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The potential of biological control on invasive weed species

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SUMMARY

Weeds (invasive weed species included) can cause serious damage to agricultural crops. Sorghum halepense is one of the invasive species in Europe. This study was made to identify the morphology of fungi on invasive weed species samples on the roots of Sorghum halepense. The samples were collected in the region of Debrecen. The experiment was conducted under laboratory conditions to determine the microscopic form of fungi. The samples were put on PDA and for identification of fungi is based on the morphological characteristics of the features and colonies of conidia that were developed in Petri dishes.

The examination of the culture revealed that the fungus from the root of Sorghum halepense was Aspergillus niger. Pathogenicity and the relationship between the fungus and Sorghum halepense are still uncertain so in the future pathogenicity tests and re-isolations from plants are very important steps.

Keywords: *fungi; weeds; biocontrol; Sorghum halepense*

INTRODUCTION

Weeds have an impact on cultivated crops. Based on an international estimation over three years, weed-related yield losses in some crops are estimated to be between 32% and 34% (Oerke and Dehne, 2004; Oerke, 2006). Herbicides are usually used to manage weeds, but they can also be harmful to the environment. In addition to severely polluting the environment, their persistent use in a similar way is connected a number of problematic weed species have developed resistance to a variety of pesticide actions (Korres et al., 2019; Heap, 2022). Weed management strategies alternatives are urgently required to be eco-friendly and economically viable and target different aspects of plant metabolism (Bordin et al., 2021). In some parts of the world to control invasive weeds, pathogens have been used in classical biological management (Bruckart and Hasan, 1991; Watson, 1991).

Plant pathogens have great promise as weed-controlling biological agents. Even though plant pathogens are used as agents to control weeds, it is possible that will be developed that in the near future novel weed-management systems using pathogen-derived genes, gene products, and genetic mechanisms (such as hypersensitive plant cell death and herbicidal bio-chemicals) (Charudattan and Dinoor, 2000). Based on TeBeest and Templeton (1985), Walker and Riley (1982) have previously reviewed the creation of two effective commercial products and a number of prospective mycoherbicides. An alternative to a mycoherbicide that is effective non-chemical alternative control while preserving the environment in general.

Invasive weeds are problematic all over the world as well as in Hungary, and they are also a problem in their management.

Johnsongrass (*Sorghum halepense*) is a *Poaceae* grass. In cultivated plants, it is one of the most problematic weeds (Holm et al., 1977). One of the most invasive weeds in the world, *Sorghum halepense* (L.) Pers. has a wide climatic niche (a niche is a specific area where a species do inhabit) (Holm et al., 1977; Barney and DiTommaso, 2011). According to Novák et al. (2009), *Sorghum halepense* has become one of the most significant weeds in Hungary after spreading quickly starting in the middle of the 1960s. As a result, across Europe, *Sorghum halepense* is already widespread in agricultural areas with a somewhat warmer climate, like in Hungary.

Numerous fungal pathogens of *Sorghum halepense* (Pers.) L. have been identified so far, and efforts to manage it biologically have been made. Two fungal species of the *Bipolaris* genus were described by Winder and Vandyke (1990).

MATERIALS AND METHODS

Area of Study

The *Sorghum halepense* samples (*Figure 1*) were collected in 2022, next to Debrecen, Kádárdülő (GPS coordinates: Latitude: 47.535547208972275º and Longitude: 21.534609105437994º). Leaf samples with symptoms were collected and packed properly until laboratory processing.

Isolates of fungi

The experiment was done in the laboratory of the Institute of Plant Protection, University of Debrecen. For the pathogen isolation, the medium was used Potato Dextrose Agar (PDA). Roots of *Sorghum halepense* were removed from the soil by washing them with tap water for five minutes after samples had been superficially cleaned with water and dried on sterile paper. For isolation, the roots of species from the

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infested plant were cut into small pieces (approximately 5 mm) and the surface was disinfected with 70% ethanol for 1min, followed by a rinse for 2 min in sterile distilled water. Sterilized plant tissues were placed on potato dextrose agar (PDA) in Petri dishes *Figure (2)* incubated at (± 24 °C) room temperature. Isolates are replicated until pure colonies were obtained.

