# **Findings of insecticide monitoring in Nordic and Baltics in 2017**

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This report aims to give a short and concise overview of the data obtained by members of the NorBaRAG insecticide subgroup in 2017. All members are encouraged to contribute to this and future reports by sending an overview of data to the insecticide subgroup chair.

In 2017, five active substances with three modes of action were tested using standard IRAC susceptibility test methods. For some of the insect pests, a specific IRAC method for the different actives has not been developed. In those cases, the method used is described.

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| **Active** | **Mode of action (IRAC)** | **Amount of active (ng/cm2)** | | |
| **20% Field rate** | **100% Field rate** | **200% Field rate** |
| λ-cyhalothrin | Pyrethroid (3A) | 15 | 75 | 150 |
| τ-fluvalinate | Pyrethroid (3A) | 96 | 480 | 960 |
| Thiacloprid | Neonicotinoid (4A) | 144 | 720 | 1440 |
| Acetamiprid | Neonicotinoid (4A) | 80 | 400 | 800 |
| Indoxacarb | Semicarbazones (22B) | 63.75  (25% Field rate) | 225 | - |

## **Brassicogethes/Meligethes spp.**

*Meligethes aeneus* is an important pest of oilseed rape particularly in Western Europe. The larvae are up to 3 mm long and white with brown sclerotised plates. Eggs are laid in the flower buds of the host-plant. The larvae develop within the flowers. Oviposition damage to the buds of oilseed rape can cause the flowers to drop off. Both adults and larvae feed on the pollen and nectar in the flowers.

Resistance to pyrethroids has been reported in this species since 1999, especially against λ-cyhalothrin. Initial reports suggest that pyrethroid resistance first occurred in North East France and over the following years has spread to other countries in Europe. Investigations into the mechanism of resistance has primarily identified enhanced metabolism by P450 monooxygenases as the prime mechanism of resistance to pyrethroids. More recently, a target site mutation has been identified in some λ-cyhalothrin resistant populations from Denmark and Sweden[[1]](#footnote-1).

### **Method 011 (synthetic pyrethroids)**

Method 011 tests the effect of synthetic pyrethroids, such as λ-cyhalothrin (Karate®) or τ-fluvalinate (Mavrik®), on pollen beetles in a laboratory setting. It is widely used for monitoring of sensitivity of *M. aeneus* throughout Europe. Beetles are placed in glass vials coated with λ-cyhalothrin for 24 hours, after which number of affected and alive beetles are noted and %affected beetles is calculated. Glass vials coated with acetone functions as control treatment. To ensure movement, pollen beetles should be exposed to light during the experiment. Beetle populations are classified into 5 susceptibility levels, ranging from highly susceptible to highly resistant. This classification will be used in this report. Classification of susceptibility levels depends on the effect of 20% and 100% field rate on pollen beetle samples.

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| **Dose rate (ng/cm2)** | | **Affected** | **Classification** |
| λ-cyhalothrin | τ-fluvalinate |  |  |
| 75 | 480 | 100% | Highly susceptible |
| 15 | 96 | 100% |
| 75 | 480 | 100% | Susceptible |
| 15 | 96 | <100% |
| 75 | 480 | 90-100% | Moderately resistant |
| 75 | 480 | 50-90% | Resistant |
| 75 | 480 | <50% | Highly resistant |

Data was obtained from Latvia, Estonia, Lithuania, Denmark, Norway, Finland and Sweden. A total of 57 and 30 population samples were collected and tested in the lab against λ-cyhalothrin and τ-fluvalinate, respectively.

#### **Results (λ-cyhalothrin)**

Of the 57 population samples tested in 2017 in the Nordics and Baltics, a single population proved highly susceptible to λ-cyhalothrin. Most of the pollen beetle population samples were resistant to λ-cyhalothrin, indicating a possible issue with controlling pollen beetles in the field. This was further shown by the relative large proportion of highly resistant pollen beetles.

#### **Results (τ-fluvalinate)**

None of the 30 population samples proved highly susceptible nor highly resistant to τ-fluvalinate. Susceptible samples were present in the Nordics and Baltics, with more than 80% of the Lithuanian samples proving susceptible to τ-fluvalinate. However, the biggest proportion of population samples were considered moderately resistant and a few populations were resistant.

