PROJECT "TARGETED IMPLEMENTATION OF INTEGRATED PEST CONTROL UNDER CONDITIONS OF INTENSIVE FARMING", NO. 35BV-KK-17-1-03770-PR001

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PEST CONTROL IN WINTER WHEAT AND RAPESEED

Recommendations

The applicant is **the Lithuanian Research Centre for Agriculture and Forestry.**

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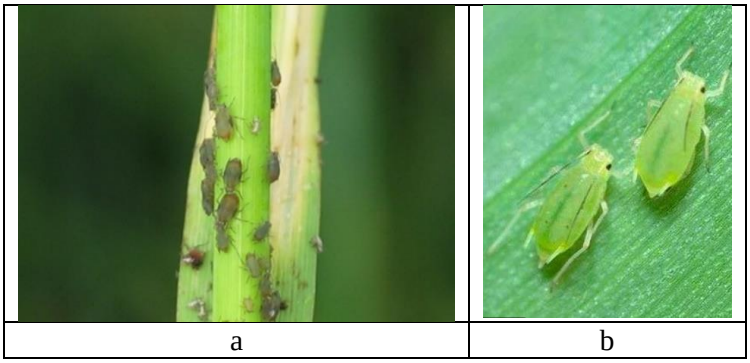
1. PEST CONTROL IN WINTER WHEAT

Many pests can be detected in winter wheat crops, however, only a few of them can cause significant damage. The spread of pests is more abundant when warm and snow-free winters predominate, and drier weather prevails during active plant growth. Under Lithuanian conditions, various pests cause greater losses to winter wheat crops only in exceptional cases. Greater attention should be paid to seed crop protection against pests, as aphids are spreaders of various viruses. In most cases, higher pest prevalence can be prevented by agrotechnical measures and crop rotation.

Main pests spreading in winter wheat crops

Bird cherry-oat aphids *(Rhopalosiphum padi)* are about 2 mm long brown-green or yellowish-green insects (Figure 1 a). There are winged and wingless individuals in the colony. These aphids form large colonies on crop stems and leaves. They are more commonly found on the lower part of the plant. They develop from a few to several generations during summer, therefore, they spread suddenly and very abundantly. Warm, moderately humid weather is favourable for bird cherryoat aphids. Prolonged droughts or heavy rainfall can completely stop their spread and damage caused. The harm threshold of aphids is when more than 10 aphids are found on 50% of stems.

Grain aphids (*Sitobion avenae)* damage winter wheat by feeding on its sap as well as spreading viral diseases. The insects are small, with a body length of up to 3 mm, colour ranging from light yellowish green to dark reddish brown (Figure 1b). About 10 generations can develop per year. It usually settles in ears and feeds on forming grains. Warm and dry weather is favourable for the spread and reproduction of grain aphids. Heavy rains wash them away from crop ears and can completely stop their spread and damage caused. The threshold of grain aphid harmfulness is when 2–3 aphids are found on 20–30% of stems.

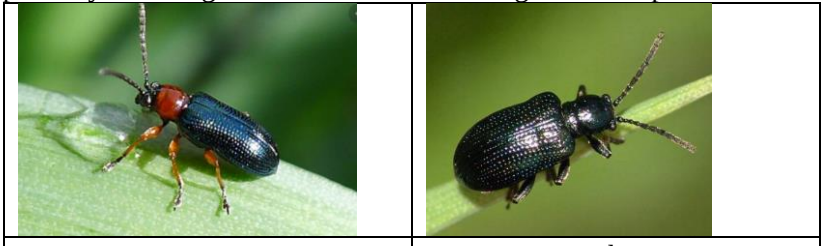


a b

Figure 1. *Bird cherry-oat (a) and grain aphids (b)*

Red cereal leaf beetles *(Oulema melanopus)* are small, 4.0–4.8 mm long, shiny, black beetles with reddish thoraces and legs that feed on cereal crop leaves (Figure 2 a). The larvae are hump-backed with black heads, yellow body, covered with brown or black mucus. When feeding, the larvae eat the upper epidermis of the leaf leaving long lines. One generation of cereal leaf beetles is produced a year. Warm and dry weather in late spring and early summer is favourable for cereal leaf beetles.

