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Review article

RHIZOCTONIA SOLANI - THE CAUSING AGENT OF DAMPING OFF DISEASE AND ITS INTEGRATED MANAGEMENT IN TOBACCO SEEDLINGS

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ABSTRACT

Healthy and quality tobacco seedlings are the base for successful tobacco production. Therefore, seedling protection is one of the most important measures that should be applied to obtain healthy and quality seedlings, successful transplanting, avoid problems with diseases and pests in the fields and obtaining a healthy and quality tobacco raw material.
The damping off is the most destructive disease in the seedlings production. The most common causing agent is the pathogenic fungus *Rhizoctonia solani*.
The knowledge of symptoms of the disease as well as morphology and biology of this causing agent, way of infection and resistance, epiphytotical properties of the pathogen etc, have the great importance for its successful control.
Its integrated management means consideration of all available plant protection methods and subsequent integration of appropriate measures that reduce the population of harmful organisms and keep the use of plant protection products to levels that are economically and ecologically justified. It refers to prevention or prophylaxis as well as the measures used to treat already diseased plants, therapy.
Its integrated management is complex and involve numerous agrotechnical measures, physical, mechanical as wel as the use of biocontrol and chemical control.

Key words: damping off disease, *Rhizoctonia solani,* integrated management

RHIZOCTONIA SOLANI - ПРЕДИЗВИКУВАЧ НА БОЛЕСТА СЕЧЕЊЕ И МЕРКИ ЗА ЗАШТИТА НА ТУТУНСКИ РАСАД

Здравиот и квалитетен тутунски расад е основа за успешно производство на тутун. Заштитата е една од најважните мерки што треба да се применат за да се добие здрав расад, да се постигне успешно расадување, да се избегнат проблемите со болести и штетници на нива и да се добие здрава и квалитетна тутунска суровина.
Болеста сечење е најдеструктивна болест во производството на расад. Најчестиот предизвикувач е патогената габа *Rhizoctonia solani*. Познавањето на симптомите на болеста како и морфологијата и биологијата на овој предизвикувачки агенс, начинот на инфекција и отпорност, епифитотиолошките својства на патогенот и сл., имаат огромно значење за негово усшешно сузбивање.
Интегралната заштита (во овој случај, на тутунскиот расад од овој патоген) значи вклучување на сите мерки за заштита на растенијата со цел намалување на популацијата на штетниот организам и употребата на производи за заштита на растенијата на ниво на економска и еколошка оправданост. Тоа се однесува на превенција или профилакса, како и на мерките што се користат за лекување на веќе заболените растенија, терапија.
Интегрална заштита во однос на овој патоген е сложена и вклучува бројни агротехнички мерки, физички, механички, како и употреба на биолошка борба и хемиска заштита.

Клучни зборови: сечење, *Rhizoctonia solani,* интегрална заштита

INTRODUCTION

Modern tobacco production aims to ensure good yields and quality of tobacco raw material. For that purpose, a number of agro-technical measures are applied.
Seedlings production is the first, initial and one of the most important links in tobacco production on which the entire further tobacco production depends. To produce healthy and successful seedlings is the basis for success in the later stages of tobacco production and finally obtaining a healthy and quality tobacco raw material.
Seedlings are also subject to a number of external influences, due to which they are attacked by a large number of pests and diseases. Therefore, seedling protection is one of the most important measures that should be applied to obtain healthy and quality seedlings, successful transplanting and avoid problems with diseases and pests in the fields.
One of the most important measures in the fight against tobacco diseases is prevention. If, despite the undertaken measures, the disease still appears, in that case it is necessary to take other measures for protection of the tobacco seedlings.
The knowledge of diseases and their causing agents are of great importance for successful protection and production of healthy seedlings.

