Researches Regarding the Spraying Uniformity of the TARAL 200 PITON TURBO machine

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ABSTRACT

Pest and disease control is an import technological link in order to maintain the health of the plantations and to obtain large amounts of high quality productions. Chemical control is the main method used in plant protection. Pesticides are applied on vegetation using sprayers specially designed for this purpose. Wear of the spray nozzle orifices, due to the hydroabrasion corrosion, leads to an uneven covering of the vegetation mass, with either untreated areas or overtreated ones. Before the start of each pest and disease control campaign, the nozzles should be tested in order to evaluate the uniformity of the liquid dispersion. In order to evaluate the dispersion uniformity for the TARAL 200 PITON TURBO spraying machine, a vertical stand was designed, fitted with 11 inclined troughs, each ending with a container for collecting the liquid. The tests were performed at different operating pressures, distances from the axis of the spraying machine, heights above the ground and fan speeds. The most uniform spray distribution was achieved for a height of 500 mm, for fan speeds of 800 and 1400 rev/min and for all the operating pressures and distances. For the height of 700 mm, uniformity was achieved for a speed of 1400 rev/min, for all operating pressures and for the distances of 1700, 1900 and 2100 mm.

Keywords: nozzle sprayers, pesticides, plant treatment, spraying, uniformity.

INTRODUCTION

Pest and disease control in vineyards is one of the most important technological links to obtain high yields of grapes. Diseases and pests can cause significant economic losses. If pesticide treatments are not applied efficiently and in time, production can be completely lost (Berca, 2001; Țenu *et al.*, 2013).

The spraying equipment should be verified periodically in order to ensure an adequate treatment from the point of view of its efficiency and in terms of protecting the environment (Nagy *et al.*, 2006). A correct application of the phytosanitary treatments, with high quality operating indices, leads to the decrease of production losses, of the amount of pesticides used and of the environmental pollution (Nagy and Coța, 2007). In time, the nozzles wear out due to corrosive action of pesticides and spraying and their orifices are decalibrated. Thus, there is a rigorous control flow achieved. For this reason, it is necessary that before each campaign to combat pests and diseases, to determine the uniformity of the spray nozzle (Neghiu, 2008).

The purpose of this study was to determine the flow distribution through the spray nozzles for the TARAL 200 PITON TURBO spraying machine.

MATERIALS AND METHODS

In order to evaluate the spray distribution uniformity for the TARAL 200 PITON TURBO machine, used for pest and disease control in intensive vineyards and orchards, a test rig was designed and built. The rig has a vertical panel fabricated from polycarbonate, with a thickness of

10 mm, a length of 1500 mm and a width of 850 mm. Eleven galvanized steel trays were placed on the panel; the trays were inclined at 5° and placed at 100 mm distance from each other. Each chute



Fig. 1. Test rig for evaluating the uniformity of the spray nozzles flow distribution, for the TARAL 200 PITON TURBO machine.

has a container at its end in order to measure the quantity of retained solution (Fig. 1).

The liquid distribution uniformity along the operating height of the machine U_d (%) must be higher than 85% and is calculated with Eq.(1):



Where q_i – the flow collected by each tray;

 q_m – the average flow rate; n – number of chutes.

RESULTS AND DISCUSSION

In order to evaluate the spraying uniformity of the TARAL 200 PITON TURBO machine laboratory tests were performed using the volumetric method, the solution collected during two minutes in each tray being measured with a graduated cylinder. The tests were performed for different heights of the test rig above the ground (500 to 700 mm), different distances of the rig from the axis of the



Fig. 2. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 800 rev/min fan speed, 500 mm rig height and distances of:(a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.



Fig. 3. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 800 rev/min fan speed, 700 mm rig height and distances of:(a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.

spraying machine (1500, 1700, 1900 and 2100 mm), different fan speeds (800, 1100 and 1400 rev/min) and several operating pressures (0.2, 0.4, 0.6, 0.8, 1, 0, 1.2 and 1.4 MPa).

With the increase of the working pressure and because to the higher turbulence, the distribution uniformity is affected, the best uniformities being achieved for the following operating pressures: 0.2, 0.4 and 0.6 MPa. For a fan speed of 800 rev/min, with the rig placed at a height of 500 mm and at 1500 and 1700 mm distance from the machine axis, trays 1, 2, 6, 7 and 8 collected higher quantities of solution, while the lowest amounts were collected in trays 10 and 11. For the distances of 1900 and 2100 mm trays 7, 8 and 9 collected the higher quantities, while lower amounts of liquid were colected into trays 1, 2, 3 and 4 (Fig. 2).

With the increase of the mounting height to 700 mm, for the same speed of the fan, it was found that, for the distances of 1500 and 1700 mm, trays 6, 7 and 8 collected higher quantities; for the distance of 1900 and 2100 mm, the maximum amount of collected liquid moved towards the trays 8, 9 and 10 (Fig. 3). This behavior is due to the fact that the spray beam moves when increasing the height and the distance from the panel.



