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TEHNOLOGII INOVATIVE PENTRU APLICAREA ÎN VII ȘI LIVEZI A TRATAMENTELOR PRIN STROPIRE CU IMPACT REDUS ASUPRA MEDIULUI. PREZENT ȘI PERSPECTIVE

INNOVATIVE TECHNOLOGIES FOR THE APPLICATION IN VINEYARDS AND ORCHARDS OF SPRAYING TREATMENTS WITH REDUCED IMPACT ON THE ENVIRONMENT. PRESENT AND PERSPECTIVES

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Abstract

The paper presents an analysis of the innovative technologies that are currently implementing spraying treatments with the reduction of specific consumption of pesticides, fuel, labour and especially the reduction of environmental pollution. They are presented for the administration of insecticides-fungicides and liquid fertilizers with machines for spraying vines and orchards of the carried type with a tank of 300-600 litres and of the trailed type with a tank of 600-2000 litres, which have standard fans or a tower with controlled spraying, 600-800 mm propellers with adjustable pitch, hot-dip galvanized metal parts, bronze nozzle holder, cardan shaft, etc. The work concludes with the recommendation of using an innovative spraying machine that allows significant savings of active substance, depending on the vegetative phase of the plantation at the time of spraying compared to conventional treatment.

Cuvinte cheie: tehnologii inovative, tratamente prin stropire, vii și livezi.
Key words: innovative technologies, spraying treatments, vineyards and orchards.

1. Introduction

Currently, at international level, there is an increasing emphasis on the improvement of spraying machines by equipping with spraying systems with superior parameters in the process of applying phytosanitary treatments in vineyards and orchards, because by solution losses and non-compliance with uniformity of distribution, etc., they contribute to overdose which leads to environmental pollution (soil, water) (Rosu et al., 2018).

In order to comply with Directive 2009/128/EC of the European Parliament and of the Council of the European Union, which establishes a framework for the sustainable use of pesticides by reducing the effects of their use on human health and the environment, research has focused on one of the ways to reduce the consumption of phytopharmaceuticals and at the same time the environmental impact, by developing machines that apply punctual spraying, according to the concept of "Precision Agriculture" (Dumitrascu et al. 2015).

The first steps taken to reduce environmental pollution when using sprayers were to use GPS navigation devices, which use satellites (up to 20 satellites) to determine the position of the unit, and the movement and deviation of the unit can be tracked on the display mounted in the tractor cab (Drocaș et al., 2010).

The low cost of electronic control systems has encouraged the development of new pest control equipment that reduces product losses and improves uniformity of distribution (Dumitrascu et al. 2018).

The development of ultrasonic sensors has led to the development of more technical equipment for spraying with variable speed in real time, and variable dose spraying allows farmers to apply pesticides only on the target, using only the correct amount depending on tree size, season and plant growth phase (Maghsoudi et al., 2015).

Ultrasonic sensors that provide only information in the form of the presence of the target and its distance can also be used to measure the culture width and adjust the applied dose (Önler et al., 2014).

INMA Bucharest designed and tested a spraying machine that uses ultrasonic sensors to detect the existence of the orchard plant mass, and the information is transmitted to a PLC programmable controller that controls the start or interruption of the spray device supply, through solenoid valves (Dumitrascu Andrei, Manea Dragoș, Căsăndroiu Tudor. 2015).

INMA also developed a technical spraying equipment that is provided with a tree point correction system based on a 2D laser sensor for light detection and ranging (LiDAR-Light Detection and Ranging)

that provides real-time information about the characteristics of the target culture, information that is processed by a computer and used for spray control (Manea et al., 2019).

The use of innovative technologies that currently apply spray treatments leads to a possible reduction in the number of treatments applied in a growing season as well as a reduction in the amount of phytosanitary substance administered per hectare, in order to increase the effectiveness of phytosanitary treatments applied in vineyards or orchards (Roman et al., 2020).

In order to reduce pesticide losses during the application of phytosanitary treatments in vineyards and orchards, different methods are being tried such as the use of flat jet nozzles, anti-drift, droplet forced precipitation and air tunnel assistance system, in which the spray parts are located in the immediate vicinity of the target object, or the use of machines to recover the working fluid, which has passed through the crown of the tree but has not deposited on the foliage (Panneton et al., 2001).

INMA Bucharest proposes in the research project "ADER 25.1.3 - Innovative mechanization technology for the maintenance of vineyards" a cycle of the technological process of vineyard treatment that includes some new operations - capture, separation of working fluid drops, collecting, filtering and pumping them in the tank for repeated use (https://inma.ro/ader-2020/).