DAMPING OFF – THE MOST DESTRUCTIVE DISEASE IN TOBACCO SEEDLINGS

According to importance of healthy and quality seedlings to tobacco production, as the basis for success in the later stages of tobacco production and finally obtaining a healthy and quality tobacco raw material, the emergence of damping off disease can really destroy production. The damage and losses are obvious and hence, determining the causing agent is the first step in protecting against this disease.
Pythium debarianum and *Rhizoctonia solani* are mentioned as the most common causing agents of the damping off disease. The symptoms are very similar and difficult to distinguish. Accurate determination is possible only by microscopy of infected material. However, the dominant causing agent in these areas is the fungus *R.solani*.
Such data are presented for some of the European countries. Kurzawienska (1980) based on laboratory tests, points out that in Poland, *R. solani* (accompanied by *Botrytis cinerea)* have been found to be the most important causing agents of damping off in tobacco beds. According to Ivancheva et al. (1978) in Bulgaria, the causing agent that dominate in tobacco beds, actually is the fungus *R.solani* (Мицковски, 1984).

RHIZOCTONIA SOLANI - THE CAUSING AGENT OF DAMPING OFF DISEASE

This destructive pathogen is worldwide pathogen responsible for serious damage of many economically important agricultural and horticultural crops (Grosh, 2003). It mostly affects the plants of the families *Solanaceae* and *Papilionaceae*. According to Lucas (1975, loc. cit. Мицковски, 1984) the disease caused by *R. solani* occurs every year. The specific symptom is observed in the acute phase - when the seedlings immediately rot and fall over the soil surface. In a small number of cases, some of the plants (before appearing of symptoms) survive the infection, but after transplanting, the growth of these plants is slower compared to healthy ones, and the symptoms also appear in the fields. In our country, it occurs on the seedlings and very rarely (al-

most never) on the tobacco in the field.
This fungus in our conditions appears in all stages of seedlings development - from germination to the stage of vigorous growth. *Rhizoctonia* is difficult to control because it survives for many years as sclerotia in soil or as mycelium in an organic matter under numerous environmental conditions (Grosh, 2003). The fungus has a wide host range, ie, limited rotational controls, there are no resistant cultivars and the fungus can grow and survive without a live plant host – it has "saprophytic ability." It cannot be eliminated but can be suppressed to a level that doesn't cause economic loss.

Symptoms of the damping off caused by *Rhizoctonia solani*

A dark brown watery spot begins to appear on the ground part of the stem, which spreads under favorable conditions. The tissue necrotizes, the supply of water and nutrients is disabled, due to which the plants die. The infection spreads to the surrounding plants, appearance of many diseased plants i.e. infected areas in the beds. These areas expand and merge, so that a big part of the tobacco seedlings are destroyed. Thus, the seedling production is degraded (Ph. 1 and 2).

Photo 1. Symptoms of disease in the beds

Photo 2. Infected plant by R. solani

Morphology and biology of *Rhizoctonia solani*

The name *R. solani Kuhn* is often mentioned in the literature for this parasite. The causing agent of this disease is also known as *Hypochnus cucumeris (Frank), Hypochnus solani* (Prill and Dalacrois), *Corticium solani* (Prill and Delacroix), *Corticium vagum sensu* (Burt), *Pellicularia filamentosa* (Pat., Rogers), *Ceratobasidium filamentosum* (Pat, Olive), and *Thanatephorus praticola* (Kotila, Fiente) (Мицковски, 1984).
R. solani is actually an anamorph (asexual stage) of the pathogen. Its teleomorph (sexual stage) is *Thanatephorus cucumeris* (Frank) (Ivanović, 1992).
According to Parmeter (1970, loc. cit. Мицковски, 1984), a large number of nuclei are observed in the young hyphae of this fungus. The hyphae of *R. solani* are wide and thick (8-12 microns) at first colorless, but with aging they turn dark brown. One septum is always present near the base of the hyphae. The hyphae branch near the septum at right angles, with slight bending at the point of branching. Basically the hy-

phae are compacted with brown pigmentation (Ph. 3 and 4).

Only mycelium develops on infected plants and infection is performed by hyphae. It forms neither vegetative nor generative organs for reproduction. The sublime shape of the fungus (basidia with basidiospores) is confirmed on to the potato tubers.

