# NEW DATA ON ENTOMOFAUNA HARMFUL TO RAPESEED CROPS AND THE ESTABLISHMENT OF MEASURES TO PREVENT AND REDUCE ATTACKS

*Elena Trotuș[1], Carmen Mincea[2], Paula-Lucelia Pintilie[1], Georgiana-Roxana Amarghioalei[1]*

[1]Agricultural Research and Development Station Secuieni, Neamț, Romania
[2]Research and Development Institute for Plant Protection Bucharest, Romania

Corresponding address:
Agricultural Research and Development Station Secuieni, Neamț
371 Principală Street, 617415, Secuieni, Romania
Tel: 0233745136
E-mail: etrotus@yahoo.com

**Abstract:** Rapeseed, the first crop established in autumn, is a species that attracts a large number of pests, from emergence to the siliquae formation and seed. Decreased production due to the attack of harmful insects can vary between 30-50%, in certain years, they can completely compromise crops. This paper presents data on the entomofauna harmful to rapeseed crops and the influence of measures to prevent and combat attacks, under specific conditions in the Central area of Moldova. The results obtained between 2017 and 2020 showed that the harmful entomofauna of rapeseed was composed of 23 species of insects, classified in five systematic orders: *Coleoptera*, *Lepidoptera*, *Heteroptera*, *Hymenoptera* and *Homoptera*. According to the number of species and the number of specimens collected, the order *Coleoptera* had the maximum share of 73.9% and respectively 88.9%. Within the order *Coleoptera*, the most abundant species were *Phyllotreta atra* (41.4%), *Meligethes aeneus* (27.8%), *Ceuthorynchus assimilis* (9.6%) and *Phyllotreta nemorum* (7.3%). Out of the total pest entomofauna, it was found that 30% affect rapeseed crops in the period between seed germination-plant emergence-leaf rosette formation, 9.1% in budding phase, 38% in flowering and 1.8% up to 2.8% in the phenophases of siliquae formation and seed. To prevent the attacks of soil pests (*P. atra*, *P. nemorum*, *Psylliodes* sp., *Athalia rosae*) was achieved by chemical treatment of the seed with Imidacloprid, Clothianidin and Thiamethoxam. The product Lumiposa 625FS-11.4 l/t seed was experimented with good results in seed treatment. To reduce the attacks of the pests during the flowering period (*M. aeneus*, *A. rosae*, *Epicometis hirta*, *Ceuthorynchus assimilis*) three treatments were applied on vegetation as follows: Decis Mega-0.075l/ha; Biscaya-0.3 l/ha; Mavrik-0.2 l/ha. This work was carried out within ADER 4.1.5 and 2.2.1 projects.

**Keywords**: *rapeseed, pest entomofauna, Romania*

## INTRODUCTION

Uses, breeding progress, advanced technologies and recent economic developments make rapeseed a culture of perspective. In Romania, even if climate fluctuations have caused large variations in areas cultivated with rapeseed, appropriate technologies can ensure constant production (Dekalb INNOVATION - Rapeseed Guide, 2013). Rapeseed, the first crop established in autumn, is the species that attracts a large number of pests, from plant emergence to siliquae formation. Ensuring productions in rapeseed cultivation is conditioned by a good knowledge of pests and measures to prevent and combat (Trotuș et al., 2002; 2007). Decreased production by harmful insects can vary between 30-50%, and sometimes in certain years, they can completely compromise crops (Trotuș et al., 2009; Buburuz et al., 2012). The control of rapeseed pests should not be viewed globally, but depending on the specifics of each pest, their biology and ecology.
Knowledge of harmful entomofauna and the bioecology of specific pests contribute to reducing attacks and their density below economic damage threshold (PED) by establishing the most effective control methods (Trotuș et al., 2019; Teodoru et al., 2019).
This paper presents data on entomofauna harmful to rapeseed crops and measures to prevent their attacks and control in the conditions of the Central area of the Moldavian Plateau. The

research was the objective of ADER projects (4.1.5 and 2.2.1) 2015-2018 and 2019-2022 and aims to establish methods and measures to prevent attacks and reduce the density of soil and plant pests by replacing the chemical treatment of the seed with insecticides from the neonicotinoid group.

