CROP PRODUCTION

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PATHOGENICITY OF MICROMYCETES STRAINS ISOLATED FROM THE SOIL AND LEGUMINOUS PLANT

Research article

Abstract

The leguminous crops grown on a natural infectious background in small-plot experiments at the Botanical Garden of the National Research University "BelSU" (Belgorod, Russia). The strains from rhizosphere and filloplanes of leguminous crops were identified by the method of water washes. The pathogenic properties of the isolated strains were determined by the bioassay method on seeds. The study of pathogenicity micromytcetes strains revealed that *Alternaria alternata*, *Cunninghamella echinulata*, *Trichoderma lignorum* had a stimulating effect on seed germination and the development of test plants of legumes, while *Aspergillus niger* and *Bipolaris australiensis* had an inhibitory effect. The species *Alternaria infectoria*, *Fusarium heterosporum*, *Stemphylium solani*, *Ulocladium botrytis* possessed a non-pathogenic property to perennial legume grasses, and in one degree or another caused inhibition of the development of annual legumes.

Keywords: pathogenicity of micromycetes, micromycete strains, microscopic fungi, legumes, rhizosphere, filloplane, plant growth inhibitors.

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ПАТОГЕННОСТЬ ШТАММОВ МИКРОМИЦЕТОВ, ИЗОЛИРОВАННЫХ ИЗ ПОЧВЫ И БОБОВЫХ РАСТЕНИЙ

Научная статья

Аннотация

Бобовые культуры выращивали в условиях мелкоделяночных опытов на территории Ботанического сада Белгородского государственного университета. Штаммы из ризосферы и филлопланы бобовых получены методом водных разведений. Изучение патогенности выделенных штаммов микромицетов показало, что *Alternaria alternata*, *Cunninghamella echinulata*, *Trichoderma lignorum* оказывали стимулирующий эффект на прорастание семян и рост проростков только бобовых культур, а *Aspergillus niger* и *Bipolaris australiensis* замедляли рост этих культур и снижали всхожесть семян.

Ключевые слова: ключевые слова, ключевые слова, ключевые слова.

1. Introduction

Models of biological farming in the modern world suggest widespread use in crop rotation of leguminous crops, which are not only a rich source of vegetable protein in food and feed, but one of the best predecessors in terms of saving fertilizers [1-3]. However, microscopic fungi that develop in the soil and on the surface of plants have a significant impact on the development of plants, the yield and its quality. Most micromycetes inhibited substances inhibit plant growth, while others, on the contrary, contribute to their development and increase in productivity [4, 5].

Since knowledge of the pathogenic properties of micromycetes of agrocenoses is an important component in managing the phytosanitary situation, and there is not enough data on the mycocenosis of leguminous crops, this has determined the purpose of this study: to study the pathogenicity of micromycetes isolated from the rhizosphere and filloplane of leguminous crops in the soil and climatic conditions of the Belgorod region (Russia).

2. Materials and methods

The strains from rhizosphere and filloplanes of leguminous crops, grown on a natural infectious background in small-plot experiments at the Botanical Garden of the BelSU National Research University (Belgorod), were identified by the method of water washes [6]. The taxonomic affiliation of micromycetes was determined by the totality of cultural and morphological characteristics using the special literature: *Alternaria alternata* (Fr.) Keissl., *A. infectoria* E.G. Simmons, *Aspergillus niger* Tieghem, *Bipolaris australiensis* (M.B. Ellis) Tsuda & Ueyama, *Cunninghamella echinulata* (Thaxter) Thaxter, *Fusarium heterosporum* Nees ex Fries, *Macrophoma phaseolicola* L.A. Kantsch., *Stemphylium solani* G.F. Weber, *Trichoderma lignorum* (Tode) Harz, *Ulocladium botrytis* Preuss [7-10]. Taxon names are unified by the databases of The MycoBank Fungal Databases (http://www.mycobank.org) and CABI Bioscience Databases (http://www.indexfungorum.org).

The pathogenic properties of the isolated strains were determined by the bioassay method on seeds. Seedlings of seven plants of different families were chosen as test objects: Legumes (radder, asparagus beans, hybrid clover, alfalfa), Cabbage (Sarepta mustard, watercress or cress), Cereals (rye). Indicators of seed growth in distilled water was taken as 100%. The pathogenicity of fungi was judged by the degree of germination of seeds; the degree of inhibition of seed germination, growth of aboveground and underground parts [11].

3. Result and discussion

The obtained results allowed us to divide the studied micromycetes into 4 groups. The group with a broad spectrum of pathogenic action includes species of *Aspergillus niger* and *Bipolaris australiensis*, which suppress seed germination, growth and development of the aerial and underground parts of all plants of 3 families. Species with a limited spectrum of pathogenic action, namely, *Alternaria infectoria, Macrophoma phaseolicola, Stemphylium solani*, inhibited the growth and development of 4-5 species of plants. Species *Alternaria alternata, Fusrium heterosporum, Trichoderma lignorum, Ulocladium botrytis*, which inhibited the growth and development of 1–3 plant species, are classified as narrowly specialized. *Cunninghamella echinulata* was not pathogenic.