Pseudosclerotia are a conservation organ, sometimes formed on artificial culture, or in rotten plants. Some of these bodies are barely visible, while others are larger (up to 6 mm in diameter). They are more or less flattened, irregular, brown or black and have a smooth surface. Sclerotic embryos develop by increasing branching and partitioning of the common hyphae. Older pseudosclerotia are composed of freely intertwined brown chlamydospores with dense contents. Sometimes the remnants of infected parts of the host plant are intertwined with sclerotic hyphae. The basidia form directly on the gray mycelia.

Photo 3. R. solani –pure culture

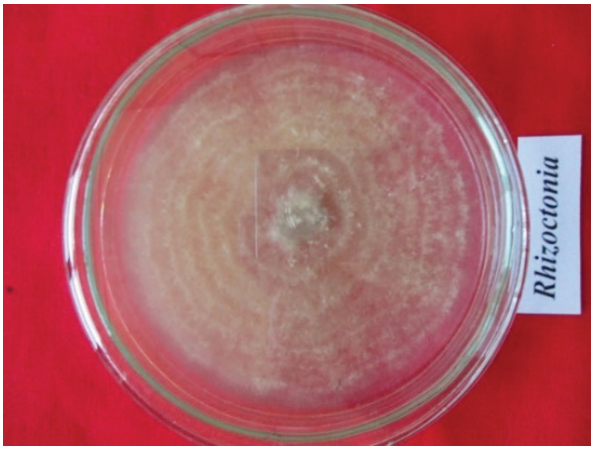

Photo 4. R. solani –mycelium

R.solani can be isolated from the tissue of infected plants, soil and rhizosphere as well as from rotten remains of plants. It can be developed in a liquid and solid environment, on standard or specialized substrates. Many researchers have studied the effect of temperature on the development of the disease. The fungus develops over a wide temperature range. According to Алексиќ, *R.solani* develops in vitro at a temperature of 25°C. Its development stopped at temperatures below 5 °C and above 30°C. For its development this fungus requires moderately wet, but can sometimes occur on relatively dry soils (Мицковски, 1984).

Infection and resistance

The development of *R. solani* is stimulated by the secretions from the germinating seeds and the root veins of the tobacco plant. The nature of these substances is not sufficiently known, but it is believed that carbohydrates and amino acids play an important role. These substances allow the hyphae to develop towards the root system of the plant or stimulate the penetration of sclerotia or basidiospores. When the connection is made, *R.solani* can penetrate the plant tissue directly or through the natural openings of the injured areas.

The parasite often attaches tightly to the host plant and develops at a distance along its surface, enclosed in an adhesive sheath before forming an appressorium. Penetration occurs intercellular or by direct penetration into the epidermal wall. The infiltrated hypha branchs through the plant tissue, the af-

fected tissues get brown (necrotize) and die. This necrotic reaction of the host occurs either from diffusely distributed metabolites of fungi or its toxins, or it occurs from the cells of the plants themselves, as a reaction to penetration of hyphae (Doomanetal 1968, loc. cit. Мицковски, 1984). Infection of the seeds occurs at the same way i.e. by penetration into the seed coat that is in contact with the soil.

Plant resistance to this pathogen is associated with the preventing of penetration or spreading throughout the organs. There are mechanisms that prevent the parasite from entering into the plant cells, or penetration is disabled due to lack of physical and chemical stimulants. After penetration, complete penetration of the fungus can be partially prevented by excreted toxins and enzymes, thus localizing the infection only to limited parts of the plant incentives.

Resistance is often related to the physical properties of the plant tissue that affect the spreading of the pathgen through the plant. But the plant's ability to limit the spread of the pathogen once the infection has already started seems to be related to the increased intensity of respiration in its tissue. Factors that reduce plant vigor, whether environmental, chemical or biological, reduce its resistance (Flentie 1957, loc. cit. Мицковски, 1984).

