ISSN 1330-7142
UDK = 632.25:632.51(497.5)

WHITE BLISTER SPECIES (*Albuginaceae*) ON WEEDS

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Original scientific paper
Izvorni znanstveni članak

SUMMARY

The obligate fungi inside the family Albuginaceae are widespread world wide and cause white rust or white blister disease. Mycopopulation of weeds has been researched within the project „The role of weeds in epidemiology of row-crop diseases". The aim of this research was to identify white blister species occurring on weeds in Eastern Croatia. Weed plants with disease symptoms characteristic for white blister species have been collected since 2001 on location Slavonia and Baranja country. Determination of white blister species was based on morphological characters of pathogen and the host. Wilsoniana bliti was determined on Amaranthus retroflexus and Amaranthus hybridus leaves. Capsella bursa pastoris is a host for Albugo candida. Ambrosia artemisiifolia is a host for Pustula sp. and Cirsium arvense was found to be host for Pustula spinulosa. Wilsoniana portulaceae was determined on Portulaca oleracea.

Key-words: white blister, weeds, eastern Croatia

INTRODUCTION

The pseudofungi which cause white rust or white blister disease are obligate plant parasites. Van Wyk et al. (1999) described about 50 species of the genus *Albugo* and some of them are known as crop pathogens. Thines and Spring (2005) have presented a revision of the genus *Albugo*, supported by molecular phylogenetic studies (Thines and Voglmayr, 2009). *Albugo candida* (Pers.) Roussel is recognized as pathogen on *Brassica* and *Raphanus* species and it is the causal agent of white rust disease (Saharan and Verma, 1992; Koike et al., 2007). *Albugo occidentalis* G.W. Wilson on spinach is a very serious disease in the USA (Koike et al., 2007).

Pustula helianthicola Rost et Thines (syn. *Albugo tragopogonis* (Person) S. F. Gray) on sunflower plants in Australia, North and South America, and Africa caused losses from 70 to 80% (Pernaud and Perny 1995, Wyk et al., 1999, cit. Gulya et al., 2002). Different fungal species grow in all parts of weeds. Fungal parasitic activity can reduce weed vitality or even cause their decay. Some of fungal species could be used in biological control of weeds. On the other hand many weed species can be alternative hosts to disease agents of cultivated plants and play an important role in disease epidemiology (Mengistu and Reddy, 2005; Barrow, 2008). Mycopopulation of weeds has been researched and many important fungal pathogens of cultivated plants were determined on weeds (Ćosić et al., 2008, Vrandečić et al., 2010) within the project „The role of weeds in epidemiology of row-crop diseases". Since weeds could play an important role in disease epidemiology of cultivated plants the aim of this research was to identify species from family *Albuginaceae* occurring on weeds in Eastern Croatia.

MATERIAL AND METHODS

Weed plants with disease symptoms characteristic for white blister were collected from 2001 to 2009 on five locations (Aljmaš, Karanac, Klisa, Cerenko and Osijek) Slavonia and Baranja county (Croatia). They were found in sunflower, sugar beet, maize and soybean fields. Samples were collected during the vegetation period. Depending on parasites, isolations were made from leaves, stems, floral handle and inflorescences. Twenty plants were collected per weed species (*Amaranthus retroflexus* L., *Amaranthus hybridus* L., *Capsella bursa pastoris* (L.) Medik., *Ambrosia artemisiifolia* L., *Cirsium arvense* (L.) Scop. and *Portulaca oleacea* L.).

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Morphological characteristics were determined by preparing native preparations from fresh material and observing them under light microscope. Host tissue containing oospores was soaked in water, and carefully squashed with needles. Sporangiospores and oospores measurement were taken using camera and Olympus DP Soft software. One hundred reproductive structures were measured per samples. Determination was based on morphological characteristics and the host, using descriptions of Choi and Priest (1995) and Branderburger (1985).

RESULTS AND DISCUSSION

Wilsoniana bliti (Biv.) Thines

In eastern Croatia intensity of white rust infection on *Amaranthus retroflexus* and *Amaranthus hybridus* varies from low to heavy. Symptoms appeared on the leaves surface as small, irregular chlorotic lesions different in size. White blister pustules were formed on the lower leaf. They were single or mostly in the groups 1-3 mm in diameter. Depending on the year and location the disease appeared as scattered pustules (sori) restricted to one or a few leaves or in most cases the fungus spread throughout plant parts. The leaves of strong infected plants were smaller than normal and internodes were shortened. Highly infected *A. retroflexus* and *A. hybridus* plant had less biomass. Pustules contained numerous hyaline, oval or spherical sporangiospores. Sporangiospores were formed in the chains on the simple, short sporogenous hyphae. Sporangiospores from *A. retroflexus* measured 15.5-25.0 x 13.3-19.9 μm (av. 19.0 x 16.3 μm) and *A. hybridus* 15.2-23.5 x 14.0-20.4 (av. 18.7 x 16.2 μm). Globose, dark-brown, irregularly ornamented oospores with protuberances sometimes forming net-like structures, formed within the leaves, measured 41.2-60.9 μm (av. 51.5 μm) from *A. retroflexus* and *A. hybridus* 44.7-58.2 μm (av. 53.4 μm). Based on morphological characters and the host, the pathogen was identified as *Wilsoniana bliti* (Biv.) Thines.