2. Material and methods

The research materials and methods consisted in the use of the reading sheets of the research phases from the research project “ADER 25.1.3 - Innovative mechanization technology for the maintenance of vineyards” developed within ADER 2020 research programme (https://inma.ro/ader-2020/).

3. Results and discussions

Below are some machines for spraying in vineyards and orchards for the administration of insecticides - fungicides and liquid fertilizers that allow significant savings of active substance, depending on the vegetative phase of the plantation at the time of spraying compared to conventional treatment.

Ideal company from Italy manufactures Ideal Alpine Sprayer (Fig. 1) which is suitable for small and medium-sized plantations. Due to its small dimensions and its special fan, it is the solution for focused treatments in orchards and vineyards both on hilly and flat grounds.

Ideal company manufactures the Alpine sprayer model for treating orchards and vineyards in several types, which can be mounted or trailed, equipped with axial fans and polyethylene tanks of different capacities, to allow different types of treatment in a plantation with many planting systems (Table 1).

The mounted ones can have capacities of the liquid tank from 100l to 600l, and the trailed ones from 600l to 1000l.

Nobili Company from Italy manufactures the sprayer (Oktopus series), mounted or trailed, with pneumatic spraying system, for treatments with small volumes of solution and with an airflow of up to 185 m/s, which leads to ultra-fine pulverisation and excellent penetration of the vegetal mass.

The Oktopus series is available in a variety of 400-500-600 polyethylene tank configurations for the tractor-mounted version and 800-1000-1500 and 2000 litres for the trailed version, and the spray head is available with 6-8 or 10 outlets (Table 2).

The sprayers (Oktopus series) are machines that allow performing phytosanitary treatments with low volume of water. The principle of their operation is the following: a high speed airflow, formed by a centrifugal fan, passes through some vent tubes and carries with it the treatment substance from the nebulizer. It comes out in the form of extremely fine particles, about 5 times smaller than in the case of conventional sprayers. There are many benefits to using nebulizers:

- reduced dispersion, due to the orientation of the airflow with substance directly towards the plants;
- removal of drops, the particles of substance are so small that no drops form on the surface of the plants;
- uniform distribution over the entire surface of the plant, even in the hidden places;
- reducing the consumption of phytosanitary product, since it is no longer lost by dispersion in the air or on the ground;
- reducing the working times, as with an equal amount of product in the tank, a much larger area of land is treated;
- reducing the costs associated with the treatments, reducing the refilling times of the tank;
- reducing fuel consumption;
- reducing the wear of the equipment, as it works at low pressures.

Nobili Company from Italy also manufactures the trailed sprayer (Ventis OTF PLUS series) for treating 3 complete rows (6 faces) in one single pass (Fig. 4).

The Ventis series is available in a variety of 1000-1500 and 2000 litre polyethylene tank configurations for the trailed version, and the spray head is available with 6-8 or 10 outlets (Table 3).

LIPCO company from Land- und Kommunaltechnik, Germany, manufactures recycling sprayers for vineyards and orchards (GSG-AN-VM-2 series), using LIPCO-TUNNEL spraying technology, through which drift is turned into valuable spraying agent because it is recycled in the tank after it has previously been very finely filtered (Fig. 4).

By using opposite air fans the recycling sprayer for vineyards and orchards (GSG-AN-VM-2 series) can save up to 40% plant protection agent.

The machine is available in a variety of 1000 -1500 and 2000 litre polyethylene tank configurations for the GSG-AN-VM-2 series version.

To apply control treatments for pathogens and pests in fruit plantations, INMA Bucharest recommends the use of spraying equipment (Fig. 5), which is provided with an automatic 2D LIDAR laser sensor system, LMS111-10100 model, to detect the characteristics of the target culture.

The automatic system for detecting the characteristics of the target culture has, depending on the requirements, two working modes: manually, when the operator selects the start/stop of the spraying that is made in continuous flow or automatically when the spraying command is given by the programmable controller depending on the information captured by the laser sensor. The laser sensor scans the geometry of the tree crown vertically. The captured information is transmitted to the programmable controller, which calculates the volume of the plant mass and the corresponding substance flow and commands the partial/total closing or opening of the proportional solenoid valves accordingly. In the case of space between trees, culture gaps or lack of plant mass, the solution flow to the corresponding spray boom is stopped.

The major advantage of using this type of equipment is the reduction of the amount of phytosanitary substance administered per hectare by 30...35% compared to conventional technology.

To combat diseases and pests in vineyards, INMA recommends the use of a recycling sprayer (Fig. 6), which allows significant savings of active substance, depending on the vegetative phase of the plantation at the time of spraying compared to conventional treatment.

