EQUIPMENTS FOR REDUCING SOIL POLLUTION WITH PESTICIDES FOR PEST AND DISEASE CONTROL IN VINEYARDS

Ioan ŢENU[1], Andreea DIACONU[1], Radu ROŞCA[1]

e-mail: itenu@uaiasi.ro

Abstract

Phytosanitary treatments are used for pest and disease control in vineyards; specialized machines and equipments are used for performing the treatments. Most of the equipments use the principle of hydraulic or/and pneumatic spraying of chemical solutions. In the process of spaying a certain part of the solution (especially at the first treatments) is lost and flows to the ground, thus leading to the chemical pollution of soil. In order to diminish this effect a special equipment was designed and constructed; its aim is to collect the droplets that do not reach the leaves. The equipment comprises two vertical panels, which are retractable and can be positioned on either side of the vineyard rows; the panels collect the chemical solution that was not retained by the plantation foliage. The recovered solution is then sent back into the tank of the spraying machine. Tests were performed in order to evaluate the efficiency of the equipment, aiming to establish the dependency between the solution retrieval rate and the position of the panels. For these tests the machine was equipped with flow meters for measuring the total amount of liquid drawn from the tank and the amount of liquid recovered by the means of the vertical panels.

Key words: spraying equipment, solution retrieval, soil pollution

In vineyards and orchards diseases and pests are accounted for up to 35% of the production harvest losses, while up to 28-30% of the overall energy consumptions are due to the operations related to pest control. These figures show the importance of pest and disease control as a component of the technological chain.

In orchards and vineyards the chemical control of pests and diseases is achieved by the means of spraying equipments, having working indices in correlation with the technological requirements of the respective crop. The constant improvement of spraying equipment and of the chemical substances used for pest control is a constant concern worldwide, the aim being the reduction of pesticide and fuel consumption.

During the spraying process a certain part of the chemical solution is lost because of the gaps between plants, because of the spray penetration through the row of plants, because of drift, because of the liquid dripping from the surface of the leaves etc. As a result the chemical solution ends by being scattered on the soil, in the air and in the neighboring plantations. In order to diminish the environmental pollution the current trend is to use lower amounts of water, while keeping the chemical dosage constant; the same aim is achieved by using spraying equipments that allow the control of droplets size and distribution, but the up to now this problem has not yet been completely solved.

In order to diminish the pollution resulting from the use of chemical substances for pest control a spraying equipment with partial retrieval of the spraying solution was designed. The present paper presents the construction of the spraying equipment and the results of the laboratory tests.

MATERIAL AND METHOD

The spraying equipment with partial retrieval of droplets is aiming to reduce soil pollution and the consumption of the chemical substances used for pest control.

The equipment was mounted on the TA 200 PITON TURBO universal spraying machine; the machine is used for pest and disease control in vineyards and intensive orchards. The equipment uses the principle of air-assisted spraying: an axial fan produces a high volume of air flow into which the spray is dispensed; a high pressure pump is used in order to produce fine droplets, which are carried by the air. These machines are used in vineyards and orchards because the flow of air sets the canopy in motion and thus the both sides of the leaves are covered with droplets.

The main characteristics of the air blast sprayer are: tank capacity – 200 l, air flow - 7920

[1] University of Agricultural Sciences and Veterinary Medicine, Iaşi

m^3/h, maximum flow of the pump - 55 l/min; pump pressure – adjustable between 0 and 4 MPa; number of spraying booms - 2; number of nozzles on each boom – 5. The equipment for the retrieval of droplets contains the following blocks (*fig. 1)*: - a metal frame (2), fixed on the spraying machine and equipped with the swinging swivels (6), on which the retrieving panels are mounted. Due to the swinging swivels the panels can be positioned at different distances relative to the axis of the equipment (1300, 1500, 1700, 1900 and 2100 mm) and different heights above the ground (300, 400, 500, 600 and 700 mm).

