European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

CONCLUSIONS and RECOMMENDATIONS

EPPO Workshop on integrated management of insect pests in oilseed rape
JKI, Berlin, 2017-09-20/22

Background on oilseed rape (OSR)

- Oilseed rape (OSR) is the major crop grown for its oil content in Northern and Central Europe.
- According to pre-workshop questionnaire filled in by 11 EPPO countries, which were also represented at the workshop (AT, CZ, DE, FR, GB, HU, LU, LV, PL, SE and SK) oilseed rape is grown on 5,400,000 ha in these countries (approximately 83% of EU oilseed rape).
- OSR remains the principal break crop in cereals rotation. Whilst there are alternatives (e.g. spring barley, field beans), none have markets that could sustain long term decreases in OSR growing area.
- OSR is production is linked to economic conditions. If the management of pest control becomes increasingly difficult and at the same time yield decreases because of the lack of effective control solutions farmers may change to other crops. Sustainable farming systems and diverse crop rotations, including OSR with its high yield potentials, are needed.
- OSR is important for farmland biodiversity, to a wide variety of invertebrates (pollinators, natural enemies of crop pests and detritivores). In addition, OSR is an extremely attractive crop and food source for a diversity of other phytophagous insects.

Range and complexity of insect pests

The insect pests attack the OSR successively all season long and damage different parts of the plant and they present a real challenge for growers to identify and keep them under control.

EPPO Code	Preferred scientific name	Common name	Other scientific names
PSYICH	*Psylliodes chrysocephala*	cabbage stem flea beetle	
MYZUPE	*Myzus persicae* (vector of Turnip Yellows Virus)	green peach/potato aphid	
CEUTNA	*Ceutorhynchus napi*	rape stem weevil	
CEUTPI	*Ceutorhynchus picitarsis*	rape winter stem weevil	
MELIAE	*Brassicogethes aeneus*	pollen beetle	*Meligethes aeneus*
HYLERA	*Delia radicum*	cabbage root fly	*D. brassicae*
BRVCBR	*Brevicoryne brassicae*	cabbage mealy aphid	

EPPO Code	Preferred scientific name	Common name	Other scientific names
CEUTAS	*Ceutorhynchus obstrictus*	cabbage seed weevil	*C. assimilis*[1]
DASYBR	*Dasineura brassicae*	brassica pod midge	
ATALCO	*Athalia rosae*	turnip sawfly	
CEUTQU	*Ceutorhynchus pallidactylus*	cabbage stem weevil	*C. quadridens*
PHYESP	*Phyllotreta* spp.	Flea beetles	
PLUTMA	*Plutella xylostella*	diamondback moth	
CEUTSL	*Ceutorhynchus sulcicollis*		
BARICO	*Baris coerulescens*		
EPISHI	*Tropinota hirta*	blossom feeder	*Epicometis hirta*

Integrated Pest Management (IPM) of insect pests of OSR

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of practices (including the judicious use of chemical plant protection products). For some OSR pests IPM tools are commercially available; many tools are still in the research pipeline.

Chemical control

- The management of insect pests still relies primarily on chemical plant protection products.
- Lack of a diversity of Mode of Actions for foliar insecticides, i.e. treatments often relying only on pyrethroids, thus leading to increasing resistance issues.
- Among the different insect species, selection pressure for developing insecticide resistance is high, as control actions are needed at different times during the growth of oilseed rape in most cases resulting in several applications. Therefore, when these pests are present in the crop, even at low level populations, they are often exposed to and affected by more than one insecticide application targeted to other species.
- In recent years, in several EPPO countries, resistance to different insecticides has been building up in particular against pollen beetle (MELIAE), cabbage seed weevil (CEUTAS), green peach aphid (MYZUPE) and cabbage stem flea beetle (PSYICH).
- The resistance pressures have become further complicated by the limitations on available modes of action for foliar and seed treatments, with evidence of increased foliar sprays (pyrethroids in particular) due to a lack of seed treatment options after the ban of neeonicotinoids.

[1] Taxonomic confusion took place for many years between *C. assimilis* and *C. pleurostigma*. It is currently considered that the turnip gall weevil is *C. assimilis* (formerly known as *C. pleurostigma*) and that the cabbage seed weevil is *C. obstrictus* (formerly known as *C. assimilis*).

