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RESEARCHES CONCERNING THE FIGHT AGAINST CYDIA POMONELLA L. FROM THE APPLE TREE PLANTATION IN THE NORD EAST AREA OF ROMANIA

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Abstract
The purpose of this paper is to use different methods of controlling/fighting the codling moth (Cydia pomonella (Linnaeus)) (Lepidoptera: Tortricidae) pest in the pedoclimatic conditions in N-E Romania, following the biological cycle of the species.
Cydia pomonella L. is one of the most damaging pests of apple plantations, it can compromise crops in proportions of up to 90-100%, with two, sometimes 3 generations per year depending on the area where the plantation is located.
The researches were carried out in the experimental field of the Iasi Growing Development Research Station, having as study material two apple varieties, namely Idared and Golden, where the pest was monitored by means of pheromone traps. Fighting this pest was achieved by applying 12 phytosanitary treatments.
The results obtained after the two years of observations, following the application of the phytosanitary treatments on the two experimental variants, registered differences regarding the attack of this pest.

Keywords: Cydia pomonella L., pheromone, traps.

1. INTRODUCTION

The apple is an important fruit species on the globe, it has an extremely high number of pathogens and pests that cause damage. There are about 80 diseases caused by viruses, mycoplasmas, bacteria, fungi and physiological imbalances; besides these diseases we can add the attack of 64 species of insects and mites, as well as 8 species of nematodes and at least 2 species of rodents (Filipescu C. et al., 2001).

The apple worm, *Cydia pomonella* L. (Lepidoptera: Tortricidae), is the most important and damaging pest of apple plantations worldwide,therefore, very studied in recent years (Basheer et al., 2016, Piskorski and Dorn, 2011; Jones and Wiman, 2008).

In our country, apple production is often affected by the Cydia pomonella L. pest whose larva can attack the fruit, once it has penetrated the fruit, the larva digs a gallery to the seedbed, consuming the seeds completely, the fruit falls before they reach full maturity.

2. MATERIAL AND METHOD

The researches were carried out in the experimental field of the Iasi Forestry Research Development Station, having as study material two apple varieties, namely Idared and Golden, where the occurrence of the pest was monitored by atraPOM pheromones, produced by the Institute of Chemistry Research "Raluca Ripan" from Cluj Napoca.

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This pheromone contains the active substance - (E.E) -8,10-Dodecadien-1-ol. Combating this pest was accomplished by applying a number of 12 phytosanitary treatments using the Garden Jet Spray Pump, 1000 L capacity.The experience was placed on the territory of Miroslava village, in an intensive apple plantation, the planting distance being 4x3, established in 2010, the crown shape used palmette.

Figure 1. Original photo - atraPOM pheromone trap

The flight of *Cydia pomonella L.* was observed by capturing adults, specifying the occurrence of the pest, the number of generations occurring during the vegetation period of the trees, as well as establishing the optimal moment of application of the phytosanitary treatments, which were applied to the warning with the following criteria: biological, green and phenological.

Pheromone traps were placed before the start of the flight in the tree crown at a height of 1.5-2 m above the ground, with 5-6 traps per hectare.

The traps were checked every two days from the end of April to August by recording the catches, followed by the flight curve of the species. At each scoring, the trap adhesive plates were changed to have better adhesion, and the pheromone was changed every three weeks.

The pest biology and the effectiveness of the treatments were influenced by the climatic conditions found in Table 1 and Table 2.

The climatic data recorded during 2017 (January - December 2017) are shown in Tables 1.

Regarding the amounts of rainfall recorded between January 2017 and December 2017, they were in excess compared to the multiannual average.

In terms of low temperatures recorded during 2017, the lowest value was recorded on February 10 and 11, 2017 (-21.9 ° C).

The period under study was characterized by rainfall distributed unevenly throughout the growing season without hailstones, with prolonged drought periods.

In the months (VI-IX) the volume of precipitations was also lower than normal and their distribution uneven, so, in the richest months of rainfall (April - May) there were values ranging from 72.0 to 140 , 4 mm, much larger than the July-September period, when values ranging from 23.2 - 67.0 mm were recorded (Table 1).

The average temperature recorded in the April-September period oscillated from 10.1 ° C (in April) to 22 ° C (in May) (Table 1). The lowest value was recorded on April 19, 2017 (-2.5 ° C) when the apple was blooming and the highest value was 37.7 ° C recorded on August 5 (Table 1).

