Pesticides application in Douro Region vineyards.

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Abstract

Experiments were conducted in vineyards installed in terrasses. The equipment used was a vineyard tractor with a mounted air carrier sprayer with hydraulic nozzles (hollow cone nozzles). Measurements of spray deposition were made in different parts of the canopy, which were defined by three stages and two sides; the fungicide used included cupper in its composition which was removed washing the leaves being the concentration determined in laboratory with an Atomic Absorption Spectrometry. Comparative trials were made between the original sprayer and the same sprayer changed to fit to the culture, with the purpose of comparing the spray quantity and its distribution in the plants. In this tests were determined also the liquid losses to the ground.

Objectives

The objectives of this research were to compare the spray performance of an original sprayer and the same one after some changes in order to adapt it specifically to the terraces vineyards with two rows.

Materials and Methods

The sprayer used was a Hardi, model Mini SPS, with the follow characteristics:

- reservoir 400 l;
- flow rate of the diaphragm pump 45 l/mn (PTO at 540 rpm);
- maximum pump pressure 2500 kPa (25 bar);
- air flow rate 11 000 m^3/h;
- radial turbine.

Figure 1- Representation of the original version and the modified one

The different boom sectors position are represented in figure 1. This position and a 45º rear angle allow a best accuracy spraying distribution in the canopy and increase the amount of pesticide deposition (Figure 2).

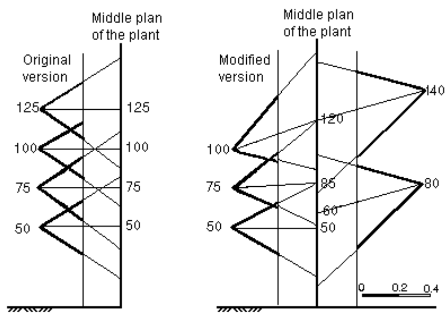


Figure 2- Localization of the differences nozzles relatively to the plant.

The tractor used was a Ferrari, model 95 RS with the follows characteristics:

- diesel engine, mark Lombardini, model 11 LD 625-3;
- nominal power 29 kW with 3000 rpm engine;
- 540 rpm PTO at 2500 rpm engine speed.

The vineyards were installed in terraces with 4 m large, with a row distance of 2 m, and the differences plants regions were the measurements were made are represented in figure 3.

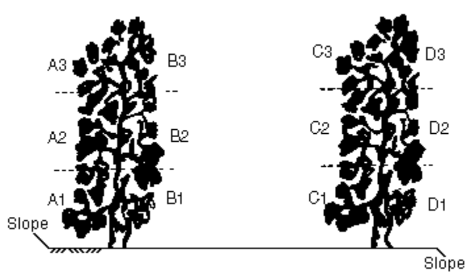


Figure 3- Representation of a vineyard terrace and the sample points of leaves within the canopy

The velocity used was the high possible within the vineyard and it was influenced mainly by the canopy development, the regularity of the soil surface and the existence or not of curves in the rows; the engine rpm should always allow to get 540 rpm in the PTO.

The independents variables were the two sprayer version, two velocities (3.58 and 4.14 km/h), the boom sectors (left and right), two pressure (300 and 600 kPa), two nozzles sizes (1.0 and 1.6 mm). The determinations concerned the copper deposited in the leaves (µg/cm^2), the coverage area (%) and the spray runoff (cm^3) to the ground; to wash the leaves a mixture of distillated water and hydrochloric acid (1%) were used.

The leaves sprayed impacts are determined with a software image analyser that gives the area percentage covered by the droplets in the water-sensitive cards, relatively to the all area; these cards were positioned in the six different parts of the plant.

To know the spray run-off some containers were positioned in the ground, under the plants, in the center and sides of the ranges. As the amount of the spray in the containers was too low we began to use the water-sensitive cards in that position to compare the spray losses to the ground.