Epiphytotical properties of the pathogen

Epiphytotical properties of a pathogen depend on the favorable environmental conditions for its development, the possibilities for its spread, as well as the change of cultivation of the crop. *R. solani* as a saprophytic fungus can use many organic substances as energy sources and so, for months to live on the waste of dead or rotten plants. It can be maintained in the soil with both the reproductive organs and the mycelium. Sclerotia are an important organ for the spread of infection. They can also be transmitted by seeds. Sclerotia, mycelium and basidia are easily transmitted by wind or irrigation water.

R.solani is a soil microorganism that can mainly provide active saprophytic existence in the soil and survive in the absence of the host plant for several months and years, colonizing organic matter. The substrate enriched with NaNO2 is very suitable for saprophyte lifestyle (Papavizas and Davey,1961, loc. cit. Мицковски, 1984).

Mycelium that lacks carbon or nitrogen may develop, but its ability to infect the plant stem is greatly reduced. Cellulose as the most common substance in the soil can be colonized and decomposed, which undoubtedly affects the stimulation and maintenance of the pathogen.

Soil moisture, aeration, texture and organic matter have a strong impact on the parasite. The highest saprophyte activity is achieved at relatively low soil moisture. The optimum soil temperature for saprophyte development is different on different soil types. The fungus usually develops at 16-20°C at a depth of 0.5-3.0 cm. The highest concentration of CO_2 reduces the activity of the fungus, as the parasitic phase is much more sensitive than the saprophytic one. Dry sclerotia remains infectious for 6 years. Maintenance increases at higher temperatures or higher humidity during conservation.

INTEGRATED MANAGEMENT OF DAMPING OFF DISEASE IN TOBACCO SEEDLINGS

Integrated Pest Management means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment (EU Commision, 2020).

Measures that prevent the contact between the pathogen and the host plant are called hygienic measures. These measures, as well as measures with aim to prevent the occurrence of the disease, are known as preventive measures for protection or prophylaxis. Measures used to treat already diseased plants are known as therapy.

Integral plant protection (as a complex of measures) consists of the application of:

- Agrotechnical measures
- Mechanical measures
- Physical measures
- Biological measures
- Chemical measures
- Legally measures

Agrotechnical measures

This type of measure prevents the multiplication of large numbers of parasites, pests and weeds in agricultural crops, and thus reduces yield losses. These measures have a preventive character of protection. They are the following:

- **Choosing a place to grow**

This agro-technical measure is of special importance. When growing tobacco, the type of soil should be taken into account (to avoid heavy clayey, saline soils), the location of the surface and, if possible, chemical analyzes for soil fertility. To prevent the occurrence of damping off disease, the beds should be on a sloping ground, drained and to allow air circulation (Vućo, 2007).

- **Crop rotation**

From the protection point of view, the crop rotation has an important role in preventing the occurrence of plant diseases, pests and weeds. Due to the frequent cultivation of plants as a monoculture, which is specific to tobacco, plant debris in the soil remains with a number of causing agent of various diseases and pests, which is a potential danger of epiphytotics in certain pathogens. Plant debris is also a primary source of infection for the new harvest. The intensity of the attack will be reduced only by crop rotation, ie by growing other crops that are not from the same family, ie. do not host a particular pathogen or pest.

There are numerous examples of successful disease prevention (including damping off in different agricultural plants) by applying crop rotation with other crops, aromatic plants, as well as annual and perennial crop rotation (Khan et al., 2019).

- **Tillage of the soil**

It directly or indirectly destroys pathogens, insects and weeds because many of them are plowed (especially with autumn plowing) deeper into the soil where they do not have favorable conditions for development. So, it means that reduces the primary sources of infection. Plowing before sowing is also very important to reduce, and especially to prevent the early occurrence of damping off, especially if the soil contains an inoculum of *R. solani* from previous crops (Nunez, 2006). With regular additional processing, weeds are destroyed, which are hosts for a large number of pests and pathogens in tobacco.