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Table 1. The climatic conditions of 2017

MONTH	Year 2017				
	TEMPERATURE ºC			RAINFALL (mm)	HUMIDITY %
	AVERAGE	MINIMUM	MAXIMUM		
I	-4.89	-17.9	7,3	83.6	97.26
II	-0.8	-21.9	14.4	13.8	82.10
III	7.89	-1.2	22.7	107	89.75
IV	10.04	-2.5	25.5	134.4	92.3
V	20.61	3.9	30.3	72	61.51
VI	20.64	9.1	34.5	56	65.9
VII	21.03	10.6	34.2	56.4	69.3
VIII	20.99	6.8	37.7	67	61.76
IX	16.79	0.7	31.5	31.2	68.09
X	10.9	-1	28	62.4	94.83
XI	5.85	-3.9	16.4	34.2	98.4
XII	3.03	-7	13.2	48	99.84

Table 2. Climatic conditions of 2018

MONTH	YEAR 2018				
	TEMPERATURE ºC			RAINFALL (mm)	HUMIDITY %
	AVERAGE	MINIMUM	MAXIMUM		
I	-0.98	-14.4	9.1	17,6	79.45
II	-2.03	-18.4	10.5	27.8	86.1
III	5.33	-17	18.6	71.2	78.45
IV	15.3	1.5	29.5	11.8	54.6
V	18,48	4.8	32.2	11	58.38
VI	20.44	7.2	34.3	164.6	71.8
VII	20.67	8.5	32	140.8	80.19
VIII	22.67	11.4	33.8	2.4	66.48
IX	16.57	2.1	31.1	17.4	68.5
X	12.32	2.4	26.7	2.4	65.34
XI	2.46	-12.3	18.8	22.8	88
XII	-1.41	-13.5	7.2	40.4	90.26

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Table 3. Apple treatment programme, 2017 at SCDP IAŞI

NO. TREATMENT	PHENOPHASE SPECTRUM OF COMBAT	PRODUCTS	CONC%
Treatment I Swelling of buds Desprout	Swelling of buds; codling moth, mites, San Jose	CONFIDOR OIL	0,15%
Treatment II 20% blooming of the flower	Swell of the corolla; scab, mildew, fire blight, insects	B. BORDELAISE	0,5%
		DECIS 45 VG	0,003%
Treatment III Shaking off the petals	Beginning of shaking off the petals, mildew, scab, monilia, insects	SYSTHANE FORTE	0,02%
		KARATHANE	0,05%
		PROTEUS	0,05%
Treatment IV as big as a nut fruit- 10 mm	From 8 to 12 days of tratament; scab, mildew, insects	ANTRACOL 70 WP	0,3%
		KUMULUS DF	0,3%
		RUNNER 2 F	0,05%
Treatment V- 10 days from T 4 As big as a nut fruit 20-25 mm	Cydia p. T1 G1, different insects, scab, mildew	CALYPSO 480 SC	0,02%
		LUNA EXPERIENCE	0,05%
Treatment VI Fruit 30- 40 mm	Cydia p. T2 G1, different insects, scab, mildew, monilia	CORAGEN	0,015%
		FLINT PLUS	0,125%
Treatment VII	San Jose T1 G1, Adoxophyes, mites, scab, mildew	BELLIS	0,8%
		NOVADIM PROGRESS	0,075%
Tretment VIII half the normal size fruit - 10 days from the previous	San Jose T2 G1, scab, leaf miners, Cydia T1 G 2	CORAGEN	0,015%
		FOLICUR SOLO	0,05%
Treatment IX 10 days from the previous	Cydia p. T2 G2, different inects, pathogens: scab, mildew.	DECIS 25 WG	0,003%
		ANTRACOL 70 WP	0,3%
Treatment X Normal size fruit 15 days from T 9	Cydia p., pathogens: scab, mildew, pests	NOVADIM PROGRESS	0,075%
		FOLICUR SOLO	0,5%
Treatment XI 10-12 days from T10	San Jose T1 G2, scab, mildew, codling moth	CALYPSO	0,02%
		SYSTHANE FORTE	0,02%
Treatment XII	Cydia p., different insects, pathogens: scab, mildew	BELLIS	0,8%

The climatic data recorded during 2018 are shown in Table 2.

The study period was characterized by low rainfall distributed unevenly, without hailstones,with prolonged drought periods in April (11.8 mm), May (11 mm), August (2.4 mm) and September (17.4 mm), these being considered deficient months from this point of view, and in June and July there was an excess of precipitation, the values of deviation from the multiannual averages being between +76.1 mm and +81.3 mm (Table 2).

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The average temperature during the January-December period oscillated from -0.98 ° C (in January) to 22.67 ° C (in August) (Tables 2). The lowest value was recorded in February 2018 (-18.4 ° C) and the highest value was 33.8^{o} C recorded on June 10 and August 26 (Table 2).
The phytosanitary programs applied during the two years of study were dependent on the climatic conditions and the occurrence of the Cydia Pomonella L. pest on pheromone traps (Table 3 and 4).