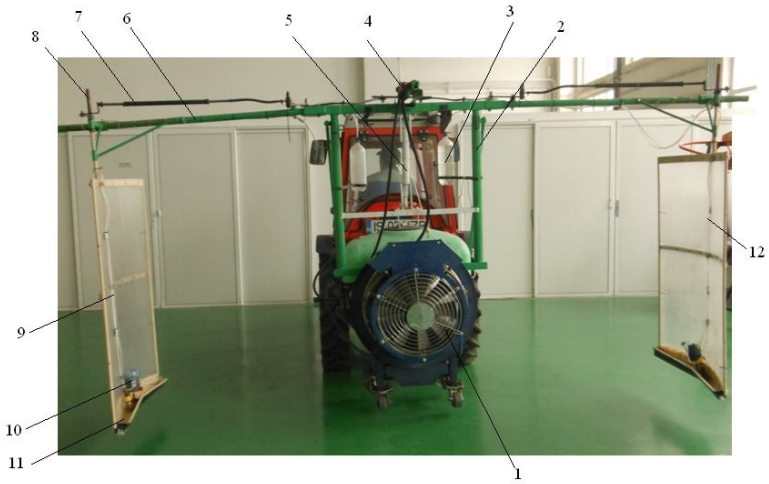


Figure 1 **Spraying machine for pest and disease control with equipment for the retrieval of droplets**
1 – spraying machine; 2-frame of the droplets retrieval equipment; 3 – graduated glass cylinders; 4 – hydraulic cylinder; 5 – tensional bar for height adjustment; 6 – swinging swivels; 7 – parallelogram mechanism; 8-supporting rods; 9, 12 - polycarbonate panels; 10 – electric pumps; 11 – spouts for droplets retrieval.

a)

b)

Figure 2 **Vineyard spraying equipment**
a) work position; b) transport position.

- two polycarbonate panels (9) for the retrieval of droplets, each of them mounted on a swinging swivel (6); the mechanism allows the panels to be either in the work position (*fig. 2 a*) or in the transport position (*fig. 2 b*).

The panels are provided with spouts at their lower ends, where the solution is collected, and with pumps for transferring the liquid to the graduated glass cylinders.

- the hydraulic system was completed with two flow meters in order to measure the liquid flow towards the nozzles (*fig. 3*); the liquid collected into the spouts is transported by the means of centrifugal pumps to the graduated glass cylinders (3).

In order to evaluate the performances of the equipment the tests should be performed in two phases: laboratory tests and field tests, in different vineyard vegetation stages.

RESULTS AND DISCUSSION

The laboratory tests were aimed to evaluate the effect of the position of the panels and of the working pressure over the amount of retrieved solution. The tests were performed considering that the foliage system is in a preliminary phase of development; water was used as the test solution.

The duration of each test was two minutes and the following variants were considered:

- working pressures: 0.2; 0.4; 0.6; 0.8; 1;0; 1.2 and 1.4 MPa;
- height of the panels above the ground: 300 mm, 500 mm and 700 mm;
- distance between the panels: 1500 mm, 1700 mm, 1900 mm and 2100 mm.

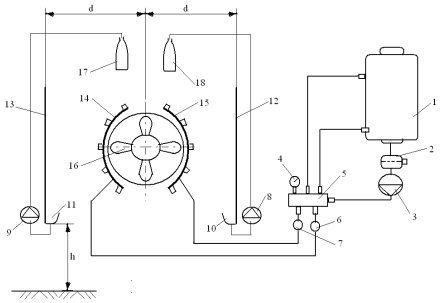
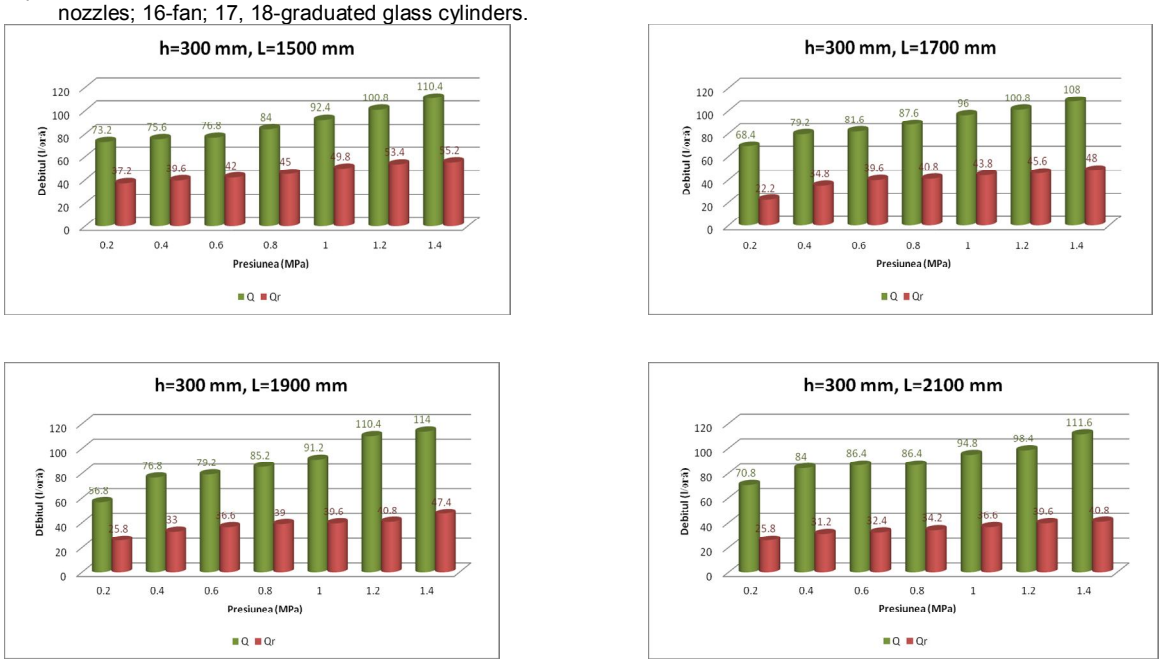


