

Guidelines for the implementation of control measures against the Mediterranean flat-headed root borer (*Capnodis tenebrionis*) in woody fruit and ornamental species of the family Rosaceae (Rosaceae) on the territory of the Republic of Bulgaria

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The Bulgarian Food Safety Agency has published “**Guidelines for the implementation of control measures against the flatheaded root borer (*Capnodis tenebrionis*) in woody fruit and ornamental species of the family Rosaceae on the territory of the Republic of Bulgaria**”. The document is the result of joint work by

scientists and experts from the Ministry of Agriculture and Food, the Bulgarian Food Safety Agency, the Agricultural University – Plovdiv, the Nikola Pushkarov Institute of Soil Science, Agrotechnologies and Plant Protection – Sofia, the Risk Assessment Center on Food Chain (RACFC), the Institute of Agriculture – Kyustendil, the University of Forestry – Sofia, and the Fruit Growing Institute – Plovdiv.

The guidelines are intended for farmers and plant protection specialists for the implementation of the necessary control measures when an increase in the population of the pest flatheaded root borer is established.

The working group outlined the causes of the increase and high population density of the flatheaded root borer as follows:

Climate change – in dry and hot climates adults lay a greater number of eggs, the development of larvae is shorter, which has a favorable effect on population development. The high temperatures over the last two years in Bulgaria contribute to the increase in the population of the flatheaded root borer;

- lack of resistant rootstocks;

- use of non-certified planting material;

- problems in the applied agrotechnology – maintaining the soil surface permanently grassed and the absence of surface (gravity) irrigation. High air and soil moisture in the area around the tree trunks and roots has a negative effect on the larvae, but under drip irrigation the moisture is insufficient;

- lack of effective tools for monitoring the pest and of efficient means of control. At present, monitoring of the flatheaded root borer is carried out through visual inspection of host trees and manual collection of adults. No pheromone traps or coloured traps have been developed for monitoring the flight of adult individuals. The ban on the use of a number of active substances in the European Union has led to a lack of effective means of control.

The difficult control of the larval stage of the pest, since the larvae are protected in the roots of the attacked trees.

Control of the flatheaded root borer must be directed at all stages of its development. Achieving sustainable management of the pest requires an integrated approach, which is described in detail in the prepared Guidelines and includes:

Agrotechnical measures

Measures to prevent the occurrence, increase and spread of the flatheaded root borer begin already at the stage of planting material production. In nurseries, the soil must be well cultivated. Additional irrigation and fertilization with mineral fertilizers should be carried out. This will help the young trees to develop at a higher growth rate, thereby shortening the period during which they are susceptible to attack by the flatheaded root borer.

In the production of planting material, professional operators carry out monitoring for the occurrence of the flatheaded root borer and, when necessary, implement the respective plant protection measures.

Selection of a suitable site for establishing an orchard, in accordance with the soil and climatic characteristics of the region and the requirements of the respective species. New orchards should not be planted immediately on sites where trees have been uprooted as a result of damage caused by the flatheaded root borer.

Research shows that females prefer drier soils for egg laying, while high moisture reduces the percentage of hatched eggs. Therefore, it is necessary to maintain higher soil moisture in orchards through surface (gravity) irrigation, especially during the egg-laying period, from 15 June to 20 August. The soil moisture maintained under drip irrigation is not sufficient to exert a negative effect on the development of the flatheaded root borer.

Old, abandoned and poorly maintained orchards in poor phytosanitary condition are a potential source of infestation and are one of the reasons for the high population density of the pest.

Biological control

Application of entomopathogenic nematodes (EPN), which effectively destroy the larvae. Entomopathogenic nematodes (EPN) are of substantial importance for the biological control of the flatheaded root borer due to their ability to survive for long periods in the soil and their active host-seeking behaviour. Their effectiveness against pests living in galleries in stems has been proven. They do not attack vertebrates and are safe for bees and the environment.

Entomopathogenic nematodes are applied to the soil in the invasive third stage. At this stage they are capable of entering diapause and surviving for a relatively long period in the soil without feeding. EPN are available on the market in various formulations – in dry form in gel, in miniature capsules, in concentrated solutions. What they all have in common is that they must be stored in a refrigerator at a temperature of 4 to 8°C.

Abiotic factors such as temperature, soil moisture and solar radiation directly influence the efficacy of EPN.

The following entomopathogenic nematodes are authorised for use for the control of larvae of the flatheaded root borer:

Heterorhabditis bacteriophora – this species can be applied at air temperatures from 15 to 35°C, but requires higher soil moisture. It has better efficacy against pupae and is suitable for autumn treatments;

Steinernema carpocapsae – this species can be applied at air temperatures from 15 to 35°C and, unlike *Heterorhabditis bacteriophora*, can be used under drier conditions;

Steinernema feltiae – a species adapted to lower temperatures (8–30°C) and suitable for application during the colder months against overwintering stages in the soil. This species is less affected by soil moisture. *The negative effect of abiotic factors on EPN can be reduced by:*

- covering the soil surface after application of EPN with plant residues or mulch;

- applying the EPN suspension below the soil surface through drip irrigation, in order to protect the nematodes from drying out and solar radiation. Two weeks before and after the use of EPN it is not recommended to treat plants and soil with plant protection products (PPP), in order to prevent any possible adverse effects on them.

When disinfecting soil with a soil insecticide, EPN should not be applied. When using EPN, the requirements described on the product label must be observed.

Chemical control through the use of PPP

For the control of the different developmental stages of the flatheaded root borer (egg, newly hatched larva, adult), only plant protection products authorised for this purpose may be used. To date, **six PPPs** have been authorised, including two for organic production, which are safe for the environment and effective against pests living in woody galleries.

The plant protection products that can be used against the eggs, larvae and adults of the pest are:

Pyrethroids (3A MoA) – sodium (Na) channel modulators, a.s. deltamethrin (PPP Meteor) and a.s. tau-fluvalinate (PPP Mavrik 2 F/Evur 2 F);

Neonicotinoids (4A MoA) – competitive modulators of the nicotinic acetylcholine receptor (nAChR), a.s. acetamiprid (PPP Mospilan 20 SG); Spinosyns (5 MoA) – allosteric modulators of the nicotinic acetylcholine

receptor (nAChR) – a.s. spinosad (PPP Sineis 480 SC); **Diamides** (28 MoA) – ryanodine receptor modulators, a.s. chlorantraniliprole (PPP Coragen 20 SC/Voliam/Shenzi 200 SC). **Nonspecific inhibitors** (8F MoA) – methyl isothiocyanate generators, a.s. dazomet (PPP Basamid granulate).

Fungal agents with an unknown mode of action (UNF MoA) – a.s. entomopathogenic fungus ***Beauveria bassiana***, strain ATCC 74040 (PPP Naturalis). Entomopathogenic fungi infect their hosts through the cuticle, unlike other microorganisms which enter the insect host via ingestion. They infect both active and inactive host stages. PPP Naturalis is a contact insecticide authorised for use in our country against the flatheaded root borer. The active substance of PPP Naturalis contains strain ATCC 74040 of ***Beauveria bassiana***, which is specialised mainly for sucking insects, not for pests of the order Coleoptera.

Compliance with the recommendations in the guidelines will ensure a unified approach in the application of measures for the control of the flatheaded root borer and sustainable reduction of its population density.

More information on the approved products and methods of control can be found **in the BFSA guidelines**.

Photo © Adult specimen of the flatheaded root borer (Capnodis tenebrionis), source: Prof. Dr R. Andreev