#### **Conclusion**

Both λ-cyhalothrin and τ-fluvalinate function as sodium channel modulators, stimulating repetitive nerve discharges, leading to death through paralysis. Results obtained in the laboratory setting using the adult vial test is not directly referable to field performance of the product, but can give indications of possible control issues. Based on 2017 trials, control issues for λ-cyhalothrin might already be present in the field as data show a large proportion of resistant or highly resistant populations. The proportion of resistant and highly resistant populations is less marked for τ-fluvalinate, but also here is resistance on the rise.

### **Method 021 (Neonicotinoids)**

Method 021 tests the effect of neonicotinoids on pollen beetles in a laboratory setting. The standard neonicotinoid used is thiacloprid (Biscaya®). This method is widely used for thiacloprid monitoring purposes for *M. aeneus* throughout Europe. Beetles are placed in glass vials coated with Biscaya® for 24 hours, after which number of affected and alive beetles are noted and % of affected beetles is calculated. Based on a baseline study[[2]](#footnote-2) of the sensitivity of pollen beetles against thiachloprid, expected mortality values when applying 144 ng/cm2, 720 ng/cm2 and 1440 ng/cm2 were obtained. These doses correspond to 20%, 100% and 200% of the field rate, respectively.

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| **Dose rate (ng/cm3)** | **Expected mortality (%)** |
| 144 | 50 ± 10 |
| 720 | 93 ± 6 |
| 1440 | 98 ± 3 |

Data was obtained from Norway, Sweden, Denmark, Latvia, Estonia and Lithuania. A total of 54 population samples were collected and tested in the lab. The data presented here, is categorized according the observed mortality at 1440 ng/cm3, corresponding to 200% field rate as described in the IRAC method.

#### **Results (thiacloprid)**

There was great country-wise differences in thiacloprid efficacy in the tested population samples. In Denmark and Sweden, the majority of population samples proved sensitive to thiacloprid, with efficacies above 75% for 200% field rate of thiacloprid. The efficacy of thiacloprid was lower in the Baltic countries and Norway, with efficacy of 52-92%.

Another neonicotinoid (acetamiprid, Mospilan®) have been tested in pollen beetles. Method 021 uses thiaclorid at the standard neonicotinoid. Both acetamiprid and thiacloprid belong to the group of chloropyridinyl neonicotinoids, so it is sensible to also use Method 021 for the monitoring of acetamiprid. Pollen beetles were tested at 20%, 100% and 200% of the field rate, corresponding to 80 ng/cm2, 400 ng/cm2 and 800 ng/cm2 acetamiprid.

Data was obtained from Denmark and Sweden. A total of 18 population samples were collected and tested in the lab. The data presented here, is categorized according the observed mortality at 800 ng/cm3, corresponding to 200% field rate, similar to that of thiacloprid.

#### **Results (Acetamiprid)**

The majority of populations samples tested proved susceptible to acetamiprid. In Sweden, acetamiprid proved effective in all but a single sample while in Denmark, acetamiprid had an effeictive above 95% in half of the samples and 75-95% in the other half of the population samples.

#### **Conclusion**

Both thiacloprid and acetamid function as postsynaptic nicotinic acetyl choline receptor modulators, stimulating repetitive nerve discharges, leading to death through paralysis. Results obtained in the laboratory setting using the adult vial test is not directly referable to field performance of the product, but can give indications of possible control issues. Based on 2017 trials, control issues for thiacloprid might already be present in the field as data show a large proportion of populations with decreased efficacy of thiacloprid, especially in the Baltics. In Denmark and Sweden control issues seem less pronounced. The same pattern was observed for trials conducted with acetamiprid, with few samples with low efficacy of the neonicotinoid.

### **Method 027 (Indoxacarb)**

Method 027 tests the effect of indoxacarb on pollen beetles in a laboratory setting. This method is widely used for monitoring purposes for *M. aeneus* throughout Europe. It is an adaption of Method 011 (synthetic pyrethroids). Beetles are placed in glass vials coated with indoxacarb for 24 hours, after which number of affected and alive beetles are noted and % of affected beetles is calculated. Pollen beetles should be tested at 63.75 and 255 ng/cm3, corresponding to 20% and 100% field rate as a minimum. At these rates, an observed mortality >90% is excepted.

