispersion uniformity of the spray nozzles mounted on the machine is very important. In order to determine the influence of TARAL 200 PITON TURBO spraying machine fan airflow on the LECHLER's IDK 120-02 air absorption nozzles uniformity of dispersion, it was designed and built a vertical test stand with 18 troughs for collecting the substance from different heights. Analyzing the results obtained under laboratory conditions, it was found that the spraying machine fan air flow influences the uniformity of dispersion of the air absorption nozzles. The best uniformity has been achieved at the speed of 1400 rpm, being 90.20% for the pressure of 0.8 MPa.*
Key words: air absorbtion nozzles, sprayers, uniformity of dispersion, axial fans

Rezumat. *Combaterea bolilor i dăunătorilor din plantaţiile viticole este una dintre cele mai importante verigi tehnologice, deoarece condiţionează starea de sănătate a culturii, respectiv producţia de struguri. Tratamentele sunt aplicate cu maşini speciale, dotate cu ventilatoare care pot controla deriva picăturilor de substanţă fitosanitară, transportându-le pe ţintă. Din acest motiv determinarea uniformităţii de dispersie a duzelor montate pe maşina de stropit este foarte importantă. Pentru a determina influenţa debitului de aer a ventilatorului maşinii de stropit TARAL 200 PITON TURBO asupra uniformităţii de dispersie a duzelor cu absorbţie de aer IDK 120-02 LECHLER, s-a proiectat şi realizat un stand de probe vertical conceput cu 18 jgheaburi pentru colectarea substanţei de la diferite înălţimi. Analizând rezultatele obţinute în condiţii de laborator s-a constatat că debitul de aer al ventilatorului influenţează uniformitatea de dispersie a duzelor cu absorbţie de aer. Uniformitatea cea mai bună s-a obţinut la turaţia de 1400 rot/min, fiind de 90,20% pentru presiunea de 0,8 MPa.*
Cuvinte cheie: *duze cu absorbţie aer, maşină de stropi, uniformitate de dispersie, ventilator axial*

INTRODUCTION

Plant protection treatments applied in a timely and effective manner ensure a high production for vine plantations. Otherwise, production suffers very large

[1]University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

losses, can reach over 30%, or may even be compromised. For this reason, the fight against pests and diseases represents a very important technological component, without which the production would not be sure and steady from year to year (Kamousantas *et al*., 2000; Corneanu, 2003; Tomoiagă, 2013; Diaconu *et al.*, 2016).

For the application of phytosanitary treatments are used, in most cases, spraying machines with mechanical dispersion and pneumatic transport of the droplets. Optimal use of the air flow generated by the fan of these machines can improve the distribution of the droplets and the efficiency of the treatment on the surfaces of the plant (Viret *et al*., 2003; Pergher and Petris, 2008). The incorrect air flow use, for a too strong or too weak jet, can produce irregularity of the quantity of liquid pesticide sprayed on the leaves surface (in some areas the amount of pesticide sprayed is in excess, and appear the leakage phenomenon, and in other areas, the surface sprayed is very small and the treatment is ineffective), so uneven distribution in the canopy, and on the other hand there is a risk of pollution increased environmental and in particular of the soil (Doruchowski *et al.*, 1997; Panneton *et al.,* 2005).

In order to determine the influence of the spraying machines fan air flow, in the context of this work, it has been designed and made a vertical stand and experimental research have been carried out in laboratory conditions.

MATERIAL AND METHOD

In the Horticultural Laboratory Machinery of the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" from Iasi was designed and made a stand for the determination of the dispersion uniformity, at different working heights, using an universal machine for vines plantations pests and diseases combating with mechanical dispersion and pneumatic droplets transport, model TARAL 200 PITON TURBO. The sprayer was fitted with air absorption flat jet type IDK 120-02 nozzles, produced by LECHLER company. These nozzles prevent drift up to 90%, due to the fact that the spraying ramps generates large air-filled droplets, broken into small drops at their contact with the leaves surface the and improves the process of work, by covering a large area with liquid pesticide.

The stand is made of a vertical panel made of polycarbonate, with a length of 2350 mm and a width of 830 mm, on which were mounted the 18 inclined troughs, made of galvanized sheet. To determine the distribution uniformity of the substance dispersed throughout the panel, at the level of each trough there were mounted containers (fig.1). The substance collected for a minute, at the level of each trough in the containers was measured with a graduated cylinder.

The troughs were numbered starting at the base of the panel, from 1 to 18, trough number 1 being at the height of 300 mm from the ground, and number 18 at 2510 mm, the troughs being mounted on panel at 130 mm distance from each other.

The experimental tests were carried out in laboratory conditions, for different working pressures (0.2; 0.4; 0.6; 0.8; 1.0; 1.2 and 1.4 MPa) and speeds of the fan of 800, 1100 and 1400 rev/min. The height of the panels layout above ground was 300 mm, and the distance from the panel to the spraying machine axis of 1500 mm.