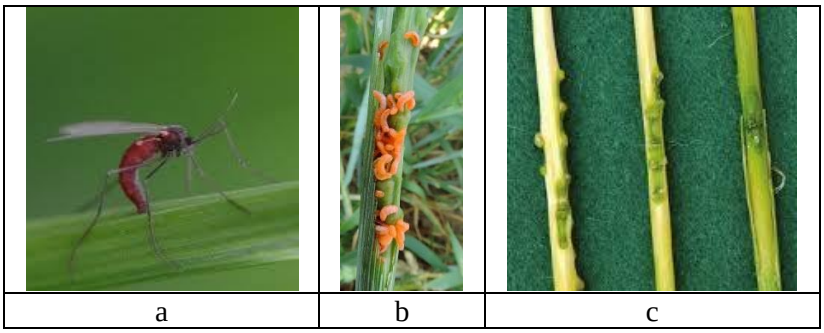
Blue cereal leaf beetles *(Oulema lichenis)* are small, 3.0–4.0 mm long, shiny, black beetles that feed on cereal crop leaves (Figure 2 b). The larvae are hump-backed with black heads, yellow body, covered with brown or black mucus. Adult larvae form white, fluffy cocoons in leave axils, from which develop into pupae and later – into beetles. Certain number of overwintering beetles is destroyed by shaving stubble and ploughing soil. Insecticides must be used in the event of an influx of cereal leaf beetles. Spraying against cereal leaf beetles can be combined with spraying against aphids by choosing an effective insecticide against both pests.



a b

Figure 2. *Red (a) and blue (b) cereal leaf beetles*

Saddle gall midges *(Haplodiplosis equestris)* are small, 4.0–5.5 mm long, red insects (Figure 3). They fly around in late May and June. Females lay their eggs on the upper and lower surfaces of leaves arranged in rafts along the leaf veins. The hatched larvae move down the leaves to feed on the stem underneath the leaf sheath. The newly hatched larvae are whitish green, turning to pale orange or pale red. Once larvae achieve maturity, they drop to the soil and overwinter until the following spring during which they pupate. They feed while eating stem tissues. The spot of the damaged stem, where the larva itself is located, is of uneven contours. The damage causes the formation of characteristic saddle-shaped galls. The stems damaged by the larvae tend to bend and lodge due to the stronger wind or break completely. The risk of spreading saddle gall midges can be reduced by crop rotation with fewer grasses. The eradication of perennial weeds in the field is also an important means of regulating the spread of pests. The threshold of harmfulness of this pest is when 50 insects are caught in five sweeps with an entomological net or 10 pests are found in a pheromone trap when wheat is at the end of stem elongation – at the beginning of ear emergence stage (BBCH 39–51).



a b c

Figure 3. *Saddle gall midge: adult (a), larvae (b) and wheat damage (c)*

In order to optimize the use of insecticides, it is <u>RECOMMENDED</u>:

- to apply agrotechnical measures: stubble shaving, ploughing, and avoid winter wheat monocropping.
- not to use insecticides preventively: unnecessary sprays not only increase the cost of production, but also pollute the environment, destroy parasites of harmful pests (natural enemies).
- the use of insecticides in winter wheat is recommended only when the pests themselves are found and their spread exceeds the economic harm threshold.
- insecticides should only be sprayed at the full registered rate, as lower rates encourage the risk of developing resistance.

2. PEST CONTROL IN WINTER RAPESEED

The increasing prevalence of pests in winter rapeseed crops is related to its increasing cultivation areas both countrywide and on farmers' farms, where rapeseed is grown in the same field only after a break of 1–2 years. However, this does not mean that the cultivation of these plants can become unprofitable due to an increased pest population. Pests of all kinds usually have their natural enemies. There are found to be about 12 species in Europe that parasitize major rapeseed pests. Rapeseed growers are not advised to use insecticides as a precautionary strategy, as unnecessary spraying kills natural enemies of pests and stimulates the development of insecticide resistance. Insecticides should only be used when the spread of pests exceeds harm thresholds.