#### **Results (Indoxacarb)**

Nine samples were collected in Norway and tested in the laboratory. Indoxacarb had an efficacy >90% for all population samples. Results obtained in the laboratory setting using the adult vial test is not directly referable to field performance of the product, but can give indications of possible control issues. So far, it seems there is no control issues with indoxacarb in the field based on the laboratory trials.

## ***Ceutorhynchus obstrictus***

*C. obstrictus* is native to Europe, where it is a major pest of oilseed rape. Like the pollen beetle, they emerge in early spring. Females lay their egg(s) in pods of oil seed rape and larva fed of the pods, possibly causing great harm. Despite that the main damage is caused by feeding larva, newly emerged adults can also cause damage to the pods by feeding before hibernation.

### **Method 031 (synthetic pyrethroids)**

Method 031 has been developed to assess the effect of synthetic pyrethroids (such as λ-cyhalothrin (Karate®) and τ-fluvalinate (Mavrik®)) on flea beetles and weevils in a laboratory setting. Target species include *Ceutorhynchus* spp., *Phyllotreta* spp and *P. chrysocephala*. The method is widely used for monitoring of λ-cyhalothrin and τ-fluvalinate sensitivity throughout Europe. Beetles/weevils are placed in glass vials coated with pyrethroid for 24 hours, after which number of affected and alive beetles/weevils are noted and % of affected beetles/weevils is calculated. Glass vials coated with acetone functions as control treatment. During the experiment, insects should be exposed to light to ensure movement. Beetle/weevil populations are classified into 3 susceptibility levels; susceptible, decreased susceptibility and resistance suspected. This classification will also be used in this report. Classification of susceptibility levels depends on the effect of 15 ng/cm3 λ-cyhalothrin and 96 ng/cm3 τ-fluvalinate (20% field rate) on beetle/weevil samples. Resistance is also suspected if a population sample show less than full effect at 50% field rate.

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| **Dose rate (ng/cm3)** | | **Affected** | **Classification** |
| λ-cyhalothrin | τ-fluvalinate |
| 15 | 96 | 100% | Susceptible |
| 15 | 96 | 90-99.9% | Decreased susceptibility |
| 15  37.5 | 96  240 | <90%  <100% | Resistance suspected |

Data was obtained from Sweden, where four and three population samples of *C. obstrictus* were collected and tested in the lab against λ-cyhalothrin and τ-fluvalinate, respectively.

#### **Results (pyrethroid)**

All and the majority of the *C. obstrictus* population samples proved susceptible to λ-cyhalothrin and τ-fluvalinate, respectively. Despite the fact that laboratory trial results cannot be directly transferred to control issues in the field, the data suggest few if any control issues of *C. obstrictus* in the field. However, the data consists of few population samples and only from Sweden, so an overall conclusion on the effectiveness of pyrethroids on *C. obstrictus* control in the Nordic and Baltic countries is limited based on the current data.

Method 031 is the only available IRAC test method for *C. obstrictus*, so this method is also used to test sensitivity of *C. obstrictus* against the neonicotinoid thiacloprid. Weevils were tested at 20%, 100% and 200% of the field rate (field rate: 720 ng/cm3). As described in IRAC Method 031, mortality data of thiacloprid at 20% field rate will be the basis for susceptibility categorization. Trials were conducted on four population samples from Sweden.

#### **Results (thiacloprid)**

In general, thiacloprid had a good effect on C. obstricus. In half of the populations samples, thiacloprid caused full mortality of C. obstricus samples and fort the other half of samples, efficacy was >90%. The samples from Sweden indicate good effect of thiacloprid in a field setting. However, as mentioned above, overall conclusions covering all countries in the NorBaRAG collaboration are difficult to define based on the available data for 2017.

**Acknowledgements**

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1. Kaiser, C., Jensen, KM.V., Nauen, R. et al. J Pest Sci (2018) 91: 447. https://doi.org/10.1007/s10340-017-0856-x [↑](#footnote-ref-1)
2. Zimmer, C. T. and Nauen, R. (2011), Pyrethroid resistance and thiacloprid baseline susceptibility of European populations of Meligethes aeneus (Coleoptera: Nitidulidae) collected in winter oilseed rape. Pest. Manag. Sci., 67: 599-608. doi:10.1002/ps.2137 [↑](#footnote-ref-2)