The dispersion uniformity of the pesticide liquid U_d (%), on the working height of the machine, must be, according to the data established in the literature, higher than 85% and is calculated with the relationship:

$$U_d = \left[1 - \frac{\sqrt{\frac{\sum_{i=1}^{i=n} (q_i - q_m)^2}{n(n-1)}}}{q_m} \right] * 100 \ (\%),$$

in which: q_i – the amount of liquid collected from each trough; q_m – the average amount calculated for all the collecting troughs; n – the number of troughs.

Fig. 1 Stand for determining the distribution uniformity of the dispersed pesticide fluid

RESULTS AND DISCUSSIONS

For the three speeds of the fan measurements have been made with an anemometer, in order to determine the velocity of the air flow discharge and air flow generated. The average speed measured at the level of the axial fan discharge section, respectively on the nozzle direction, was of 8.27 m/s for the speed of 800 rot/min, 11.71 m/s for 1100 rot/min and 14.32 m/s for 1400 rot/min. For these conditions it was calculated the fan air flow, after it was also determined the area of the discharge

section, being of 0.41 m^2, namely 12204 m^3/h at 800 rot/min, 17280 m^3/h at 1100 rot/min and 21132 m^3/h at 1400 rot/min.

For all three flow rates of the airflow generated by the fan of the spraying machine is was obtained a greater amount of the liquid collected in the trough at the height level of 820 mm from the ground (fig. 2, 3 and 4).

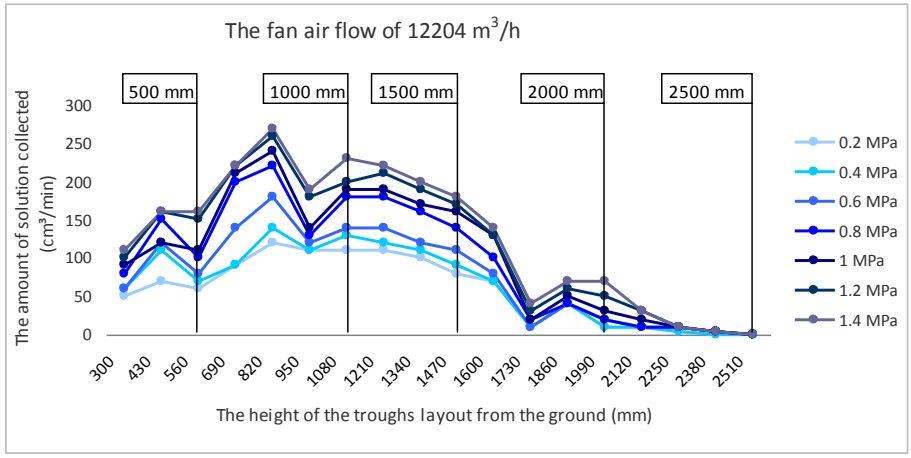

Fig. 2 The amount of liquid collected at the level of each trough for the fan air flow of 12204 m^3/h

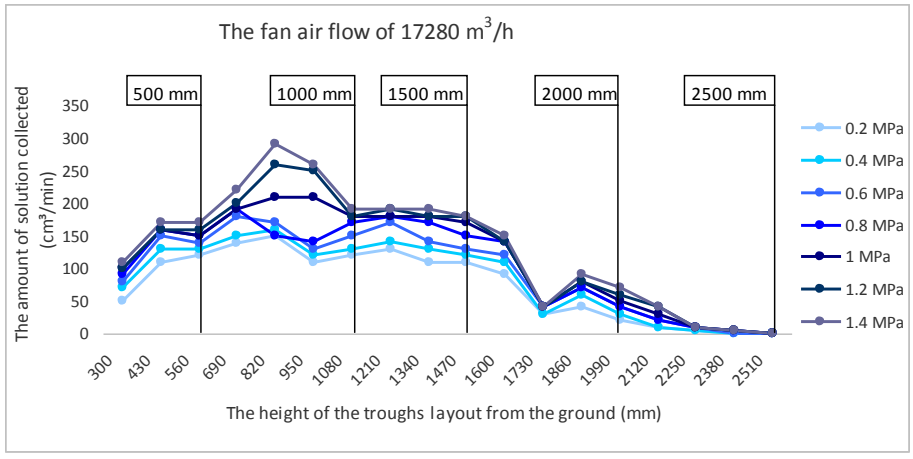

Fig. 3 The amount of liquid collected at the level of each trough for the fan air flow of 17280 m^3/h

The amount of liquid collected by the troughs decreases from the height of the of 1080 mm from the ground to the upper part of the stand of 1600 mm and from 560 mm to the lower part of the stand at 300 mm. The decreasing of the amount of liquid collected in the 1000-1500 mm range is more pronounced in the air flow case of 12204 m^3/h than in the air flow case of 17280 and 21132 m^3/h. In

the upper part of the panel, from 1730 mm to 2510 mm, the amount of fluid collected is smalller and comes from the drift of the droplets (fig. 2, 3 and 4).