Figure 3 **Hydraulic diagram of the spraying machine**
1-tank; 2-filter; 3-pump; 4-manometer; 5-distributor; 6, 7-flowmeters; 8, 9-electric pumps; 10, 11-spouts; 12, 13-vertical panels for the retrieval of the solution; 14, 15-booms with nozzles; 16-fan; 17, 18-graduated glass cylinders.

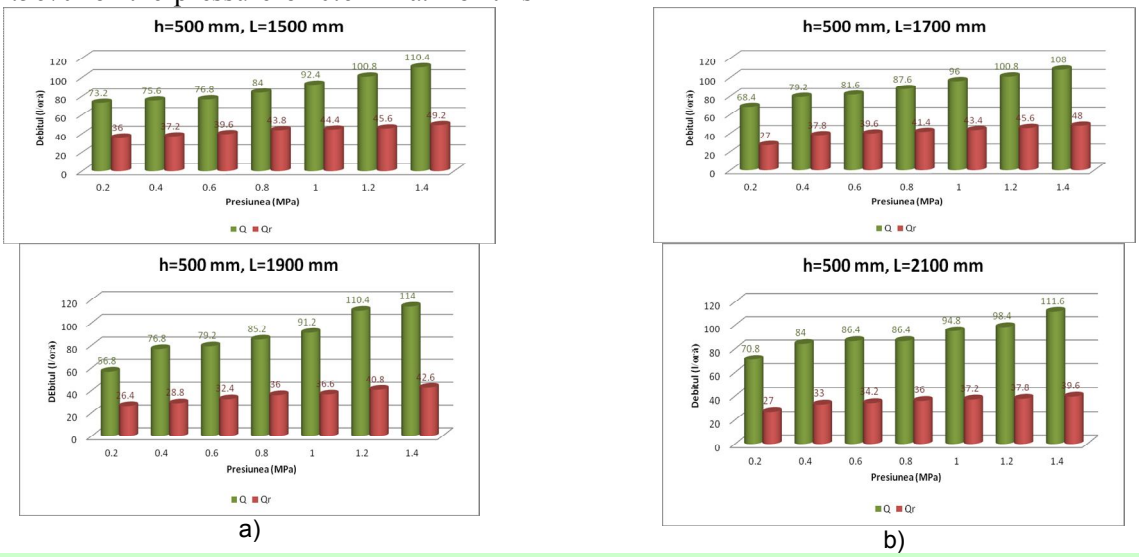
For the height of 300 mm, the best solution retrieval rate (54.68%) was accomplished for a pressure of 0.6 MPa and for a distance of 1500 mm between the panels (*fig. 4*); at 1.4 MPa, the retrieval rate decreased to 50.5%. For the same pressure of 0.6 MPa the retrieval rate decreased when the distance between the panels was increased, reaching 48.52% for a distance of 1700 mm and 34.2% for the distance of 2100 mm.



a) b)