Results and discussion

The graphic representation of the air stream velocity measured from a 0.5 m distance of the air outlet in the original and modified version was:

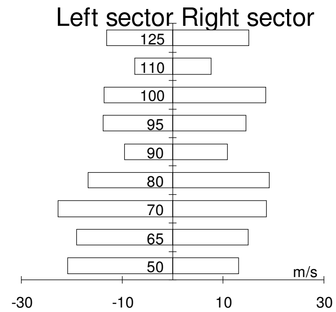
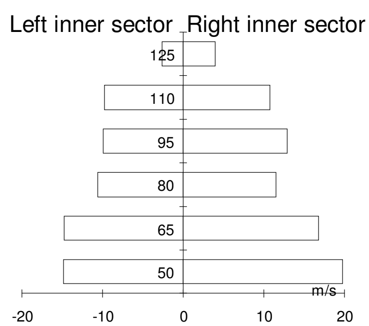


Figure 4 - Graphic representation of the velocity (m/s) in the original version at several distances from the ground.

In the original version, only with four outlets because the upper one of each side was tapped, in both sides (LS- left side, RS- right side), the velocity variation from the ground to the upper part of the sprayer, is significantly but, more important is too high.



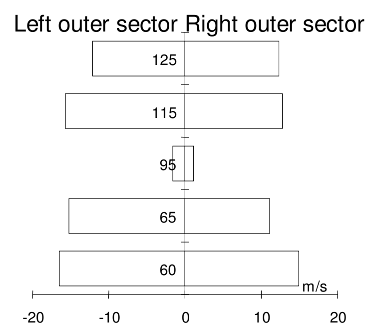


Figure 5- Graphic representation of the velocity (m/s) in the modified version at several distances from the ground.

In the modified version the air velocity was determined in the two sectors and for the two sets of outlets; the outside had two nozzles spray and the inside three nozzles orifices why, in the first situation, the space between the nozzles isn't almost influenced by the air stream.

Table 1- Sprayer flow rate results in the original (OV) and modified (MV) versions (*)

	Vel. ($km.h^{-1}$)	Pressure (kPa)	Nozzles (mm)	Flow (Nozzles) ($L.min^{-1}$)	Flow (ha) ($L.ha^{-1}$)	Flow (Nozzles) ($L.ha^{-1}$)
OV	3,58	300	1	5,58	233,80	29,22
			1,6	8,96	375,42	46,93
		600	1	7,74	324,30	40,54
			1,6	12,4	519,55	64,94
	4,14	300	1	5,58	202,17	25,27
			1,6	8,96	324,64	40,58
		600	1	7,74	280,43	35,05
			1,6	12,4	449,28	56,16
MV	3,58	300	1	7,30	305,87	30,59
			1,6	11,53	483,10	48,31
		600	1	10,19	426,96	42,70
			1,6	15,99	669,97	67,00
	4,14	300	1	7,30	264,49	26,45
			1,6	11,53	417,75	41,78
		600	1	10,19	369,20	36,92
			1,6	15,99	579,35	57,93

(*) In these trials we did not consider the spray output for each sector because they were very similar.

The canopy spray deposits that were taken at different plants development stage were statistical analyzed using ANOVA to get the copper mean values deposition in different plants zones and its coefficient of variation (cv) that is determined by the division of the standard deviation of the coverage and its means; this value express more accurately the distribution of chemical deposits because is unaffected by the factors that influence the spray deposition, such as the tractor speed.

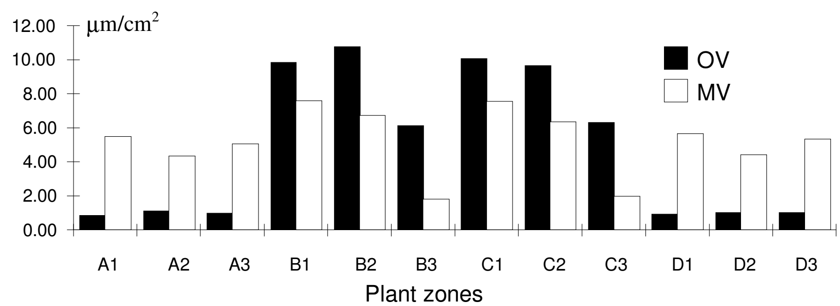


Figure 6- Graphic representations of the copper deposit with two sprayer versions