The technological process of machine operation is the following:

- from the tank, the liquid is sucked by a pump, through a filter and discharged to the distribution body, provided with a manometer. From the distribution body, part of the liquid is transmitted to the tank through the valve, for stirring the liquid, and another part is directed to the spray booms located on the central and side panels, through a valve, being sprayed;
- the dispersed working liquid passes through the leaves of the plants. Some of the drops are deposited on the leaves, and the rest, drip on the panels and reach the storage tanks located at the bottom of the panels;
- the liquid that is filtered by a filter is transported by means of the solution recovery system with some direct current electric pumps in the liquid tank for reuse.

The major advantage of using this type of sprayer is the recovery of the amount of phytosanitary substance administered per hectare by 40...80% depending on the growth state of the vine compared to classical technology.

4. Conclusions

The research results allow useful recommendations for farmers who want to use innovative mechanization technologies for the maintenance of orchards or vineyards cultivated in conditions specific to wine regions or vineyards in Romania.

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Tables and Figures

Fig. 1. Ideal Alpine mounted sprayer (Source: https://www.idealitalia.it/)

Table 1. Types of Alpine sprayers (Source: https://www.idealitalia.it/)

			CV			A	B	C	kg
100 PA		13/15	20	500	1	1060	840	1000	126
200 PA		15/20	20/25	630	1	1060	840	1100	135
300 PA		15/20	20/25	630	1	1060	840	1375	145
400 PB		20/25	30/35	700	1	1390	1160	1450	215
500 PB		20/25	30/35	700	1	1390	1160	1450	225
600 PB		20/25	30/35	700	1	1390	1160	1450	235
	600	20/25	30/35	700	2	2780	1000	1700	405
	800	20/25	30/35	700	2	3000	1060	1700	455
	1000	20/25	30/35	700	2	3135	1220	1750	475

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Fig. 2. Sprayer (Oktopus series) (Source: https://www.nobili.com/oktopus/s2d24efd2)

Table 2. Sprayer types Oktopus series

Oktopus	lt.	rpm = 540 bar 0-20 litri/1′	ø	rpm	m/sec	mc/h			HP	kW	A mm.	B mm.	C mm.	Kg
43-400 08P	400	81	430	2700	60	11.600	2-6	0-3	30-35	18-26	1470	1200	2000	314
43-500 08P	500										1580	1320	2000	317
45-500 10P	500										1580	1370	2300	340
43-600 08P	600										1580	1320	2000	320
45-600 010P	600		450		56	14.000	2-8	0-5	40-50	30-37	1580	1320	2500	340
43-600 08T	600	110	430	2700	60	11.600	2-6	0-3	30-35	18-26	2900	1200	2100	420
43-800 08T	800								35-40	26-30	3170	1200	2350	430
43-1001 08T	1000								40-50	30-37	3550	1350	2400	520
43-1500 08T	1500								50-60	37-45	3600	1600	2500	740
43-2000 08T	2000								50-60	37-45	3740	1570	2550	790
45-1001 010T	1000		450		56	14.000	2-8	0-5	50-60	37-45	3550	1500	2700	540
45-1500 010T	1500										3600	1600	2800	780
45-2000 010T	2000								50-60	45-52	3740	1570	2550	820

Table 3. Sprayer types Ventis series

Ventis OTF SA	lt.	ø	rpm	m/sec	mc/h	HP	kW	A mm	B mm	C mm	kg (*)
1000	1000	500 D.A.	4180	180	13800	70 - 80	51 - 58	4040	2180	2730	1050
1500	1500	500 D.A.	4180	180	13800	70 - 80	51 - 58	4280	2120	2730	1150
2000	2000	500 D.A.	4180	180	13800	70 - 80	51 - 58	4400	2120	2780	1190

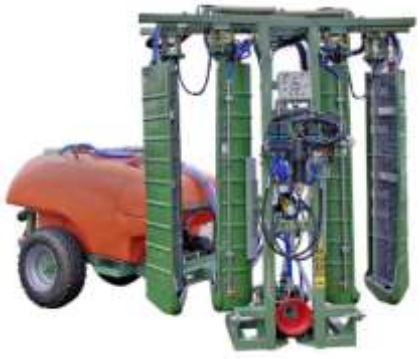

Fig. 4. Trailed sprayer (GSG-AN-VM-2 series) (Source: https://www.lipco.com/en/)

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Fig. 5. Spraying equipment provided with automatic system for detecting the characteristics of the target culture

Fig. 6. Recycling sprayer