• Sowing time and sowing norm

Sowing time is of particular importance and primarily determines the stages of development (Khan et al., 2019). Sowing time should allow rapid germination and development, but of course it should not be a wet and cold period (Nunez, 2006).

The right choice will ensure the vigor of the seedlings, which is in addition to disease resistance. By sowing at the optimal time, the seedlings are more developed, thus avoiding critical periods for attack in a curent phenophase.

In addition to the optimal sowing periods, it should be taken a care with the sowing depth and the sowing norm. When sowing tobacco seeds, it should be used a smaller amount of seeds per 1 m^2 to avoid the dense seedlings, which is one of the main reasons for the occurrence of damping off. It also prevents transmition of the diseased seedlings to the fields.

• Selection of varieties and hybrids

The use of resistant varieties and hybrids in order to reduce the occurrence of plant diseases (including damping off), is of particular importance for the integrated plant protection as well as tobacco. It is the cheapest method of protection, without residues in production and without harmful consequences for the environment. When choosing varieties, resistance varieties should always be preferred, which will reduce production costs. This is the most modern and most promising protection measure.

The use of resistant varieties and hybrids is of particular importance for reducing the occurrence of plant diseases (including damping off). It is the cheapest and the contemporary method of protection, without residues in production and without harmful consequences for the environment. It also reduce production costs. Resistant varieties should be preferred when choosing varieties. This is the most modern and most promising protection measure.

• Spatial insulation

This agro-technical measure (although its bigger importance for the transplanted tobacco) has an impact on the protection of the seedlings, too. The pathogen *R. solani* has many plant species as its hosts, especially from the family Solanaceae (potato, tomato, pepper). Hence, these planted areas are favorable opportunity for the damping off disease occurrence in tobacco beds (danger of spreading the pathogen during irrigation and various operations). There is also the possibility of viruses spreading.

• Fertilization

Quality nutrition is a guarantee for growing the healthy seedlings. However, if large amounts of nitrogen are used, weak plants are obtained that can be attacked by a number of pathogens. Excessive nitrogen fertilization is known to increase plant susceptibility. Hence, there is a particularly great danger of damping off. In order to prevent its occurrence, the nutrition of the seedlings should be in accordance with the stage ie needs of the seedlings.

Recently, modern biostimulants (which represent different formulations of components) are present on the market. They improve plant's physiological processes as well as the growth and plant vigor. At the same time, they have a fungicidal effect. Their application has a special contribution for protection of the tobacco seedlings from the occurrence of the damping off.

According to the goals of modern protection of tobacco seedlings, Scientific Tobacco Institute - Prilep has tested some bioproducts applied through appropriate application models.

• Irrigation

Proper irrigation contributes to the production of healthy and quality seedlings. However, excessive irrigation is especially harmful for the seedlings because the densed plants (big numbert of plant per area) retains water, thus increasing all predisposing factors for infection (microclimate, transmission and retention of the pathogen in the soil and ground etc.). Therefore, irrigation should be moderate, carried

out carefully and timely, in accordance with the real needs at the appropriate stage of the seedlings development.

• **Weed control**

R. solani as a saprophytic fungus can persist on many weeds, thus increase the natural inoculum and the risk of seedling infection. Also, the presence of weeds reduces the possibility of proper nutrition of the seedlings and thus increases the susceptibility of plants to the pathogen. The large presence of weeds also creates a microclimate that is conducive to achieve an infection and development of the disease.

By weeds control, in fact, there are efforts to reduce all predisposing factors for infection and thus the risk of disease. Hence, these agrotechnical measures for tobacco seedlings protection is a justified.

• **Timely preparing and tempering for transplantation**

Delaying of preparing and tempering of seedlings to be rooted and transplanted (especially if irrigation is continued) increases the possibility of damping off disease. During that period, no protection is provided, so, the seedlings are in danger of other fungal diseases (blue mold, brown spot, etc.). Perceiving this danger, seedlings have to be properly tempered, planning for the rooting which has to be timely achieved.