Tab.4 Apple treatment programme, 2018 at SCDP IAŞI

NO. TREATMENT	PHENOPHASE SPECTER DE COMBAT	PRODUCTS	CONC. %
Treatment I Swelling of buds Desprout	Aphids(hibernating eggs), hibernanting larvae of "Quadraspidiotus perniciosus" and of red spidre's winter eggs, "Panonicus ulmi" mildew, scab	OVIPRON TOP	0,15%
		DECIS 25 WG	0,003%
		B.BORDELLAISE	0,5%
Treatment II 20% blooming of the flower	Fire blight of rosacea, Scab, Mildew San Jose louse, Aphids, Apple worm, Apple's wasp, Ladybug beetles	CHORUS 50 WG	0,05%
		KUMULUS	0,3%
		MOSPILAN 20 SG	0,03%
		BORO ET	0,1%
Treatment III Shaking off the petals	Scab, mildew, fireblight Apple worm, miners insects, aphids, San Jose louse, wasps	FLINT PLUS 64 WG	0,125%
		RELDAN 22 EC	0.18%
		CODICEVO	0,2%
Treatment IV Fruit as a nut- 10 mm	Scab, mildew Cydia p. T1 G1, codling moth, defoliators, Miner insects	MACCANI	2,25
		KUMULUS DF	0,3%
		CALYPSO	0,02%
Treatment V 10 days from T 4 Fruit as a nut 20-25 mm	Scab, mildew Cydia p. T2 G1, codling moth, defoliators, Miners insects	LUNA EXPERIENCE	0,05%
		VONDOZEB 80 WP	0.2%
		CORAGEN	0,01%
		ENERGEVO	0.3%
Treatment VI Fruit 30- 40 mm	Scab, maildew Cydia p., Defoliators	DELAN 700 WG	0,05%
		NOVADIM PROGRESS	0.075%
		FIGHTER PHOS	0.2%
Treatment VII	Scab, mildew San Jose louse, T1G1, codling moth, defoliatoars, miners insects	SYSTHANE FORTE	0.02%
		DECIS 25 WG	0.003%
		KERAFOL	0.2%
Treatment VIII Half the normal size fruit - 10 days from the previous	San Jose louse T2G1, Cydia p., defoliatoars, miners insects, mitens scab, mildew	ANTRACOL 70 WP	0.3%
		CALYPSO 480 SC	0.02%
Treatment IX 10 days from the previous	Cydia p. T2 G2, miners insects, defoliatoars codling moth, scab, mildew	CORAGEN	0.01%
		DELAN PRO	0,2%
		ENERGEVO	0.2%
Treatment X Normal size fruit 15 days from T 9	Cydia p. spotted tentiform leafminer, leaf miners - Leucoptera, wooly apple aphid, San Jose louse G2 – summer generation	RELDAN 22 EC	0.18%
		SYSTHANE FORTE	0.02%
Treatment XI 10-12 days from T10	Cydia p., different insects, pathogens: scab, mildew	FOLICUR SOLO	0.05%
		NOVADIM PROGRESS	0.075%
Treatment XII	Cydia p., different insects, pathogens: scab, mildew	BELLIS	0,08%
		CALYPSO 480 SC	0,02%

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3. RESULTS AND DISCUSSIONS

We can see in the graph that in 2017, the flight curve of the species recorded a maximum catch of 18 adults on the trap on May 15 compared to 2018 when traps on May 15 were 21 adults per / trap, with a difference between the two years on maximum catches recorded by 4 butterflies, due to the fact that temperatures were relatively higher than in the same period of 2017.Temperature along with recorded precipitations are very important in the appearance of the Cydia pomonella L., so no days of rainfall have been recorded on the pheromone trap.

Figure 1. Analysis of flight curves in years of study

The climatic conditions (high temperatures, precipitation and high relative humidity) in 2017 influenced the evolution and attack of the apple worm so that the first generation debuted on May 3rd and June 20th respectively the second generation with a number of adults trapped which go beyond the economic threshold of harm.

Although the number of catches was above the economic threshold for damage,

between the appearance of the pest in 2017 and the date of appearance in 2018 there were no significant differences.

Although the number of catches was above the economic damage threshold in both years of study, both the 2017 and 2018 phytosanitary programs recorded a high effectiveness in combating apple worm in the two years of study, particularly with Calypso 480 SC (0.02%), Mospilan 20 SP (0.015%), Coragen (0.15 l / ha).

Warning periods for apple worms - Cydia pomonella L. in the two years of study were

- in 2017: G I: May 11^{th}-^{19th}; G II: June 28^{th}.-July 4^{th};
- in 2018: G I:May 8^{thv}-^{17th}; G II: June 18^{th} - 30^{th};

The obtained results help us to determine the optimal moment of phytosanitary treatments in order to correlate good phytosanitary protection of the orchard with good economic yield.

4. CONCLUSIONS

Both phytosanitary programs have yielded results in the control of Cydia Pomonella L., we can recommend Calypso 480 SC, Coragen, Mospilan 20 SG products, with very good results in control of Cydia Pomonella L., a low degree of attacked fruit being registered.

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Extremely important to prevent Cydia Pomonella pest attack is the time of application of phytosanitary treatments, which may vary depending on climatic conditions, with preventive treatments being the most recommended before the damage of crops. The results of the occurrence of the Cydia Pomonella L. pest in apple orchards can be applied in the area where the experience has taken place.

5. RECOMMENDATIONS

To control this very dangerous pest for apple orchards, it is recommended:
- Monitoring the appearance of the pest according to the climatic conditions of the area where the crop is located;
- Development of a phytosanitary plan according to the estimated reserve of the previous year;
- Applying treatments to the warning when the economic threshold for damage is exceeded;
- Protect useful entomofauna by using selective insecticides;

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