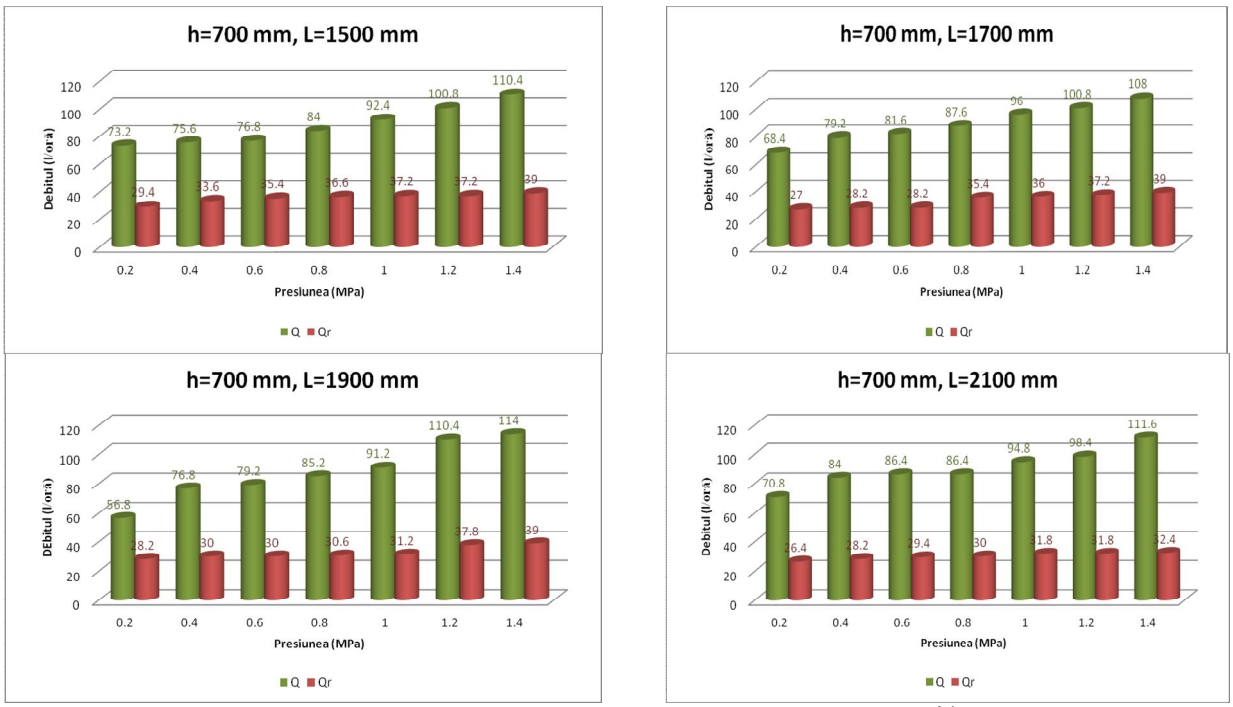
Figure 4 **The quantity of solution sprayed (Q) and retrieved (Q_r) for the right (a) and left boom (b), for the height of 300 mm**

When the panels were positioned at the height of 500 mm the best retrieval rate was also achieved for a distance of 1500 mm between the panels, reaching 52.14% for a pressure of 0.8 MPa and 51.56% for the pressure of 0.6 MPa. For this case also the retrieval rate decreased when the distance between the panels was increased, the best results being recorded for the same pressures (0.6 MPa and 0.8 MPa, *fig.5*).



a) b)

Figure 5 **The quantity of solution sprayed (Q) and retrieved (Q_r) for the right (a) and left boom (b), for the height of 500 mm**



a) b)

Figure 6 **The quantity of solution sprayed (Q) and retrieved (Q_r) for the right (a) and left boom (b), for the height of 700 mm**

When the panels were placed at a height of 700 mm the retrieval rate recorded its maximum value (46.09%) for a pressure of 0.6 MPa and a distance of 1500 mm between the collecting panels. As the distance between the panels was increased to 1700, 1900 and 2100 mm, the retrieval rate reached only 40.41% for the pressure of 0.8MPa, 39.06% for 0.4 MPa and 37.28 % at 0.2 MPa. The lowest values were recorded at a pressure of 1.4 MPa (*fig. 6*). The laboratory tests confirmed the efficiency of the equipment, proving that its use on spraying machines leads to the retrieval of an important quantity of chemical solution. The laboratory tests must undergo validation through field tests, for different stages of development of the vineyard foliage system.

CONCLUSIONS

The researches regarding the design and construction of an equipment aimed to retrieve the chemical solution used for disease and pest control in vineyards, as well as the experimental results obtained in laboratory conditions led to the following conclusions:

- the equipment fulfils the requirements imposed by the research theme;
- the equipment allows the reduction of the specific consumption of active substance used for disease and pest control;
- the retrieval of the surplus of chemical substance by the means of the panels placed on either side of the row leads to the diminishing of soil pollution;
- the retrieval of the chemical substance has the potential to achieve significant financial savings;
- spraying of multiple rows may lead to fuel savings and to the increase of the productivity of labor;
- the equipment is simple, reliable and easy to service and does not need any supplementary labor power;
- the equipment is cheap and is not expensive to service and maintain.

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