## MATERIAL AND METHOD

The experiments were placed in a rapeseed culture according to the method of randomized blocks in four repetitions, at Agricultural Research and Development Station Secuieni, Neamț County, under specific conditions of the Central area of Moldova, between 2017 and 2020.

The pest insects sampling and collection techniques consisted of: (i) soil surveys with a metric frame (25/25 cm) from sowing to rosette formation; (ii) threads with entomological net, from the elongation of the stem to siliquae formation; (iii) yellow bowl traps from the emergence of crops to the plant maturity. The biological material consisting of pest entomophauna was analyzed under a binocular magnifying glass and determined by species.

A range of insecticides have been applied in rapeseed treatment to prevent the soil pests *Phyllotreta* spp. and *Psylliodes* spp.

For pests affecting rapeseed crops during stem elongation and seed formation, a range of insecticides, applied to vegetation through 1 or 2 chemical treatments, were experimented, of which: T1 at pests emergence; T2 at 8-10 days after T1. The effectiveness of insecticides was calculated by the number of insects per $m^2$ and by the frequency of attack recorded on the treated variants and the untreated control. The data were calculated statistically using the analysis of variance.

## RESULTS AND DISCUSSIONS

The pest entomofauna recorded from rapeseed crops in the conditions of the Western part of the Central Moldavian Plateau during 2017-2020 period totalled 23 species belonging to five orders, *Coleoptera*, *Heteroptera*, *Hymenoptera*, *Lepidoptera* and *Homoptera* (Table 1). The maximum values of recorded pests ranged between 1 insect/$m^2$ (*Eurygaster* spp.) and 234 insects/$m^2$ (*Phyllotreta atra*). The average density of the pest entomofauna was 317.5 insects/$m^2$, with values between 0.5 insects/$m^2$ (*Eurygaster* sp.) and 120.5 insects/$m^2$ (*Phyllotreta atra*). The most insects per $m^2$ were recorded for the species: *P. atra*, *M. aeneus*, *C. assimilis*, *P. nemorum* and *A. rosae*.

**Table 1.** Pest entomofauna in rapeseed crops in the area of the Central Moldavian Plateau, Secuieni, 2017 - 2020

| No. | Species | Popular name | Order | Density (insects/$m^2$) | | |
|---|---|---|---|---|---|---|
| | | | | min | max | average |
| 1 | *Agriotes* spp. | Wireworms | *Coleoptera* | 5 | 6 | 5.5 |
| 2 | *Opatrum sabulosum* | Darkling Beetle | *Coleoptera* | 2 | 3 | 2.5 |
| 3 | *Melolontha melolontha* | White grub cockchafer | *Coleoptera* | 0 | 1 | 0.5 |
| 4 | *Eurydema* spp. | Cabbage stink bugs | *Heteroptera* | 1 | 17 | 9.0 |
| 5 | *Phyllotreta atra* | Cabbage flea beetle | *Coleoptera* | 7 | 234 | 120.5 |
| 6 | *Phyllotreta nemorum* | Striped flea beetle | *Coleoptera* | 6 | 41 | 23.5 |
| 7 | *Phyllotreta nigricens* | Black flea beetle | *Coleoptera* | 1 | 7 | 4 |
| 8 | *Psylliodes chrysocephala* | Cabbage-stem flea beetle | *Coleoptera* | 1 | 14 | 7.5 |
| 9 | *Harpalus* spp. | The ground beetle | *Coleoptera* | 3 | 9 | 6.0 |
| 10 | *Entomoscelis adonidis* | Red Turnip Beetle | *Coleoptera* | 1 | 3 | 2.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | *Ceutorynchus napi* | Rape stem weevil | *Coleoptera* | 1 | 16 | 8.5 |
| 12 | *Baris chlorizans* | Cabbage blue weevil | *Coleoptera* | 1 | 5 | 3.0 |
| 13 | *Meligethes aeneus* | Rape beetle | *Coleoptera* | 1 | 157 | 79 |
| 14 | *Sitona lineatus* | Pea leaf weevil | *Coleoptera* | 1 | 3 | 2.0 |
| 15 | *Ceuthorynchus assimilis* | Cabbage seed weevil | *Coleoptera* | 3 | 54 | 28.5 |
| 16 | *Epicometis hirta* | Flowers hairy beetle | *Coleoptera* | 1 | 5 | 3.0 |
| 17 | *Oulema melanopa* | Cereal leaf beetle | *Coleoptera* | 0 | 2 | 1.0 |
| 18 | *Vanessa cardui* | Painted Lady | *Lepidoptera* | 0 | 5 | 2.5 |
| 19 | *Athalia rosae* | Turnip sawfly | *Hymenoptera* | 1 | 36 | 18.5 |
| 20 | *Colaphellus sophiae* | Mustard beetle | *Coleoptera* | 3 | 5 | 4.0 |
| 21 | *Pieris brassicae* | Large White Butterfly | *Lepidoptera* | 2 | 6 | 4.0 |
| 22 | *Eurygaster* spp. | Cereal bug | *Heteroptera* | 0 | 1 | 0.5 |
| 23 | *Brevicoryne brassicae* | Cabbage aphid | *Homoptera* | 0 | 5 | 2.5 |
| **TOTAL** | | | | **41** | **635** | **317.5** |