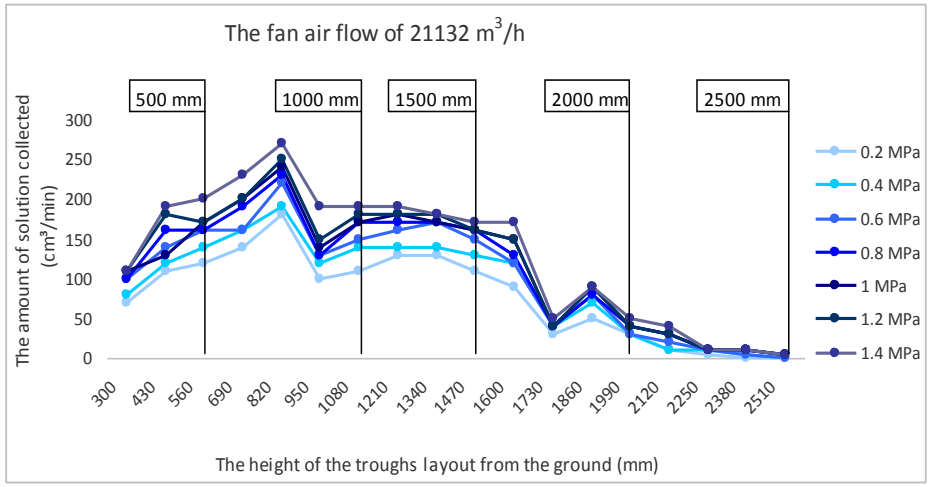

Fig. 4 The amount of liquid collected at the level of each trough for the fan air flow of 21132 m^3/h

By increasing the pressure it is noted that for all air flow rates generated by the spraying machine's fan the amount of liquid collected at the level of each trough increases, due to the larger amount given by the nozzles (fig. 2, 3 and 4).

To determine the uniformity of the liquid dispersion U_d (%) on the spraying machine working height, there have been removed from the calculation troughs from 15 to 18, i.e. those positioned above the height of 2000 mm, because above this quota, the vegetation of the plantation is reduced, and the amount of dispersed solution values are insignificant.

It is noted that the obtained values of the uniformity constant were greater than 85% in all the variants tested. The fan air flow of 21132 m^3/h has achieved the best uniformity, obtaining the following values: 90.20% for pressures of 0.8 and 1.0 MPa, 90.00% for 0.6 MPa, 89.57% for 0.4 MPa and 89.55% for 0.2 MPa. For the fan air flow of 17280 m^3/h there were obtained high values of uniformity to the following presures: 89.80% for the pressure of 0.6 MPa, 89.76% for 0.8 MPa and 89.66% for 1.0 MPa. For the fan air flow of 12204 m^3/h it was obtained a lower uniformity than in the other cases, the best uniformity being 88.70% obtained at the pressure of 1.4 MPa, followed by the pressure obtained at 1.2 MPa with 87.80% and then by 0.2 MPa with 86.80% (fig.5).

So, by increasing the air flow generated by the spraying machine fan, you can get a better treatment uniformity (fig.5).

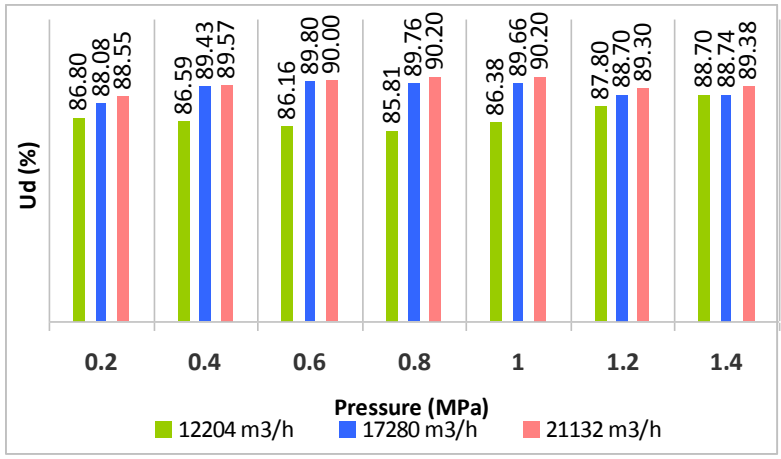

Fig. 5 Liquid dispersion uniformity on the working height of spraying machine for different axial fan air flow rates and working

CONCLUSIONS

The fan air flow of the TARAL 200 PITON TURBO spraying machine affects the dispersion uniformity of the air absorption nozzles. The best uniformity was obtained at the flow rate of air 21132 m^3/h, being of 90.20% for the 0.8 and 1.0 MPa pressures.

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