Sanitary measures

Numerous hygienic-technical measures should be practiced in the seedling production to prevent the development of the pathogenic fungus *R. solani*, to prevent the infection of the seedlings and the spreading of the infected poins in the beds. Thus, the diseased seedlings should not be manipulated, but it should be taken out of the beds. This should preferably be done by one person and the others to uproot the healthy seedlings.

Mechanical measures

They should enable the destruction of the plant organs through which the parasite spreads but also reduce the inoculum to a minimum for the next season. Most often, as mentioned earlier, this includes the manual removal of infected plants and their destruction - burial or (better) burning outside the beds.

It is necessary to inspect the infected areas in the beds and completely “clean” them to prevent spreading the infection, merging them and therefore, huge damages. According to (Vućo, 2007), such a mechanical operation is necessary before treating the beds.

Physical measures

These measures include the use of light, heat, low and high temperatures and the application of various kind of rays.

Thermal disinfection of the soil performed by dry heating or water vapor is a hygienic measure that destroys the spores of many fungal pathogens. This would be especially useful for soil pathogens such as *R. solani*. But there is no developed method of its application in tobacco production.

Solar energy allows partial disinfection of the soil, so exposing the seedlings to light (especially in the early stages) influences not only the development, but also has a

certain indirect protective effect.
Thermotherapy is used in seed production to kill pathogens, thus avoiding the introduction of the pathogen by sowing. Because tobacco seeds are stored for up to several years, this measure is unacceptable. Also, *R. solani* is a pathogen in the soil, so the adequacy of this method of protection is debatable.

Biocontrol

Biocontrol is the use of biocontrol agents or products of their metabolism in the suppression of harmful agents. Biocontrol agents (can be fungi, bacteria or viruses) act through a number of mechanisms in such as: competition for space and food, antagonism or antibiosis, mycoparasitism, induced resistance and etc. Propagated appropriately or, favoring their development in the environment itself, do the biocontrol. The genus *Trichoderma* show antagonistic relationships on the number of fungal pathogens in plants (Harman, 1996).
The reducing effect, as well as the nature of the action of *Trichoderma* sp. on several pathogens, including *R. solani* in tobacco was proved by Гвероска (2009), Gveroska and Ziberoski (2011), Gveroska (2015). *T. harzianum* has been shown to has the best reducing effect.
The application of these biocontrol agents can be effective in in standard conditions of agricultural production, especially when using herbicides. According to Gveroska (2015), this biocontrol agent can be used in such conditions, with appropriate "compensation" of the first reducing effect of the herbicide on the population of the biocontrol agent.
The modern directions of tobacco protection in the Republic of North Macedonia require its inclusion in the protocols for integrated managent system with the most appropriate application model of *T. harzianum* (Gveroska, 2020).
The biological control of pathogens, beside the microorganisms-antagonists includes various biological preparations based by enzymes, plant extracts, antibiotics, various low molecular weight compounds, etc., as well as microorganisms with specific activity. Thus, the primary activation of certain rhizobacteria can be supplemented by fungicidal action, which can be used to protect pathogenic fungi. Such a role is played by the rhizosphere ammonifying bacteria *Bacillus subtilus* Ch13 which has a promising role in protection against the pathogen *R. solani*. Another strain – *B. subtilus QST 713* recently has been also included in biological control.
Good results in control of damping off disease has the preparations based on EM technology, ie the technology of effective microflora. Its basic principle is based on the application and increasing the population of efficient and beneficial microorganisms in the soil, which expels degenerative microorganisms, especially soil pathogens. There are also probiotics with a "strengthened" formula which, in addition to the four groups of active microorganisms included in the basic formula of probiotics (lactic acid bacteria, photosynthetic bacteria, actinomycetes and yeasts) are constantly evolving and supplementing with other bioactive components.
From all the above data and scientific facts, it can be concluded that biocontrol is one of the basic ways to reduce the use of chemicals and environmental management in the direction of sustainable agricultural production.