Analysing the number of species, the order *Coleoptera* was best represented by 17 species, totalling 73.9% of the total pests' entomophauna. The orders *Lepidoptera* and *Heteroptera* were represented by two species each and had 8.7%. The orders *Hymenoptera* and *Homoptera* recorded 4.3% and 4.4% respectively, being represented by only one species.

According to the number of specimens of insects collected, it was found that the order *Coleoptera* had the maximum share of 88.8%, totalling 565 insects/$m^2$ out of a total of 635 insects/$m^2$ collected, followed by *Hymenoptera* which totalled 36 insects/$m^2$ (5.8%), *Heteroptera* with 18 insects/$m^2$ (2.8%), *Lepidoptera* with 11 insects/$m^2$ (1.8%) and *Homoptera* with 5 insects/$m^2$ (0.7%).

The 17 species of harmful insects belonging to the order *Coleoptera* recorded values between 2 insects/$m^2$ (*Oulema melanopa*) and 234 insects/$m^2$ (Table 2). The proportion of harmful species in the order *Coleoptera* ranged between 0.3% as recorded in the species *O. melanopa* and 41.4% in *P. atra*.

**Table 2.** Structure of harmful species belonging to the order Coleoptera

| **No.** | **Species** | **Density** | |
|---|---|---|---|
| | | Max no of insects / $m^2$ | % |
| 1 | *Agriotes* spp. | 6 | 1.1 |
| 2 | *Opatrum sabulosum* | 3 | 0.5 |
| 3 | *Melolontha melolontha* | 1 | 0.2 |
| 4 | *Phyllotreta atra* | 234 | 41.4 |
| 5 | *Phyllotreta nemorum* | 41 | 7.3 |
| 6 | *Phyllotreta nigricens* | 7 | 1.2 |
| 7 | *Psylliodes chrysocephala* | 14 | 2.5 |
| 8 | *Harpalus* spp. | 9 | 1.6 |
| 9 | *Entomoscelis adonidis* | 3 | 0.5 |
| 10 | *Ceutorynchus napi* | 16 | 2.8 |
| 11 | *Baris chlorizans* | 5 | 0.9 |
| 12 | *Meligethes aeneus* | 157 | 27.8 |
| 13 | *Sitona lineatus* | 3 | 0.5 |
| 14 | *Ceutorynchus assimilis* | 54 | 9.6 |
| 15 | *Epicometis hirta* | 5 | 0.9 |
| 16 | *Oulema melanopa* | 2 | 0.3 |
| 17 | *Colaphellus sophiae* | 5 | 0.9 |
| **Total** | | **565** | **100** |

Analysing the spreading of harmful species during vegetation phases of rapeseed plants, it was found that 30% of the total harmful entomofauna collected attack in the period between seed germination - plant emergence - leaf rosette formation (BBCH 0 - 18), 38% in the flowering phenophase (BBCH 61 - 69), 18.3% in the bud phenophase (BBCH 33 - 57). In the phenophases of stem elongation, siliquae formation and seed maturation, the harmful entomofauna was much lower, between 1.8% and 9.1% (Fig. 1).