Pests of winter rapeseed that spread in autumn

Slugs *(Deroceras spp., Arion spp.)* damage plants in the early stages of their growth and can therefore significantly reduce overall crop productivity in the presence of high pest infestations. Slug damage includes irregularly shaped holes in the leaves and eaten leave edges *(Figure 4).* Shiny mucus is visible on soil or on the surface of damaged leaves.

Figure 4. *Slugs and their damage in winter rapeseed*

Molluscicides are used for the control of slugs, which are spread on the soil surface. The application is recommended only when there are visible lesions on plants. In addition, traps can be set up in the fields to monitor slug populations. Dig shallow pits up to 10–15 cm deep in several spots of the field. Cover them with a sheet of pressed paper (50 × 50 cm) and apply some weight to protect it against the wind. During the day, slugs hide from the sun in the installed traps. When rainy weather prevails, slugs can also be seen during the day. No harm thresholds have been set, but for rapeseed up to three leaf stage (BBCH 13) and in the case of finding 1–2 slugs per day in traps, it would be appropriate to use molluscicides. Slugs are more common in fields with minimal tillage and in poorly cultivated crops with large clumps of soil on the surface.

At the same time, turnip (yellow and striped) **flea beetles** (Phyllotreta spp.) are spreading in winter rapeseed crops. The beetles are 2.5 to 3.5 mm in size, the body is convex, oblong and oval (Figure 5). Hind legs are adapted for leaping. The head is black, with a faint greenish or bluish sheen. They have a yellow narrow stripe running the length of each wing case. Rapeseed plants are damaged by turnip flea beetle larvae, which mine petioles, make paths inside them and thus reach the bud by gnawing. Turnip flea beetles are the most dangerous for seedlings and young rapeseed plants. Damaged plants tend to be weaker, grow poorly, become sensitive to frost, and may die. When it is noticed in autumn that turnip flea beetles damage 10 % of leaf surface and under favourable conditions for the pest spread (warm and dry), it is recommended to spray with insecticides. Plant protection measures are the most effective when the plant is in the stages between germination and leaf development (BBCH 09–16). Insecticides are effective only against beetles. Insecticide protection becomes ineffective when the larvae hatch in soil and mine petioles. Turnip flea beetle larvae can only be destroyed by systemic insecticides before they have mined petioles.

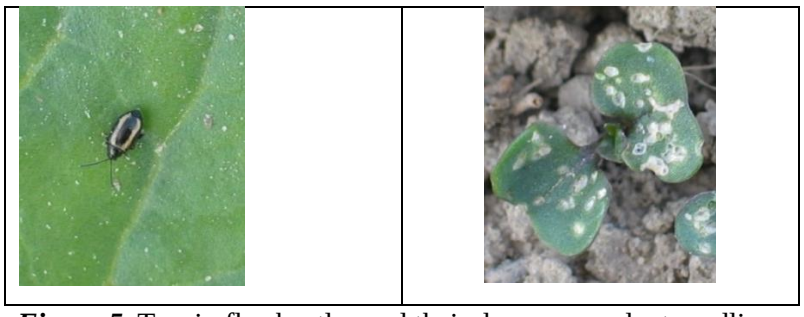


Figure 5. Turnip flea beetles and their damage on plant seedlings

Cabbage-stem flea beetles *(Psylliodes chrysocephala)* are 3–4.5 mm in length, the body is oval, greenish-blue-black with a metallic tinge, and the head is pink (Figure 6). The hind femora are black, large, the legs can be used to jump. Adults eat rape seedlings and young first true leaves. Cabbage-stem flea beetle females lay their eggs in the soil. The larvae that hatch in the soil next to plants mine them via the petioles of older leaves. The developed larvae are 6–8 mm in length, yellowish white with dark spots, the head is brownish-yellow, and it has three pairs of legs. The harm threshold for cabbage-stem flea beetles, as well as that for turnip flea beetles, is when about 10 percent of leaf area is damaged.

