

## RESEARCHES CONCERNING THE EFFICACY OF SOME VEGETAL METABOLITES IN THE CONTROL OF COLORADO POTATO BEETLE (*COLEOPTERA - LEPTINOTARSA DECEMLINEATA SAY*)

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*The researches are framed in the tendency of intensifying of studies of secondary metabolites with insecticide properties in order to develop natural insecticides or to include them in the transgenic organisms. It is considerate that only a small amount of the plant biodiversity was studied. The efficacies of some vegetal secondary metabolites in the control of Colorado potato beetle were tested. The experiments were carried out at the Agricultural Research Station from Suceava, in field conditions. High mortality degrees were obtained applying aqueous extracts of autochthones plants as lady fern - *Athirium filix-femina*, birthwort - *Aristolochia clematidis*, the nettle - *Urtica dioica*, thus - *Arthemisia absinthum* as well as combinations of tansy - *Tanacetum vulgare* with *Arthemisia abinthus* and *Tanacetum vulgare* with the danewort - *Sambucus nigra*. Some plant extracts presented also phytotoxic effects.*

**Key words:** secondary plant metabolites, biological control, Colorado potato beetle

The researches for alternative solutions in the integrated pest management (IPM) versus the chemical insecticides increase, in order to fulfill an organic farming and to preserve the biodiversity of some ecosystems. From more the 2500 studied plants there were isolated and tested 350 compound with insecticide effects and 900 with anti feeding effects [4].

Numerous researches have meet en evidence the efficacy of new plant metabolites against various insect species, such as:

- the treatment of the Colorado potato beetle larvae with extracts of *Heracleum sosnowskyi* Manden (75–80%), *Artemisia absinthium* L. (70%), *Artemisia dracunculus* L. (47%-L 1, 43%-L2), *Tanacetum vulgare* L. (24%) and *Levisticum officinale* Koch (33%) [6] presented a significant level of mortality;

- in the laboratory conditions, the extracts of *Allium sativum* L., *Taxus baccata* L., *Heracleum sosnowskyi* Manden, *Primula veris* L., *Urtica dioica* L., *Achillea millefolium* L., *Colchicum autumnale* L., *Phaseolus vulgaris* L. and

*Tussilago farfara* L. decreased significantly the feeding activity of *Hylobius abietis* L. [10];

- the extracts of *Ocimum basilicum* L., *Origanum majorana* L. and *Salvia officinalis* L. had toxic behavior against the larvae of *Spondoptera littoralis* Boisd. [8];

- the extract from dry leaves of *Melia azedarach* L. mixed with distilled water at 48°C, filtered after 24 hours, applied on the cabbage leaves killed 90% from the caterpillars of *Plutella xylostella* L. and other insects [1,4,5];

- the Neem extracts have controlled the Lepidoptera from the green bean [9];
- the infusions of vermouth (*Artemisia abisinthium* L.) and *Tanacetum vulgare* L. tested on Homopterous of *Macrosiphum* sp. on potato, *Trialeurodes vaporariorum* West. on cucumber and *Cinaria cupressi* Buckton on thuya, presented maximal efficacies of 30–40% [2];

- the active compounds from medicinal plants induced various mortalities degrees, such as: *Acanthoscelides obtectus* Say. - 90%; *Mentha piperita* L., - 80%; *Hypericum perforatum* L., - 96%; *Achillea millefolium* L. and *Calendula officinalis* L., showed also repellent, anti-feeding and anti-reproductive effects [3].

The aim of the researches is to establish the efficacy of some metabolites in the IPM, in order to use them in the organic farming.