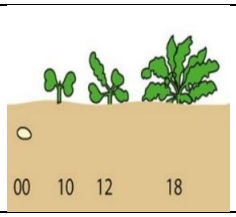
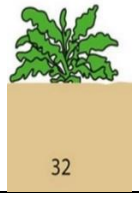
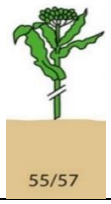
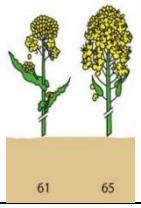
| | | | | | | |
|---|---|---|---|---|---|---|
| Share of harmful entomofauna % | 30 | 9.1 | 18.3 | 38 | 2.8 | 1.8 |
| Vegetation period | Germination-emergence-formation of leaf rosette | Elongation of the stem | Bud | Blooming | Siliquae formation | Maturation |
| The development stage of plants<br>BBCH scale |  |  |  |  |  |  |

**Fig. 1**. The share of harmful entomofauna on the phenological phases of rapeseed

To prevent attacks caused by specific pests affecting rapeseed crops in the period between germination - emergence - leaf rosette formation and rescue of rapeseed crops, good results in 2017/2018 were obtained by chemical treatment of the seed with neonicotinoid insecticides (Table 3). The average density of the species *Phyllotreta* spp., *Psylliodes* spp., *Athalia rosae* but also the average frequency of attack was low, statistically assured as very significant negative in the variants treated with Imidacloprid, Clothianidin and Thiamethoxam compared to the untreated control.

**Table 3.** The influence of some neonicotinoid insecticides applied in the treatment of rapeseed on the pest population and the frequency of attack, Secuieni 2017/2018

| No. | The experimental variant | Density | | F % attack | | *Athalia rosae* | |
|---|---|---|---|---|---|---|---|
| | | *Phyllotreta* spp./m$^2$ | *Psylliodes* spp/ m$^2$ | *Phyllotreta* spp./ m$^2$ | *Psylliodes* spp./ m$^2$ | Density larvae/plant | F % attack |
| 1. | Untreated control | 54 | 17 | 100 | 72 | 12 | 81 |
| 2. | Imidacloprid | $19^{000}$ | $4^{000}$ | $31^{000}$ | $12^{000}$ | $6^{00}$ | $15^{000}$ |
| 3. | Clothianidin | $17^{000}$ | $3^{000}$ | $29^{000}$ | $10^{000}$ | $4^{000}$ | $10^{000}$ |
| 4. | Thiamethoxam | $11^{000}$ | $5^{000}$ | $30^{000}$ | $10^{000}$ | $6^{00}$ | $12^{000}$ |
| | DL 5% | 4.11 insects/m$^2$ | 3.4 insects/m$^2$ | 15 % | 17 % | 3.4 insects/m$^2$ | 23 % |
| | DL 1.0 % | 6.0 insects/m$^2$ | 4.7 insects/m$^2$ | 27 % | 32 % | 5.1 insects/m$^2$ | 34 % |
| | DL 0.1 % | 8.3 insects/m$^2$ | 6.3 insects/m$^2$ | 41 % | 51 % | 7.0 insects/m$^2$ | 51 % |

In the agricultural year 2019 - 2020, the protection of rapeseed crops against pests was achieved by chemical treatment of the seed with Lumiposa 625 FS - 11.4 l/t. The average density of *Phyllotreta* spp., *Psylliodes* spp., *Athalia rosae* and *Pieris brassicae* as well as the average frequency of attack was much lower compared to the untreated control and the variant treated only with fungicide (Table 4).

To reduce attack caused by *C. napi*, *C. assimilis*, *M. aeneus*, *E. hirta* and *B. brassicae*, three chemical treatments were applied during the vegetation period, from stem elongation to silica formation, Decis Mega 0.075l/ha (T1), Biscaya 0.3 l/ha (T2) and Mavrik 0.2 l/ha (T3).

Rapeseed production was positively influenced by the good protection provided by the insecticide Lumiposa 625 FS, 11.4 l/t applied in the treatment of the seed. The difference in production obtained for the variant treated with insecticide was ensured statistically as very significant (Table 5).

In the conditions of the agricultural year 2020-2021, the average density of the species *Phyllotreta* spp., *Psylliodes* spp., *A. rosae* and *P. brassicae* was between 0 and 7.2 insects/$m^2$ in the variant treated with Lumiposa 625 FS - 11.4 l/t and between 0.2 insects/plant and 44.2 insects/$m^2$ in the untreated control. The average frequency and degree of attack of these specific pests varied between 0.0% and 1.98% in the treated variant compared to 3.6% and 35.61% in the untreated control (Table 6).