Albugo candida (Pers.) Roussel

According to Fungal databases at the USDA-ARS Systematic Botany and Mycology Laboratory (Farr et al., 2004) *A. candida* was recorded on more than 300 hosts. It is known as a crop pathogen on various *Brassicaceae* species. White rust caused by *A. candida* is not a serious disease on cultivated plants in Croatia. In Slavonia and Baranja County it is widespread on uncultivated area, mostly on *Capsella bursa pastoris* and disease is present every year in different intensity, depending on the year and location. Symptoms included white to cream-colored, blister-like (pustules) lesions on leaves, stems, floral handle and inflorescences. Pustules were approximately 1 to 2 mm in diameter. Local and systemic infections were present on *Capsella bursa pastoris*. Local infections were observed as pustules on leaves, stems and floral parts. Malformed, swollen and sterile flower, abnormal growth appeared as a result of systemic infection. Sporangiospores produced in chains, nearly spherical to angular in outline, hyaline, mostly vacuolate, and measured 12.2-19.2 x 12.0-18.5 μm (av. 14.6 x 14.0 μm). Oospores were not found.

Pustula spinulosa (de Bary) Thines

P. spinulosa is newly described species and previously was reported as *A. tragopogonis*. According to Thines ans Spring (2005) *P. spinulosa* is species occuring only on *Cirsium* genus. We isolated *P. spinulosa* from *Cirsium arvense* found in soybean and sugar beet fields. On *Cirsium arvense* symptoms of infection were noticed on lower leaf. White blister was determined frequently, but intensity of disease was mostly very low. Pustules with sporangiospores were presented on both sides of leaf. Sporogenous hyphae are simple, short and unbranched. Hyaline, spherical or spherical-oval sporangiospores measured were15.8 -24.4 x 14.6 - 23.5 μm (av. 20.7 x 19.5 μm). Oospores were not found. Infection with *P. spinulosa* often occured with *Puccinia suaveolens* (Strauss) Rostr infection.

Figure 1. *W. bliti* on *Amaranthus retroflexus*
Slika 1. W. bliti na Amaranthus retroflexus

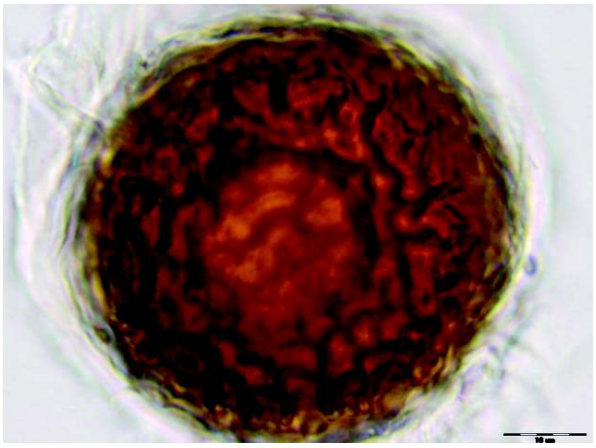

Figure 2. Oospore of *W. bliti*
Slika 2. Oospore - W. bliti

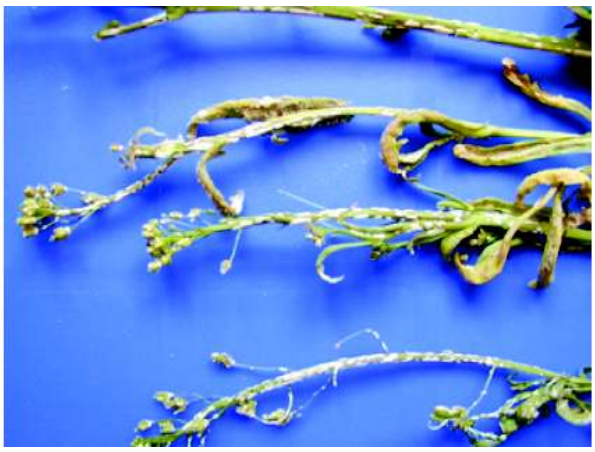

Figure 3. *A. candida* on *Capsela bursa pastoris*
Slika 3. A. candida na Capsela bursa pastoris

Figure 4. *A. candida* – sporangia
Slika 4. A. candida – sporangije

***Pustula* sp.**

White blister on *Ambrosia artemisiifolia* were found on plants growing in sunflower fields. The disease was observed only in 2001 and 2002. White blister-like pustules (1-3 mm in diameter), containing sporangia, were present on infected lower leaf surface. Pustules, on some leaves, were numerous and covered all lower leaf surface. They were also found on leaf petiole. The symptoms on the upper leaf surface were small, irregular yellow areas (chlorotic lesions). If plants were systemically infected, leaves were smaller than healthy and internodes were shortened. The heavy infected leaves fell off. Sporogenous hyphae are simple, short and unbranched. Hyaline, spherical or spherical-oval sporangiospores measured 15.8-24.4 x 14.6- 23.5 μm (av. 20.7 x 19.5 μm). Globose, dark-brown oospores measured were 40-58 μm (av. 50.5 μm).