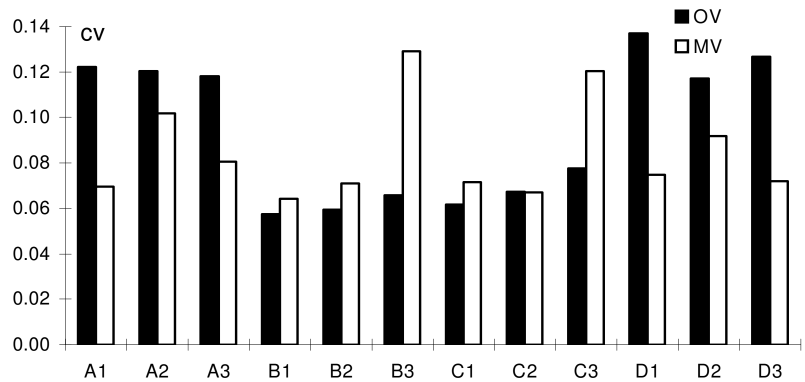


Figure 7- Variation coefficient in different canopy plants regions with the original version (OV) and the modified one (MV) in the different plants zones.

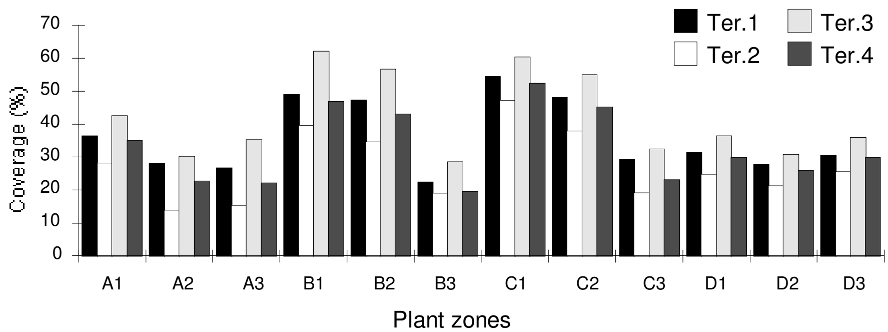


Figure 8- Spraying rate coverage in the different parts of the plants, using the modified version, in four terraces

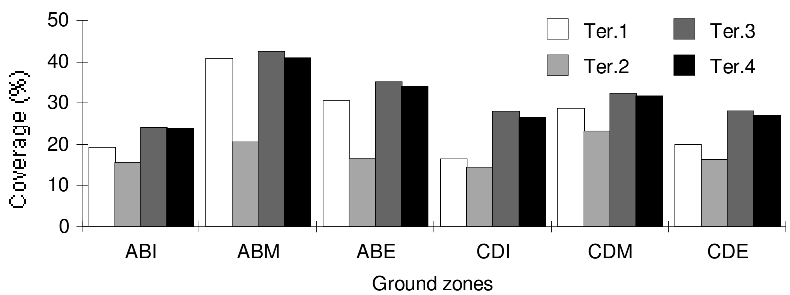


Figure 9- Ground rate coverage area in four terraces

The biological efficiency in all experiences was total why can't be used to compare the different options.

Conclusions

Considering the leaves copper deposited with the two sprayer versions it was noticed significant differences between the two situations being, with the original version, the deposits too high in the inside zones; to increase the deposits in the plants outside faces with the original version the inside face was too sprayed which could be hazardous to the plants. Relatively to the spray coverage area with the modified version the values range from 27.25 to 42.23 % for outputs ranging from 265 to 427 l/ha.

If the coefficients of variation in the different canopy zones were considered a better uniformity will be reach with the modify version, except in the regions B3 and C3.

The under canopy ground area covered by the drops, using the spray doses applied for the disease control, are especially relevant (17.8 to 31.7 %) why some improvements must be done to reduce theses spray losses; these losses result, mainly, from the shock of the air streams coming from the outside nozzles against the inside ones.

Comparing these results with some ones obtained for others authors it is possible to reduce the spray losses in the modified version reducing the air stream velocity that is yet too high when compare with those studies.

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