- **The products we have need to be used appropriately, including the implementation of resistance management strategies, new application techniques (e.g. dropleg technique to avoid pollinator exposure), following appropriate thresholds, and avoiding wherever possible side effects on beneficials and pollinators.**

Seed treatment (after ban of neonicotinoids)

- OSR is grown from seed and seed treatments may be an effective tool against pests which have a negative impact on crop establishment because the active substance is systemic within the germinating seed. In some countries, after the ban of products for seed treatment, soil treatments with granules (often with lower efficacy) are used. The lack of seed treatments leads to increased pressure to use foliar treatments, which may not be as effective.
- Lack of seed treatments, and less effective alternatives, has negative impacts not only on direct crop establishment and possibly crop losses, but patchy crops may also encourage weed growth and can have impacts on herbicide programmes and weed control.
- A high percentage of crops are affected by turnip yellows virus (TuYV), transmitted by *M. persicae* (the aphid vector is no longer under control due to lack of seed treatment). These aphids due to resistance cannot be controlled by the active substances authorized for foliar use in OSR in most countries.
- Loss of control of turnip sawfly (ATALCO) and diamondback moth (PLUTMA) and cabbage stem flea beetle (PSYICH) damage at early crop stages resulted in yield loss and an increasing number of pyrethroid applications.
- If no seed treatments are available, farmers will continue to decrease OSR cropping area in high risk areas (in some countries farmers have abandoned OSR growing, and often replace it with cereals or maize, which has a negative impact for biodiversity).
- Until now no authorization for any active substance to control pest damage by HYLERA (except very recent authorization of a diamide active substance for seed treatment in Poland).

Accurate prognosis and monitoring tools

Monitoring is necessary to establish pest density and assess risk (e.g. assess % feeding damage; number of larvae per plant, count beetles in water traps).

Monitoring:

- Provides information on when the control threshold for a pest has been reached
- Helps to assess efficacy of control measures
- Can help develop methods based on understanding of crop location behaviour, phenology, immigration behaviours and spatio-temporal distributions
- Is adopted, but time consuming for farmers
- Acceptance by farmers could be improved via development of new technologies to provide accuracy and save time via semi-automation e.g. real-timing monitoring of insect pests (camera traps being developed, LIDAR (Light Detection and Ranging 'laser' sensor technology being tested to detect OSR pests and beneficials)

- Should be linked to **digitalization of agriculture: new opportunities of digital field management** e.g. *Bayer Digital Farming* including smartphone applications; **On-line risk assessment tools**.

Thresholds refer to the number of pests or level of pest damage above which control measures are required.

Thresholds:

- Are hugely diverse, some are historic with limited underlying data, or non-existent data. A more coordinated (harmonized) approach is needed to defining them.
- Need to be reviewed, updated and new ones developed where necessary so that farmers have confidence in them. Should not be based on 'economic' price of insecticide treatment programmes; a lesson should be learnt from the overuse of pyrethroids (and their relatively low price leading to widespread use and ignoring thresholds).
- Should be based on plant physiology and impacts of damage, understanding how OSR may compensate for the damage.
- Adapt thresholds to a strictly need basis; might support reduction in application frequency.
- Threshold setting will be assisted by new tools under development which support correct use of thresholds and timing of applications.

Non-chemical control methods

Cultural methods

- In general, good plant protection practice for OSR starts with avoidance of build-up of pest populations. Adequate **crop rotation** should be practised. It is generally not advisable to plant both winter and spring rape in the same areas, as this increases the risk of high levels of pests in the spring crop. Also, OSR is often grown as a break crop in intensive cereal-growing areas. It is important not to include OSR too often in the rotation, as pests may build up to a level where the crop can no longer be grown economically. It should be noted that most oilseed pests are also pests of other brassicas, so there is a risk of movement between crops.
- **Healthy (good quality) seeds** should be used.
- A **suitable cultivar should be chosen**; **use of resistant cultivars**. These are not available for insect pests, however resistant cultivars are available for diseases: (stem canker, light leaf spot), commercially available resistant cultivars to TuYV (resistance to virus, not to the aphid vector).
- **All agronomic techniques should be used to succeed in good establishment and continuous growth of the crop,** e.g. good preparation of the seedbed for rapid crop establishment, appropriate sowing date, favour the root system growth, avoid pre-emergence herbicides.

Current and future research on non-chemical methods: Lot of valuable research is conducted on non-chemical methods, but limited implementation occurs in farming practices; growers need clear messages and knowledge transfer should be improved.

Habitat diversification: intercropping (crop associations/companion crops: e.g. undersowing OSR with legume mixtures can reduce cabbage stem flea beetle (PSYICH) infestation), cover crops, mixed cropping, **trap cropping** can limit pest damage to OSR.

- Trap crops (turnip rape *Brassica rapa* is more attractive than OSR to pollen beetle, seed weevil and cabbage stem flea beetle) were effective in some experiments but not in others; however, the extra harvest required for trap crops raises costs.
- The trap cultivar has to attract and retain the pollen beetle until the main OSR cultivar reaches flowering stage. Therefore the flowering stage and pollen production must last as long as possible in the trap cultivar or different trap cultivars have to be mixed to maintain attractiveness as long as possible.
- Undersown crops (e.g. legumes) may also be a useful technique. A common problem with some potential candidates is, that sometimes they outcompete the crop and then become difficult to control because of limited selective herbicide options. (Hybrid varieties with faster emergence may alleviate this to some extent).