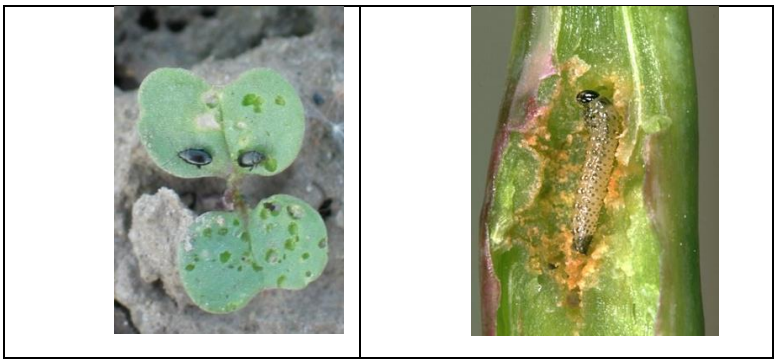


Figure 6. Adult cabbage-stem flea beetle and its larva

Turnip gall weevil *(Ceutorhynchus pleurostigma Marsh.)* is 2–3 mm in length. The larvae are white, without legs (Figure 7). The pests spread in winter rapeseed crops in warm and dry weather. The females lay their eggs beneath the skin of a root. The rounded galls occur in the damaged spots; these are swellings of about 1 cm in diameter, a typical sign of damage by these pests. Inside the cut gall, chambers and larvae are found. A severely damaged crop increases the risk of plant freezing and fungal decay. There is no harm threshold of this pest identified, however, yellow water traps can be used to determine the start of its spread. Autumn spraying against flea beetles can also coincide with the spread of weevils and reduce their population.

Figure 7. Larva of turnip gall weevil and damage caused

<u>Pests of winter rapeseed, spreading in spring</u>

Cabbage stem weevils (*Ceutorhynchus pallidactylus*) are 2.5–3.5 mm in length and have a long, slender proboscis (Figure 8). The upper half of the body is black with a brown hue. Wing cases with small, light spots covered with grey or yellow-brown scales. The larvae are 3–5 mm in length, yellowish-white, legless, with a small brown head. Females lay their eggs in rapeseed stalks, below the apical bud. The larvae feed on the inner tissues of the stem, gnawing tunnels.

Figure 8. Adult cabbage stem weevil, its larva and damage caused

Common pollen beetles (*Meligethes aeneus)* are black, bluish-black or greenish-black, ovate-oblong, 1.5–2.7 mm in length, its body is moderately convex. The larvae are up to 4 mm long, yellowish with light brown spots, a brown head, and 3 pairs of legs (Figure 9).

Figure 9. Adult common pollen beetles, larvae and damage caused

Adult beetles damage buds, so they drop and no longer develop flowers and pods. In spring, when the temperature rises to 12 °C, the beetles begin to feed on the pollen of various plants growing around their wintering sites. They migrate to winter rapeseed crops when the temperature rises to 15 °C, then fly to spring rapeseed fields. At lower temperatures, beetles are less active and less harmful. Eggs (1 to 6) are laid in flower buds. The larvae hatch in 4–9 days. The first instar larvae feed on the bud pollen until the flower opens. The second instar larvae migrate to flowers in the upper part of inflorescence and feed on their pollen. Common pollen beetles are economically very harmful pests; therefore, great attention must be paid to the monitoring of these pests and plant protection in rapeseed crops during the stages of stem elongation and inflorescence emergence. Rapeseed growers are advised to determine the abundance of pests in a particular rapeseed crop before deciding to use insecticides. The harm thresholds of common pollen beetles in Lithuania have not been determined by special studies. According to the data from other countries, the use of insecticides is recommended when there are 1–2 beetles per plant at the beginning of the stem elongation stage, and 3–4 beetles at the inflorescence emergence stage on average.

