Summary

The biology and protection against *Colletotrichum lupini* on lupines

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Key words: white lupin, narrow-leaf lupin, yellow lupin, big-leaved lupin, Andean lupin, anthracnose of lupin, *Colletotrichum lupini*, mycelium growth, chemical control, biological protection, isolation of fungi

The epidemic pathogen appeared between 20th and 21st century and caused anthracnose of lupin which led to significant economic and environmental losses. It was the reason why the Department of Phytopathology and Entomology of the University of Warmia and Mazury started a wide research programme to investigate this issue. During the years 2004-2006, 2011-2015 and 2016-2018 in the Experiment and Education Station in Tomaszkowo near Olsztyn there were three field experiments carried out and during the years 2004-2006 also three pot experiments took place in the greenhouse of the University of Warmia and Mazury. Their aim was to study: the species of pathogen causing the anthracnose of lupin, the intensification of disease depending on the species and cultivar of lupin, the possibilities and purposefulness of chemical or biological protection of lupin and the influence of chosen environmental factors on the development of *C. lupini*.

During the entire research period the laboratory works was also carried out to determine the influence of selected environmental factors on the growth rate of *C. lupini*, the interaction between the pathogen and common microorganisms in the agricultural environment, the impact of the analyzed factors on the number and species composition of fungi inhabiting lupine roots and seeds.

During the research it was described that the anthracnose of lupin is caused by a strictly specialized species: *C. lupini.* The most susceptible to infection were the cultivars of yellow lupin (*Lupinus luteus*), and white lupin (*L. albus*). The research confirmed that the cultivars of narrow-leaf lupin (*L. angustifolius*) were less susceptible to infection. Comparably high intensity of infection noted on big leaved lupin (*L. polyphyllus*) and sky lupine (*L. nanus*) could have been a factor causing their disappearance from the landscape. The cultivars with determined growth type and the varieties with undetermined growth type were attacked by *C. lupini* at a similar level.

During the field and pot experiments the possibilities of disease control were analyzed. It was possible by limiting the pimary infection of seeds and the reduction of secondary infection related to the spreading of conidial spores. The application of seed dressing strongly limited the primary infection, which indirectly slowed down the secondary infection. For this reason the intensity of early symptoms on the shoots was lower. The application of seed dressing had no significant influence on the thousand seeds weight (TGW). The fungicides applied in the form of spraying during the vegetation period proved high effectiveness in limiting the disease symptoms.

At the moment all the active substances tested in the experiments have beeen withdrawn from application. The lack of fungicides to control of *C. lupini* can be partially compensated by the application of growth stimulators (Asahi SL, Bio-algeen) or compounds of silver ($AgNO_3$, nanoparticle SBTC), or titanium (TiO_2, nanoparticle titanium). The tested biological factors, both available for sale and prepared in the Department, were ineffective or only slightly effective in limiting the symptoms of the disease. Limiting the infection caused by *C. lupini* contributes to restricting the disease intensity on pods and as a result it protects agains the infection of seeds.

Higher temperature influences positively the development of *C. lupini.* The optimal temperature is 15°C, but the patogen develops well even in the temperature of up to 25°C. The pathogen can be well bred on the nutrient solution based on glucose and potatoes (PDA) with low pH (4,7).

From the lupin seeds many fungi species were isolated. The dominating ones were *Alternaria alternata, C. lupini*, *Fusarium* spp., *Penicillium* spp. In the laboratory tests the development of *C. lupini* was stopped by some fungi (*Trichoderma harzianum*, *Botrytis cinerea, Fusarium culmorum*). *C. lupini* was most seldom isolated from the seeds of narrow-leaf lupin from the cultivar Sonet and Baron and the seeds of big leaved lupine. The application of chemical protection at the beginning of blooming period most frequently restricted the appearance of pathogen on the obtained seeds.

The concentration of $16x10^3$ of *C. lupini* spores in 1 ml of water was the lowest of the researched concentrations in which the infection of all the cultivars of white, narrow-leaf, and yellow lupin was noticed. The most susceptible to infection were the cultivars Sonet (narrow-leaf lupin) and Markiz (yellow lupin).