Figure 5. *Pustula* sp. on *Ambrosia artemisiifola*
Slika 5. Pustula sp. na Ambrosia artemisiifola

Figure 6. *Pustula* sp. – sporangiospores
Slika 6. Pustula sp. – sporangije

***Wilsoniana portulacae* (DC.) Thines**

W. portulacae was isolated from *Portulaca oleacea*. In Eastern Croatia the disease is present almost every year in different intensity. Particularly high intensity of disease was determined in 2008. Numerous white pustules were observed on upper leaf surfice, sparsely on lower surfice and on stems. Small, irregular yellow areas (chlorotic lesions) were presented on lower surfice. On short sporogenous hyphae, sporangiospores were produced in chains, they were colorless, sphaerical if seen from above and usually elongate if seen from the side measured were 13.81 - 21.65 x 10.19 - 15.47 μm (av.13.00 x 17.67 μm).

Figure 7. *W. portulacae* on *Portulaca oleacea*
Slika 7. W. portulacae na Portulaca oleacea

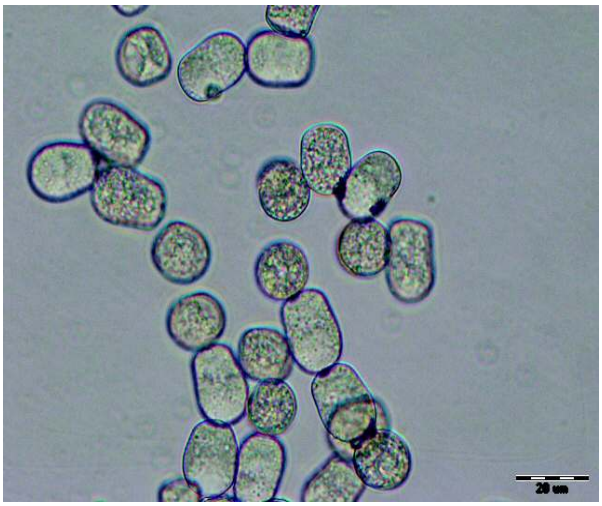

Figure 8. *W. portulacae* - sporangiospores
Slika 8. W. portulacae - sporangije

CONCLUSION

White blister occurred on weeds was studied within the project "The role of weeds in epidemiology of row-crop diseases" on location Slavonia and Baranja county (Croatia) from 2001 to 2009. It was determined on *Amaranthus retroflexus* and *Amaranthus hybridus Wilsoniana bliti. Capsella bursa pastoris* is a host for *Albugo candida. Ambrosia artemisiifolia* is a host for *Pustula* sp., *Cirsium arvense* is a host for *Pustula spinulosa* whereas *Portulaca oleracea* is a host for *Wilsoniana portulacae.*

ACKNOWLEDGEMENTS

This study was carried out within the project (079-0790570-2995) financed by the Ministry of science, education and sports of The Republic of Croatia.

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UZROČNICI BIJELE HRĐE *(Albuginaceae*) NA KOROVIMA

SAŽETAK

Gljive iz porodice Albuginaceae utvrđene su diljem svijeta i uzrokuju bolesti poznate pod imenom bijela hrđa. U okviru projekta „Uloga korova u epidemiologiji bolesti okopavinskih kultura" proučava se mikopopulacija korova, a cilj ovoga rada bio je proučiti Albugo vrste koje se javljaju na korovima u istočnoj Hrvatskoj. Korovi sa simptomima bolesti karakterističnim za bijelu hrđu prikupljani su od 2001. godine na lokacijama Slavonije i Baranje. Determinacija uzročnika bijele hrđe temeljila se na morfološkim karakteristikama patogena i domaćinu. S lišća Amaranthus retroflexus i Amaranthus hybridus izoliran je Wilsoniana bliti. Capsella bursa pastoris je domaćin za Albugo candida. Ambrosia artemisiifolia je domaćin za Pustula sp., Cirsium arvense za Pustula spinulosa, a Wilsoniana portulacae izolirana je s Portulaca oleracea.

Ključne riječi: bijela hrđa, korovi, istočna Hrvatska

(Received on 31 January 2011; accepted on 23 May 2011 - *Primljeno 31. siječnja 2011.; prihvaćeno 23. svibnja 2011.*)