Figure 1. **Sorghum halepense on the field**

Source: Kabashi (2022)

Figure 2. **Pathogen isolated from *Sorghum halepense* on PDA**

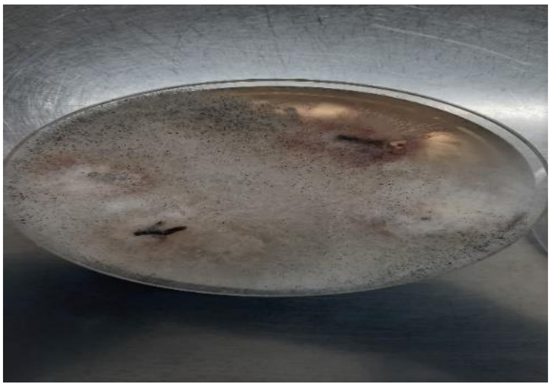
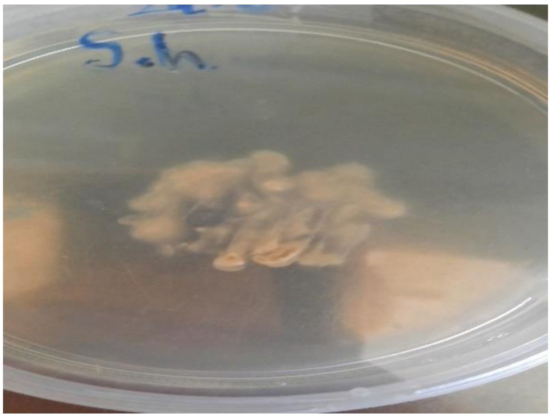


Figure 3. **Fungal colony isolated from *Sorghum halepense* on PDA**



Morphological identification

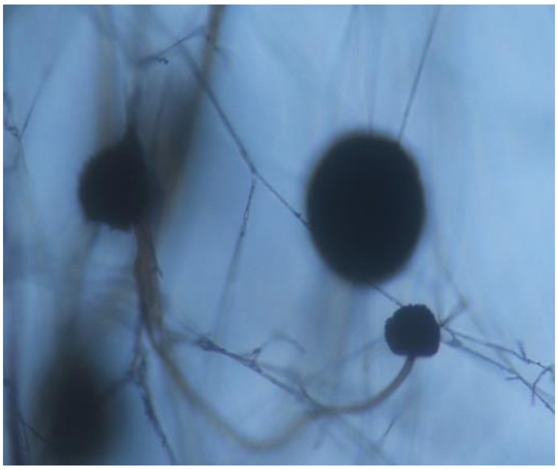
The microscopic descriptions of pathogens were made after PDA was incubated at ± 24 °C at room temperature. The grown mycelium was transferred to a new PDA medium as a pure culture. For the identification of fungi on *Sorghum halepense* lactophenol cotton blue was used and the morphological characteristics were observed under a light microscope and colony specifications. Conidia were photographed under a microscope by a Nikon camera. Identification was based on the fungal identification book by Barnett and Hunter (1998).

RESULTS AND DISCUSSION

Morphological characteristic of *Aspergillus* spp. on *Sorghum halepense*

Figure 3 shows the morphological characteristics of fungal species associated with *Aspergillus* spp. symptoms of *Sorghum halepense.* Fungal species associated with disease symptoms on the root of *Sorghum halepense* were grown in the PDA and then observed. Based on the forms observed under the microscope (*Figure 4*) the fungus was identified as *Aspergillus* spp. under microscope examination of disease and the presented morphological characteristics.

Figure 4. **The morphology of *Aspergillus* spp. on *Sorghum halepense* under the microscope**



Based on the research done by Kangarloo et al. (2014) *Aspergillus* spp. has been found also in the leaves of Johnsongrass (*Sorghum halepense).*

CONCLUSIONS

Johnsongrass (*Sorghum halepense*) is perennial weed which is very difficult to manage and resulting serious losses in agriculture. The control is not only difficult but too expensive.

The aim of this research was to identify the fungi which was occurred on the root of Johnsongrass. The *Aspergillus* spp. isolates from *Sorghum halepense* root were identified on the base of morphology under the

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microscope. This fungus may can be a potential agent to control *Sorghum halepense.* In the future, it is important to investigate this pathogen as a biological control.

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