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STRATEGII ALTERNATIVE DE COMBATERE A PĂDUCHELUI DIN SAN-JOSE ÎN CONDIȚIILE BAZINULUI POMICOL DÂMBOVIȚA

ALTERNATIVE STRATEGIES FOR CONTROLLING OF SAN JOSÉ SCALE (*QUADRASPIDIOTUS PERNICIOSUS* COMST.) IN THE DÂMBOVIȚA FRUIT-GROWING REGION

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Abstract

The research was carried out at Voinești Research and Development Station for Fruit-Growing during the years 2023-2024, on apple cultivars with disease resistance 'Florina', 'Remar', 'Real, 'Inedit and on susceptible cultivars 'Jonathan', 'Golden Delicious', and 'Idared'. Starting from the existing biological reserve, treatments were applied during the "mouse ear" phenophase and continued through the two summer generations, during the vegetation period. Various insecticides and combinations of pesticide products were tested. The most effective results during the "mouse ear" stage were obtained with the product combination: Plant-oil (*paraffinic oil 790g/l*) at 1.5% concentration + Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at the concentration 0.05% (chemical insecticide), achieving a mortality rate of 96.5%, followed by Plant-oil (*paraffinic oil 790g/l)* alone at 1.5%, which lead to 90.5% mortality. For the summer generations, effective results were obtained with the following combinations: Mospilan 20 SG -*acetamiprid 200 g/kg* SG (0.05%) + Plant-oil - *paraffinic oil 790g/l* (0.1%), and Decis 25 WDG - *deltametrin 250 g/kg* (0.005%) + horticultural oil (0.1%), both leading to a mortality rate of 92.0%, compared to the untreated control, where natural predators contributed to only 29.5% mortality. In addition to applying alternative treatments carried to avoid resistance development, several other sustainable strategies are recommended, such as: installing pheromone traps for monitoring and mating disruption; performing proper pruning to remove infested branches; and eliminating plant debris. Alternative strategies provide a sustainable approach to managing San José scale (*Quadraspidiotus perniciosus Comst*.), a dangerous pest in fruit orchards, due to its significant impact on fruit quality and commercial value, and its ability to cause tree decline and eventual death.

Cuvinte cheie: soiuri de măr, dăunător, nivel de infecție, insecticide, system de avertizare, eficacitate.
Key words: apple cultivars, pest, infestation level, insecticides, warning system, efficacy.

1. Introduction

In recent years, the Dâmbovița Fruit-Growing Region has seen an alarming increase of the San José scale (*Quadraspidiotus perniciosus Comst.),* attacks mainly due to abandoned, neglected orchards and the accumulation of biological reserves over the years.

The San José scale (*Quadraspidiothus perniciosus Comst*.) is an extremely dangerous pest for the orchards of Dâmbovița County, initially manifesting itself through the general weakening of the trees and stunted growth, which within a few years leads to their drying out. The pest feeds by piercing and sucking the sap from the tissues of the attacked organs and simultaneously injects an enzyme complex to which the plant reacts by turning the affected areas in red and red-purple, the attack on the fruits located mainly in the calyx and peduncle depressions.

The attacked branches lose their buds, the tissues become necrotic and crack, and the leaves turn yellow and fall off, leading to the drying of the trees from the top to the base.

Young trees can dry out in 2-3 years if severely attacked.

2. Material and methods

The research was carried out in the apple orchards of Voinești Fruit-Growing Research and Development Station for Farm no. 1, in an experimental plot with both genetically disease-resistant cultivars ('Florina', 'Remar', 'Real', 'Inedit') and disease-sensitive cultivars ('Jonathan', 'Golden Delicious', 'Idared').

The crown shape is free palmette, with planting distances of 4.0 x 3.5m, the intervals between the trees rows being kept grassed, through repeated mechanical mowing, and herbicides were used along the trees row aiming to control weeds.

The trees age for resistant cultivars is 10 years, and 17 years for disease-sensitive cultivars, which were grafted onto M.106 rootstock.

Two plots were organized to determine the biological reserve and four variants for both winter treatments and summer generations during the growing season.

To determine the biological reserve, 1-3-year-old branches, shoots and branches were harvested from areas with a high degree of attack and observations were made under a binocular microscope.

In order to control the biological reserve, a single treatment was applied in the “mouse ear” phenophase - the first unfolded leaflet. For the summer generations, the pest was monitored on samples of infested branches, recording the appearance of the first mobile larvae, the peak of occurrence, and the end of each generation (Fig. 1).

The treatments were applied 'on warning', with a total of 4 treatments (2 treatments/generation), and 2 observations and determinations were made on branches of different ages: 1 year, 2 years, and over 3 years, on sections of 30 cm taken from the affected areas.