**Table 4.** Evolution of the attack caused by specific pests to rapeseed

| Variant | Attack in the autumn | | | | Attack in spring - summer | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | F% attack produced by: | | | | F% attack produced by: | | | | | | |
| | *Phyllotreta* spp. | *Psylliodes* spp. | *At. rosae* | *P.brassicae* | *Phyllotreta* spp. | *Psylliodes* spp. | *C. napi* | *C. assimilis** | *M. aeneus* | *E. hirta** | *B. brassicae** |
| Untreated | 23.7 | 14.7 | 11.8 | 2.9 | 10.2 | 9.4 | 7.8 | 6.3 | 24.5 | 5.9 | 16 |
| Royal Flo 3.75 l/t | 22.8 | 15.0 | 10.4 | 1.1 | 9.6 | 9.0 | 7.2 | 6.5 | 20.2 | 5.5 | 12 |
| Lumiposa 625 FS 11.4 l/t | 13.4 | 7.1 | 3.7 | 0.0 | 9.2 | 8.2 | 6.9 | 6.0 | 20.6 | 5.5 | 12 |

* attack produced in the phenophases of flowering - formation of siliceous - formation of grains in siliquae
Pest control: T1 - 18.03.2020: Decis Mega 0.075 l/ha; T2 - 12.04.2020: Biscaya 0.3 l/ha; T3 - 24.04.2020: Mavrik 0.2l/ha

**Table 5.** Influence of protection measures on rapeseed production and quality

| No. | Variant | Dose l/to | Production | | | Production quality | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Kg /ha | % | Difference from the control | MMB (g) | MH (kg/hl) | Oil content (%) | Protein content (%) |
| 1 | Untreated control | - | 2254 | 100 | Mt | 2.96 | 68.5 | 44.1 | 19.8 |
| 2 | Royal Flo | 3.75 | 2360 | 105 | 106 | 3.31 | 68.9 | 45.8 | 20.8 |
| 3 | Lumiposa 625 FS | 11.4 | 2744 | 122 | 492 | 3.48 | 68.9 | 46.3 | 20.9 |

DL 5% = 154 kg/ha; DL 1% = 194 kg/ha; DL 0.01% = 235 kg/ha

**Table 6.** Evolution of the attack of specific pests on rapeseed sown in autumn 2020

| No. | Variant | Dose l/to | *Phyllotreta* spp | | *Psylliodes* spp | | *Athalia rosae* | | *Pieris brassicae* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | GA% | insects /$m^2$ | GA% | insects /$m^2$ | GA% | insects /$m^2$ | GA% | insects /$m^2$ |
| 1 | Untreated control | - | 15.7 | 37.5 | 2.74 | 5.4 | 35.6 | 44.2 | 3.6 | 0.2 |
| 2 | Integral Pro | 1.6 | 15.2 | 37.5 | 2.56 | 5.0 | 35.12 | 44.0 | 3.4 | 0.2 |
| 3 | Lumiposa 625 FS | 11.4 | 1.8 | 7.2 | 0.17 | 1.1 | 1.98 | 3.1 | 0.0 | 0.0 |

## CONCLUSIONS

The harmful entomofauna from rapeseed crops comprised 23 species classified into five systematic orders *Coleoptera*, *Lepidoptera*, *Heteroptera*, *Hymenoptera* and *Homoptera.*

The order *Coleoptera* had the maximum weight compared to the rest of the systematic orders.

Of the total pest entomofauna, 38% affected rapeseed crops in the flowering phenophase, 30% in the period between germination - emergence - formation of leaf rosette, 18.3% during formation and development of buds, and 1.8% up to 9.1% in the phenophases of stem elongation, silica and seed formation.

To reduce the attacks of soil pests in the years 2017, 2018, chemical treatment of the seed with neonicotinoid insecticides was applied.

To reduce the attacks of specific pests, chemical treatment of the seed with the insecticide Lumiposa 625 FS -11.4 l/t was applie in 2019, 2020.

The protection of rapeseed crops against pests that affect rapeseed crops during the elongation of the stem - budding - flowering - the siliquae formation was achieved by applying three chemical treatments with: Decis Mega, Biscaya and Mavrik.

Rapeseed production was positively influenced by the good protection provided by the chemical treatment of the seed with the product Lumiposa 625 FS - 11.4 l/t.

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