Breeding for insect resistance in OSR - Research in progress:

- Resynthesized lines can be a potential source of resistance to pest insects (e.g. partial resistance to *C. pallidactylus*). Resynthesized rapeseed lines e.g. a cross between the parental species *B. oleracea* and *B. rapa* can be used to broaden the genetic diversity and to develop a genetically diverse gene pool for rapeseed hybrid breeding.
- Hybridization with resistant species (e.g. *Sinapis alba* resistant to attack by *Ceutorhynchus obstrictus (B. napus x S. alba* → novel resistant lines).
- In Canada hairy canola is being developed (using GM techniques).

Semiochemicals e.g. pheromone repellents (several possibilities but nothing commercialized yet).

Conservation of endemic predators and parasitoids

- 12 key parasitoids are sufficiently widespread and abundant across Europe to be of potential economic importance for biocontrol of pests.
- Percentage parasitism of pest larvae varies between countries and years; levels frequently exceed 30%, indicating their impact on populations of new-generation adults.
- Mean parasitism of *B. aeneus* and *C. assimilis* was increased by an IPM system, compared to a ‘standard management system’.
- Strategies for conservation and enhancement of parasitoid efficacy need to be improved in further studies.

Bioinsecticides

- Entomopathogenic fungi and nematodes are under research.
- Bioinsecticides potential as an IPM element is increasing, challenge for future include use of these in the open field and showing positive effects on yield and developing more virulent strains.
- For the entomopathogenic nematodes *Steinernema feltiae*, research indicates potential for a longer-term control as it needs time to establish significant levels of parasitism across more than one season.
- An advantage is that bioinsecticides are easy to apply through conventional application machinery, but current lack of selective strains needs consideration.

Botanical insecticides

Many are broad spectrum and therefore may have similar adverse impacts on natural beneficials. In addition, as with any other chemicals, they may be at risk of resistance development.

Genetic research: RNAi-mediated gene silencing, ongoing research of novel technologies at the University of Manitoba, (will affect digestive system of flea beetle). Sprayable RNAi is under investigation as an insecticide, however off-target effects and environmental safety needs to be determined.

Recommendations (key messages):

Before entire Mode of Actions (MoAs) are banned it is necessary to carefully consider what the impact will be to farming and the environment of the effects of ban. Less diversity results in higher selection pressure on remaining MoAs and facilitates resistance development.

A diversity of effective and proven methods is needed for IPM including a diversity of chemical MoAs as well as non-chemical control options. Research on non-chemical options needs intensification but in most cases chemical options will be needed from time to time to avoid economically important crop failures.

Further development of ecological approaches to IPM of oilseed rape pests will ensure insecticides are used only when necessary; preventing or delaying insecticide resistance and thus prolonging their active life, safeguarding the environment, maximizing profitability and contributing towards sustainable intensification of the crop.

Monitoring and forecasting and threshold values need research to avoid any unnecessary actions. Advice for farmers needs to be intensified to implement resistance management strategies and to reduce reliance purely on chemical solutions.

To make farmers more interested in IPM solutions, they need confidence in efficacy of available tools and planning of control programmes. Technology may reduce reluctance to use new solutions by developing monitoring methods that can be semi-automated (and eventually may link directly to application machinery).

Possible breeding solutions to enhance/develop resistance may provide options within IPM programmes. However, the current reluctance within the EU to consider GM may limit commercial development.

New technology also offers prospects of more targeted spraying and significant reductions in the proportion of an area treated; for example automatic recognition and differentiation between pest and beneficial insect species could lead to ‘spot’ spraying. However, regulators will also need to consider revising risk assessments and encompassing new technology in the way Good Agricultural Practice (GAP) are expressed and assessed.

Better cooperation in Europe needed (exchange of information, knowledge), e.g. **pest monitoring network** (real time information for farmers, overcome language barriers). A large scale (e.g. European) solution is necessary for research activities needed in near future to address the needs.

The value of national resistance action groups (RAGs) is that they are cross-discipline with regulator, grower groups, industry, independent agronomists and researchers. These networks can help tailor IPM and resistance management strategies to national circumstances and regional needs; and communicate to growers. The challenge is how to improve communication with existing groups, how to encourage others to create similar groups and finally how to successfully implement a strategy "at the farmers' gate".

EPPO should consider how to support knowledge transfer, and also reflect upon new methodologies (e.g. using automated assessment methods) in Plant Protection Products Standards.

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