3. Results and discussions

In recent years, orchards in Dâmbovița County have seen a resurgence of the San José scale (*Quadraspidiothus perniciosus Comst*.), especially in apple orchards. The damage caused by this insect requires accurate treatment 'on warning' and the promotion of the best control products.

Following observations made in the laboratory using a binocular microscope, a significant reserve was found on the affected and visualized branches (Table 1).

From the data presented in Table 1, the San José scale (*Quadraspidiothus perniciosus Comst.*), has a natural mortality rate of 63.30% on resistant cultivars and 48.70% on disease-sensitive cultivars in 2023 compared to viability, where the percentage was 36.70% on resistant cultivars and 51.30% on disease-sensitive cultivars.

In 2024, a natural mortality rate of 57% was recorded for resistant cultivars and 39.90% for disease-sensitive cultivars, compared to viability, where the values ranged from 43.00% for resistant cultivars to 60.1% for disease-sensitive cultivars.

From the recorded data, it was concluded that the biological reserve exists and is transmitted year after year with a high degree of attack in all apple orchards, requiring a safety treatment in the “mouse ear” phenophase - the first detached leaflet (Table 2).

Thus, the following combinations of products were studied aiming to control the biological reserve:

V_1. Plant-oil (*paraffinic oil 790g/l*) at 1.5% concentration + Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at 0.05% concentration,

V_2. Plant-oil (*paraffinic oil 790g/l*) at 1.5% concentration + Decis 25 WDG *deltametrin 250 g/kg* WDG at 0.005% concentration,

V_3. Plant-oil (*paraffinic oil 790g/l*) at 0.15% concentration,

V_4. Untreated control.

Following the application of the winter-spring treatment, the combination of *paraffinic oil 790g/l* at 1.5% concentration + Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at 0.05% concentration proved to be very effective, with a mortality rate of 95.60%, followed by the products *paraffinic oil 790g/l* at 1.5% concentration + Decis 25 WDG *(deltametrin 250 g/kg* WDG) at 0.005% concentration, with a percentage of 90.50% compared to the reference product - Plant-oil *(paraffinic oil 790g/l)* at 1.5% concentration with only 85.40% and the untreated control, where 38.99% natural mortality was recorded (Fig. 3)

For the summer generations, the experiment was organized as follows:

V_1. Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at 0.05% concentration + Horticultural oil at 0.1% concentration,

V_2. Decis 25 WDG (*deltametrin 250 g/kg* WDG) at 0.005% concentration + Horticultural oil at 0.1% concentration,

V_3. Trebon 30 EC (*etofenprox 300 g/l*) at 0.04% concentration,

V_4. Untreated control

For each generation of the pest, two treatments were applied at 7-8 days interval.

The optimal time for applying the treatments was 4-5 days after the appearance of mobile larvae.

The results are presented in Table 3.

Following observations, it was found that the product Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at 0.05% concentration + Horticultural oil at 0.1% concentration showed good efficacy, with a mortality rate of 94.23% for mobile larvae, followed by the combination Decis 25 WDG (*deltametrin 250 g/kg* WDG) at 0.005% concentration + Horticultural oil at 0.1%, concentration with a percentage of 92.11%, compared to

the reference product Trebon 30 EC (*etofenprox 300 g/l*) at 0.04% concentration with a mortality rate of 89.78% and the untreated control 29.64%.

4. Conclusions

In the Voinești Fruit-Growing Region, the San José scale (*Quadraspidiothus perniciosus Comst*.) is an extremely dangerous pest, developing two generations during the growing season, the most damaging being the second generation, which degrades fruit quality if no control treatments are applied.

An important role in managing the pest is played by the key treatment, in the “mouse ear” phenophase, the first unfolded leaf, with mineral oil and chemical insecticide in order to limit and destroy the biological reserve from the previous year.

Based on observations, it was concluded that the biological reserve exists and is transmitted year after year with a natural mortality rate of 56% compared to a viability of 44.00% for 2023 for both cultivars, and in 2024 the mortality rate was 48.45% compared to a viability of 51.55%.

Following the winter-spring treatment, the combination of Plant-oil (*paraffinic oil 790g/l*) at 1.5% concentration + Mospilan 20 SG (*acetamiprid 200 g/kg* SG) at 0.05% concentration proved to be highly effective, with a mortality rate of 95.60%, followed by Plant-oil (*paraffinic oil 790g/l*) at 1.5% concentration + Decis 25 WDG (*deltametrin 250 g/kg* WDG) at 0.005% concentration, with a percentage of 90.50% compared to the reference product (Plant-oil) - *paraffinic oil 790g/l* at 1.5% concentration, with a mortality rate of 85.40% and the untreated control, where 38.99% natural mortality was recorded.