## MATERIAL AND METHODS

The experiments were fulfilled at the Agricultural Research and Development Station Suceava during the year 2007, on the potato variety Loial. The surface of each experimental area was 5 m<sup>2</sup>. Against manna there were applied two treatments with Curzate and Antracol. The treatments were applied with 0.5 l hand pumps for a uniform distribution of the metabolites. The metabolites were extracted from 25 gr. dry plant, in one liter of water, by cold maceration, under stirring for 24 h and filtration. The extractions were carried out from the following autochthones plants from the spontaneous flora: *Aconitum vulparia* Reichenb., *Dryopterix filix-mas* L., *Tanacetum vulgare* L., *Stachys sylvatica* L., *Sambucus ebulus* L., *Artemisia absinthium* L., *Athyrium filix-femina*, and *Aristolochia clematitis*. The first treatment was applied on 11 June 2007, when 50% of the larvae were at the first and second age, and the second treatment at 21 June 2007. There were counted the larvae before and after the treatments. There were also observed the metabolites phytotoxic effects. The efficacy was calculated with the Schneider-Orelli formula.

The second treatment were applied on a crop where the larvae from the firsts ages were predominant. There were used the same extracts as for the first treatment, preserved in refrigerator at 4°C.

## RESULTS AND DISCUSSIONS

The observations concerning the larvae's mortality were fulfilled only for 9 days because after that an important amount of larvae retired in the soil for pupae stage (*tab.1*). The alone applied plant extracts with higher mortalities were *Artemisia abisinthium* (46%) and *Athyrium filix-femina* (96,14%). If for *Athyrium filix-femina* the extract was active for the entire period, for *Artemisia abisinthium*

the efficacy was observed only at the end, maybe due to the repellence effect. At *Stachys sylvatica* the extract was active for the first three days; after that the number of larvae increased due to a new egg-hatching. As for combinations, high mortalities were observed at *Tanacetum vulgare* with *Sambucus ebulus* (85,77%) and at *Aconitum vulparia*, *Driopteris filix mas* and *Stachys sylvatica* (58,2%).

Table 1

**Mortality of Colorado potato beetle larvae (*Leptinotarsa decemlineata* Say) after treatment with plant extracts**

Variant	Mortality of larvae %, after number of days				E %
	1	3	7	9	
1. <i>Aconitum vulparia</i>	0	0	0	0	0
2. <i>Dryopteris filix-mas</i>	19,71	0	0	0	0
3. <i>Tanacetum vulgare</i>	0	0	0	0	0
4. <i>Stachys sylvatica</i>	24,68	54,81	0	0	0
5. <i>Sambucus ebulus</i>	0	32,2	20	19,73	0
6. <i>Artemisia absinthium</i>	0	0	4,58	60,3	46
7. <i>Athyrium filix-femina</i>	25,54	15,42	87,71	96,14	94
8. <i>Tanacetum vulgare</i> + <i>Sambucus ebulus</i>	0	0	0	22,04	0
9. <i>Aconitum vulparia</i> + <i>Dryopteris filix-mas</i> + <i>Tanacetum vulgare</i> + <i>Stachys sylvatica</i>	0	0	0	58,2	43
10. <i>Artemisia absinthium</i> + <i>Athyrium filix-femina</i>	32,33	0	0	0	0
11. <i>Aconitum vulparia</i> + <i>Tanacetum vulgare</i> + <i>Sambucus ebulus</i>	20,58	15	14	10,29	0
12. <i>Tanacetum vulgare</i> + <i>Artemisia absinthium</i>	12,44	13	78,66	85,77	80
13. Untreated	0	0	0	22,04	-

Some phytotoxic effects were observed: at *Stachys sylvatica* the potato leaves become rare discoloring spots and a light yellow turn of the plants; as at *Sambucus ebulus* all the potato plants presented 1-2 mm discoloring spots on 70% of the foliar system; the combination *Tanacetum vulgare*, *Sambucus ebulus* and *Artemisia absinthium* induced a light yellow turn after three weeks; the combination *Aconitum vulparia*, *Driopteris filix mas*, *Tanacetum vulgare* and *Stachys sylvatica* induced a light yellow turn of the plants; *Artemisia absinthium* and *Athyrium filix-femina* induced a light yellow turn; the combination *Aconitum vulparia*, *Tanacetum vulgare* and *Sambucus ebulus* with 1-2 mm discoloring spots.