As the results of the study showed, pathogenic properties were expressed in all studied soil fungi, with the exception of *C. echinulata*, which stimulated both seed germination by 1-8% and growth of the aerial (3-49%) and underground parts (5-126%) all seven test plants of three families compared with sterile water.

The species *A. alternata* showed in some cases a stimulating effect on germination (up to 20% higher in clover) and growth in above-ground (59% longer in clover) and underground parts of plants (112% in mustard) and had a weakly pathogenic property to rye seedlings (reduced their germination by 36% compared with the control).

At the same time, the pathogenic properties of another species of the genus, *A. infectoria*, were more pronounced, but it had an inhibitory effect on the growth of annuals of the Legumes and Cabbage families. Bean seeds in a suspension of conidia *A. infectoria* did not grow. This mushroom suppressed the development of the root system (from 40% in watercress to 51% in mustard). Along with this, the stimulating effect of the fungus *A. infectoria* on the length of aboveground and underground parts of clover seedlings was noted by 38 and 37%.

The pathogenic properties of *A. niger* and *B. australiensis* are expressed in all test objects, the highest pathogenicity of *A. niger* was detected in relation to the seedlings of plants of the legume family (clover, alfalfa and beans), their seeds did not sprout in the conidia suspension of this fungus. *A. niger* acted negatively on cowpea, mustard, watercress and rye seedlings: it oppressed seed germination by 20–51%, reduced the length of the aerial part (36–100%) and roots (45–96%).

Also, *B. australiensis* showed a high level of pathogenicity in relation to mustard seedlings (0% germination during seed treatment with a suspension of its conidia). The species *B. australiensis* reduced germination of seeds by 15-86%, inhibited the growth of the aerial part by 23-100% and plant roots by 53-100%.

Only three species (beans, mustard and rye) revealed the pathogenic properties of the *F. heterosporum* fungus. Under the influence of the suspension of its conidia, plant germination decreased by 20-70%, the length of the aerial part decreased by 19-26%, and the roots - by 33-44%. The species had a stimulating effect on the growth of the aerial parts of cowpea and watercress (14-18%), and the root system (21-62%) of clover and alfalfa.

A high level of pathogenicity manifested *U. botrytis* to bean seeds (0% germination during seed treatment with an aqueous suspension of its spores). For cress sprouts, the species appeared to be slightly pathogenic (inhibition of root length by 49%). The fungus was non-pathogenic to the rest of the test objects, even stimulated the growth of the aerial part and clover roots by 19% and 42%, respectively, compared with the control.

The appearance of *M. phaseolicola* showed in some cases pathogenic properties. The highest level of pathogenicity had to bean sprouts (inhibit seed germination by 100%). It inhibited the growth of the aerial parts of alfalfa, mustard and watercress by 23-50%, and inhibited their growth of roots by 49-90%.

The fungus *T. lignorum* was non-pathogenic to the representatives of the legume family and stimulated the germination of clover seeds by 22%, the growth of the cowpea roots by 11%, the length of the aerial part of these species by 36-47%. At the same time, the seedlings of the Cabbage and Grasses family showed pathogenic properties. He suppressed the development of the above-ground system of mustard and watercress by 10-25%, and their root system by 46-53%. Strong inhibition of rye seed germination by 36% was also noted.

The species *S. solani* stimulated both the germination of seeds and the growth of aboveground and underground parts of perennial legumes (clover and alfalfa). At the same time, it had an inhibitory effect on the seedlings of other plants, and the seeds of the beans grown in the aqueous suspension of its conidia did not ascend. In cowpea, mustard, watercress and rye, the *S. solani* strains suppressed mainly the growth of the root system by 34–56%.

Analysis of the effect of the studied fungi on the growth of aboveground and underground parts of the test plants showed that the fungi *F. heterosporum, M. phaseolicola, S. solani, U. botrytis* predominantly inhibited the growth of the underground part of plants, while *A. infectoria, A. niger, B. australiensis, T. lignorum* had a systemic inhibitory effect on all growth processes. The *A. alternata* species had practically no effect on these test plants (except for monocots), even in some cases it stimulated the growth and development of plants. A species of *C. echinulata* in all cases had a stimulating effect on these test plants.

4. Conclusion

Thus, *A. niger* and *B. australiensis* species possessed a wide range of pathogenic effects and influenced all growth processes. Species with a limited spectrum of pathogenic action were *A. infectoria, M. phaseolicola, S. solani*, the last two inhibited preferentially the growth of the primary roots of plants. Narrowly specialized species *include A. alternata, F. heterosporum, T. lignorum, U. botrytis.* The stimulating effect was provided by the species *C. echinulata.*

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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