After making the observations, during the summer treatments, it was found that the product Mospilan 20 SG *(acetamiprid 200 g/kg* SG) at 0.05% concentration + Horticultural oil at 0.1% concentration showed good efficacy with a mortality rate of 94.23% for mobile larvae, followed by the combination Decis 25 WDG (*deltametrin 250 g/kg* WDG) at 0.005% concentration + Horticultural oil at 0.1% concentration, with a mortality rate of 92.11%, compared to the reference product Trebon 30 EC (*etofenprox 300g/l*) at 0.04% concentration with a mortality rate of 89.78%.

The attack of the San José scale (*Quadraspidiothus perniciosus Comst*.) on young trees leads to changes in their growth and development, and the lack of treatment within 2-3 years leads to the complete drying out of the tree.

Cultural hygiene plays an important role by pruning, removing infested branches, collecting and burning them, in order to reduce the biological reserve accumulated throughout the year, maintaining trees at their maximum health and production potential.

Alternative the administration of insecticide products, 'on warning', reduces the possibility of insecticides resistance occurrence, respecting the recommended doses and the correct application of the solution on the tree, greatly influencing the health of orchards throughout the growing season.

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Tables and Figures

Fig. 1 Infested branches, and the appearance of the first mobile larvae

Fig. 2 Heavy infested apple in the untreated control variant

Fig. 3 Healthy fruits free of San José scale obtained in the variant treated with insecticide-horticultural oil combinations

Table 1. Biological reserve of the San José scale (*Quadraspidiothus perniciosus* Comst.) on the cultivars studied during the period January-February 2023-2024

Year	Apple cultivars	Total individuals [N]	Of which:			
			Mortality		Alive	
			[N]	[%]	[N]	[%]
2023	'Florina', 'Remar', 'Real, 'Inedit' (disease-resistant cultivars)	1,000	633	63.30	367	36.70
	'Jonathan', 'Golden Delicious', 'Idared' (disease-sensitive cultivars)	1,000	487	48.70	513	51.30
Great Total		2,000	1,120	56.00	880	44.00
2024	'Florina', 'Remar', 'Real, 'Inedit' (disease-resistant cultivars)	1,000	570	57.00	430	43.00
	'Jonathan', 'Golden Delicious', 'Idared' (disease-sensitive cultivars)	1,000	399	39.90	601	60.10
Great Total		2,000	969	48.45	1,031	51.55

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Table 2. Biological efficacy of several products in managing the San José scale (*Quadraspidiothus perniciosus* Comst.) on both disease-resistant and disease-sensitive apple cultivars during the period 2023-2024

Product / combination	Conc. %	Year	Total observed individuals [N.]	of which, Mortality	
				[N.]	[%]
Mospilan 20 SG (*paraffinic oil 790g/l*) + Mospilan 20 SG (*acetamiprid 200 g/kg* SG)	1.5 0.05	2023	478	468	97.90
		2024	755	722	95.60
Variant Total			**1.233**	**1.190**	**96.50**
Plant-oil (*paraffinic oil 790g/l*) + Decis 25 WDG *(deltametrin 250 g/l WDG*)	1.5 0.005	2023	367	341	92.91
		2024	611	545	89.19
Variant Total			**978**	**886**	**90.50**
Plant-oil (*paraffinic oil 790g/l*)	1.5	2023	859	739	86.03
		2024	737	624	84.66
Variant Total			**1.596**	**1.363**	**85.40**
Untreated control	-	2023	693	283	40.83
		2024	777	303	38.99
Variant Total			**1.470**	**586**	**39.86**

Table 3. Biological efficacy of products combinations in controlling of San José scale (*Quadraspidiothus perniciosus* Comst.) during the period 2023–2024.

No.	Variant/product	Conc. [%]	Year	Observations [N]	Total mobile larvae [N]	of which Mortality	
						[N]	[%]
1.	Mospilan 20 SG (acetamiprid 250 g/kg WG) + Horticultural oil	0.5 0.1	2023	I	809	767	94.80
				II	675	633	93.77
				Total	**1484**	**1,400**	**94.33**
			2024	I	824	775	94.05
				II	788	744	94.41
				Total	**1612**	**1,519**	**94.23**
2	Decis 25 WDG *(deltametrin 250 g/l WDG*) + Horticultural oil	0.005 0.1	2023	I	755	694	91.92
				II	633	585	92.41
				Total	**1388**	**1,279**	**92.14**
			2024	I	707	650	91.93
				II	903	833	92.24
				Total	**1610**	**1,483**	**92.11**
3	Trebon 30 EC (*etofenprox 300 g/l*) (reference product)	0.04	2023	I	624	557	89.26
				II	795	714	89.81
				Total	**1419**	**1,271**	**89.57**
			2024	I	769	697	90.63
				II	875	779	89.02
				Total	**1644**	**1,476**	**89.78**
4	Untreated control		2023	I	737	209	28.35
				II	805	244	30.31
				Total	**1542**	**453**	**29.37**
			2024	I	833	258	30.97
				II	877	249	28.39
				Total	**1710**	**507**	**29.64**