In the second experiment the larvae were at the firsts two ages and the effects of plants extract were established from the first days from the application. Among the extracts with a higher efficacy is to notice *Aristolochia clematitis* (73,83%) and *Urtica dioica* (48,38%) (tab.2). The *Urtica dioica* extract presents a

high efficacy to against phytophagous hymenoptera as the red ant (*Dorylus orientalis*)[12]. Comparatively with the first experiment, some extracts reduces their efficacy, as at *Arthemisa absinthium* and *Athyrium filix-femina*. This effect is possible due to the storage at 4<sup>0</sup> who did not stop completely the fermentation of the extracts. In order to avoid such processes in the future we will fulfill the metabolites extraction with alcohol. As at *Aristolochia clematidis* it can be observed that alone, the efficacy was greater than in combination with *Tanacetum vulgare*; on the other way, the combination of *Tanacetum vulgare* + *Sambucus ebulus* presented a high mortality level (83,75 %).

Table 2

**Mortality of the young larvae of Colorado potato beetle (*Leptinotarsa decemlineata* Say) after treatments with plant extracts**

Variant	Mortality of larvae %, after number of days				E %
	1	2	4	7	
1. <i>Arthemisia absinthium</i>	4,89	2,1	3	25,16	25,16
2. <i>Aristolochia clematidis</i>	6,94	20,06	19,56	73,83	73,83
3. <i>Urtica dioica</i>	29,6	8,82	12,7	48,38	48,38
4. <i>Adonis vernalis</i>	0	6,49	8,65	19,91	19,91
5. <i>Tanacetum vulgare</i>	20,15	15	15,27	0	0
6. <i>Sambucus ebulus</i>	24,2	45,53	28,91	5,12	5,12
7. <i>Athyrium filix-femina</i>	0	18,84	10,62	21,14	21,14
8. <i>Arthemisia absinthium</i> + <i>Adonis vernalis</i>	0	15,75	17,92	23,94	23,94
9. <i>Arthemisia absinthium</i> + <i>Tanacetum vulgare</i>	28,77	2,29	3,22	13,35	13,35
10. <i>Sambucus ebulus</i> + <i>Athyrium filix-femina</i>	5,71	6,08	4,76	24,14	24,14
11. <i>Tanacetum vulgare</i> + <i>Aristolochia clematidis</i>	0	10,4	0	0	0
12. <i>Tanacetum vulgare</i> + <i>Sambucus ebulus</i>	13	8,77	43,92	83,75	83,75
Untreated withness	-	-	-	-	-

From those results is to remark high efficacies at the application of the plant extracts, alone or in various combinations, and that confirm the facts that they acts as insecticides, anti-feedings or repellents. They act better against the young larvae at the old ones. The results confirm the high efficacy of *Arthemisia absinthium* (70%) against the Colorado potato beetle's larvae, a les higher efficacy of *Tanacetum vulgare* [6] or that *Urtica dioica* can inhibit significantly the feeding of *Hylobius abietis* [10]. *Arthemisia absinthium* and *Tanacetum vulgare* presented efficacies of 30-40% against some homopterous, [2] or the high insecticide activity against aphides and trips [11]. The researches emphasize high efficacies of the various *Artemisia* varieties against aphides, similar with the efficacy of the chemical insecticides [7], fact that confirms the interest in their use in the IPM.

## CONCLUSIONS

The aqueous extracts from plants, applied against the Colorado beetle induced high levels of mortality at the treatments with *Athirium filix-femina*, *Aristolochia clematidis*, *Urtica dioica* and *Arthemisia absinthium*. The combinations of *Tanacetum vulgare* with *Arthemisia abinthium* and *Tanacetum vulgare* with *Sambucus nigra* presented the greatest mortalities.

High efficacies were observed against the larvae of first ages. Some extracts induced phytotoxic phenomena like the turning to yellow of the leaves.

In order to avoid the fermentation of the extracts it is recommended to use organic solvents for extraction that permits a better long-time preservation.

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