Chemical measures

Seed treatment with fungicides is considered a good protection option, especially in the early developmental stages of seedlings (Khan et al., 2019; Nunez, 2006). However, pathogen-specific fungicides should be used for this purpose. On the other hand, since it is a soil pathogen, this procedure is difficult and its justification is questioned.

In addition to the application of other measures to protect tobacco seedlings from damping off caused by the pathogen *R. solani*, the most acceptable and fastest way is the chemical, ie the application of fungicides. Unfortunately, for a long time there were no preparations for the suppression of *R. solani* (except a.i. thiophanate-methyl which at this point is not approved).

The studies of (Csinos et al., 1998) for the control of this pathogen, the active ingredients flutolanil, iprodione, fluazinam and tebuconazole are pointed. At one time, in our country there were attempts to use some fungicides in the protection of tobacco seedlings.

There were any investigations in Macedonia as effort to use some fungicides in the protection of tobacco seedlings - such as Pilarič 75% - 0,2% WP and Bravo 500 SC-0,2% -a.i. chlorothalonil, Folicur EW-250 - 0,1% -a.i. tebuconazole , Score 250 EC- 0.05% -a.i. difenoconazole, Quadris 25 SC- 0,1% -a.i. azoxystrobin and the others (Gveroska, 2008, 2012).

Later, good efficacy (in artificial inoculation with *R. solani*) was achieved with the fungicide Signum 33 WG (a.m. boskalid + piraklostrobin) in the concentrations of 0.1 and 0.15%, and especially with Quadris 25 SC (a.m. azoxysistrobin - 0.2 and 0.15%). Recently, new active substances and, accordingly, fungicides have appeared on the market. Despite their registration for use in other crops, the most are effective in controlling this pathogenic fungus and they have a great commercial application. These are the active substances Azoxystrobin, Boscalid + Pyraclostrobin and Ametoctradin + Methiram (Gveroska, 2018).

The application of chemical protection in tobacco production is in line with modern guidelines for sustainable agricultural production and the principles of environmental protection (EU Commission, 2020). Specifically, monitoring the onset of diseases, intensity of attack, accurate (not premature) application of chemical protection, application of reduced doses (according to low intensity of attack), reduced frequency of treatment, monitoring of the threshold of harmfulness, risk assessment of / not treatment as well as the risk of resistance, etc. Particular care is taken when applying active substances - to be less toxic. Also, the application of biopreparations is moving upwards.

It is necessary to apply all modern protection measures to achieve the goal - sustainable tobacco production

Legally measures

Legally measures regulate the use of pesticides in agriculture, and hence in tobacco production. They are in accordance with the legislation of each producer country, but also the country (and company) that imports tobacco raw material.

The legislation regarding the placing of plant protection products on the market and their application is in line with the modern protection of tobacco and the goal – selection and the true choice of active ingredients, reduction of the number of treatments and use of preparations in small quantities, but with a large efficiency. Tobacco production stands for no use active ingredients that belong to class I toxicity to the World

Health Organization (and from II - in exceptional conditions).
Modern chemical protection as part of the IPM of tobacco has an ultimate goal - to ensure economically and environmentally acceptable tobacco production and obtaining quality tobacco raw material.

CONCLUSIONS

The damping off in tobacco seedlings is the most destructive disease due to which seedlings production has great damage.
Rhizoctonia solani is the most common causing agent of the damping off disease. A number of measures are taken for its control in order the damages to be at the lowest level.
The fight against this pathogen is difficult due to its pronounced ability for saprophyte development and the presence of a large number of hosts.
Integrated management of *Rhizoctonia solani* (as well as other diseases and pests) is a set of measures to be taken to obtain a healthy tobacco seedling.
Biocontrol is a modern and environmentally friendly way of protection that provides long-term benefits for tobacco production.
Chemical measures, ie the use of fungicides (with the right choice and safety application) are part of the measures for protection against damping off disease.
Applying all the principles and integrated protection measures, sustainable production of tobacco seedlings and tobacco can be ensured.

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