Fig. 4. U_d (%) depending on the operating pressure and the distance from the machine axis (800 rev/ min): (a) height 500 mm; (b) height 700 mm.

For a fan speed of 800 rev/min, with the rig placed at a height of 500 mm, the distribution uniformity index was higher than 85% for all the operating pressures and distances (Fig. 4a).

When the rig was placed at a height of 700 mm above the ground the values of the distribution uniformity index were higher than 85% for the following test conditions: pressures of 0.2 0.8 and 1.0 MPa, distances of 1500, 1700 and 1900 mm; for the distance of 2100 mm a value lower than 85% was recorded at an operating pressure of 0.4 MPa (Fig. 4b).

The results for the fan speed of 1100 rev/min were similar to the ones obtained for the speed of 800 rev/min: as the distance increased from 1500 to 2100 mm, the maximum flow moved from the lower part of the panel towards its upper part). Flow uniformity was achieved only for pressures between 0.6 and 0.8 MPa and a distance of 1900 mm (Fig. 5).

Increasing the height above the ground to 700 mm resulted in higher flow rates being recorded in the lower part of the rig (trays 1, 2, 3) and towards its middle (trays 5 and 6), for all the tested distances (Fig. 6).

For a fan speed of 1100 rev/min and the height of 500 mm, values of the distribution

uniformity index higher than 85% were recorded for the following operating pressures: 0.4; 1.0; 1.2 to 1.4 MPa and for all the distances taken into account; when the pressure was set to 0.8 MPa the distribution uniformity index recorded values below 85% for all the variants. With the operating pressure set to 0.2 and 0.6 MPa the recorde uniformity was above 85% for the distances between 1700 and 2100 mm (Fig. 7a).

When the rig was placed at a height of 700 mm

 U_d (%) recorded values higher than 85% only for the pressures of 0.4, 1.2 and 1.4 MPa; for all the other pressures values below 85% were recorded for all the distances considered (Fig. 7b).

Fig. 8 presents the results recorded for the fan speed of 1400 rev/min. For all the distances taken into account the lower area of the panel (trays 1, 2 and 3) recorded higher flow values, the quantities being diminished towards the upper area of the panel. Higher uniformities were achieved for the pressures of 0.2, 0.4 and 0.6 MPa (Fig. 10).

Similar results were obtained when the pannel was placed at 700 mm above the ground, larger quantities of liquid being collected in the lower part of the panel and lower quantities in the upper part (Fig. 9).



Fig. 5. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 1100 rev/min fan speed, 500 mm rig height and distances of: (a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.

For the fan speed of 1400 rev/min and the height of 500 mm all the values of the distribution uniformity index were above the 85% limit (Fig. 10a).

When the panel was placed at a height of 700

mm, most of the values of the U_d (%) index were higher than 85%; exceptions were recorded for the 1500 mm distance and the pressures of 0.6 and 0.8 MPa (Fig. 10b).

CONCLUSION

• The results of researches performed in laboratory conditions regarding the spraying uniformity of the TARAL 200 PITON TURBO machine led to the following conclusions:

- the spraying machine fulfills the conditions referring to a uniform and efficient spraying;
- for a fan speed of 1400 rev/min the uniformity achieved was higher than 85% in all the tested variants, except for the following: height of 700 mm, distance of 1500 mm, pressures of 0.6 and 0.8 MPa;
- for a fan speed of 800 rev/min values over 85% were recorded only when the panel was placed at a height of 500 mm;
- for a fan speed of 1100 rev/min U_d (%) recorded values higher than 85% at all distances, when the operating pressure was set to 0.4, 1.2 and 1.4 MPa, with the panel placed at a height of 700 mm; for the height



Fig. 6. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 1100 rev/min fan speed, 700 mm rig height and distances of: (a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.



Fig. 7. U_d (%) depending on the operating pressure and the distance from the machine axis (1100 rev/min): (a) height 500 mm; (b) height 700 mm.



Fig. 8. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 1400 rev/min fan speed, 500 mm rig height and distances of: (a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.



Fig. 9. Spraying uniformity of TARAL 200 PITON TURBO, depending on the operating pressure, at 1400 rev/min fan speed, 700 mm rig height and distances of: (a) 1500; (b) 1700; (c) 1900; (d) 2100 mm.



Fig. 10. U_d (%) depending on the operating pressure and the distance from the machine axis (1400 rev/min): (a) height 500 mm; (b) height 700 mm.

of 500 mm the requirements regarding the spraying uniformity were achieved only for the operating pressure of 1.0 MPa;

- in order to obtain higher quantities of liquid distributed in the central area of the panel the distance between the pannel and the machine axis should be of 1500 and 1700 mm when it is placed at 500 mm above the ground; for a height of 700 mm the optimum distance is of 1900 mm;
- the preferred height of the rig above the ground is 500 mm in order to achieve a high quality of the plant treatment;
- spraying uniformity was achieved for the operating pressures of 0.2; 0.4 MPa, 0.6 MPa and 0.8 MPa;
- the nozzles that equip the TARAL 200 PITON TURBO spraying machine ensure the distribution uniformity.

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