Cabbage seed pod weevils (*Ceutorhynchus obstrictus)* are 1.9–2.8 mm in length, oval, grey, matte, covered with fine grey scales (Figure 10). The proboscis is long, slender, cylindrical and curved. The adult larvae are about 5 mm long, white in colour, with a brown head, without legs. The symptoms of beetle damage are difficult to notice because small holes in the plant tissues heal quickly. The hatched larvae mine the seed epidermis and feed inside it. The damaged pods mature earlier and become deformed. As the pods mature, larval entrance holes are visible on their surface. The harm threshold is when an average of 1 beetle is found per plant starting from the beginning of the flowering stage to the formation of pods (BBCH 63–71).

Figure 10. Adult cabbage seed pod weevil, its larva and damage caused

The brassica pod midge (*Dasineura brassicae)* is 0.7–2.2 mm in length, with a yellowgrey or pinkish belly, which is usually cylindrical or conical. Its proboscis is short, without piercing bristles. Headless and legless larvae are white or yellowish, up to 2 mm in length (Figure 11). The females' eggs are usually laid in the pods damaged by weevils. The hatched larvae feed on the inside of pods or seeds, while secreting saliva. Damaged pods are deformed, swollen, get yellow, and then crack lengthwise, they can often be shelled out by birds in search of larvae.

Figure 11. Brassica pod midge and its larvae

Results of precision field experiments

The study conducted at the Institute of Agriculture, LRCAF, Akademija, Kėdainiai D., compared the effects of different chemical classes of insecticides on common pollen beetles and cabbage stem weevils. The spraying was performed when the plants reached the end of the inflorescence emergence stage (BBCH 57). According to the recommendations, insecticides against common pollen beetles should be used when an average of 3–4 pests are found per plant. During the experiment, the number of pests was small – 1.01 individuals on average. The spraying was applied as the use of insecticides against common pollen beetles is not recommended after the plants have reached the flowering stage (BBCH 61) due to the adverse effects of the products on bees. In addition, during flowering, the pollen beetles do not harm the plants, on the contrary – they facilitate the pollination of the flowers. Before spraying, an average of 15 stem weevils were found in yellow water traps. The insecticides were effective in reducing both pollen beetle and cabbage stem weevil populations. According to the study results, it is not recommended to delay the spraying of insecticides against stem weevils until the end of the inflorescence emergence stage. Although the use of insecticides reduced the number of larvae in the stems, only a slight increase in yield was obtained.

Table 1. *Effectiveness of insecticides against pollen beetles and cabbage stem weevils*

Treatment	Average number of pollen beetles per plant	Effectiveness of insecticides 2 days after spraying	Effectiveness of insecticides 4 days after spraying	Average number of pests in yellow water trap before spraying	Average number of larvae of cabbage stem weevils per plant 3 weeks after spraying, individuals	Insecticide efficiency, %	Yield t/ha	Yield increase t/ha
Control	1,01	–	–	15,0	6,3	–	2,95	–
Sprayed with contact insecticide	1,01	100 %	66,67 %	15,0	3,4	46,03 %	2,96	+0,01
Sprayed with a mixture of systemic and contact insecticides	1,01	100 %	83,33 %.	15,0	1,5	76,19 %.	3,03	+0,08

In order to optimize the use of insecticides in winter rapeseed, it is RECOMMENDED:

- to apply agrotechnical measures: proper soil preparation, optimal sowing dates, sufficient fertilization with essential nutrients ensuring optimal growing conditions for winter rapeseed
- to apply crop rotation so that winter rapeseed grows in the same field after at least three, preferably after a break of four years
- in order to reduce the risk of insecticide resistance while using insecticides several times a season, it is recommended to choose products belonging to different chemical classes
- during flowering, insecticides and other pesticides can be sprayed from 9 p.m. until 4 a.m. to avoid adverse effects on bees. In addition, one must register with the PPIS system at least 2 days before the planned spraying.