ACTA MYCOLOGICA
Vol. 40 (2): 185-189
2005

The effect of local population of *Ustilago trichophora* on *Echinochloa crus-galli*

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Pusz W.: *The effect of local population of Ustilago trichophora on Echinochloa crus-galli*. Acta Mycol. 40 (2): 185-189, 2005.

Ustilago trichophora is a pathogenic fungus infecting the grass of *Echinochloa* genus. The effect of this pathogen on the growth of *Echinochloa* was not yet described. *Ustilago trichophora* was found and described first time in Poland in 1998 on *Echinochloa crus-galli* specimen. Then *U. trichophora* was found in several places in the region of Lower Silesia in the following years.

The aim of the investigation was to study the effects of *Ustilago trichophora* on the biometric parameters of plants as well as of seeds of *Echinochloa crus-galli.* The infected specimens of barnyards grass were found lower, they displayed poorer tillering and they produced a smaller number of panicles than the healthy plants. Seeds from infected bunches weight, were characterized by lower germination and energy capacity than the control ones.

Key words: *Ustilago trichophora, Echinochloa crus-galli*

INTRODUCTION

Ustilago trichophora (Link) Kunze ex Körnicke influences the growth of *Echinochloa crus-galli* L. and other species of the genus *Echinochloa* (Almaraz and Durreiu 1997; Ingold 1996; Kochman and Majewski 1973; Mordue 1995; Tsukamoto, Gohbara, Tsuda and Fujimori 1997). *Ustilago trichophora* was found and described first time in Poland at Nadolice Małe in Lower Silesia in September 1998 (Pusz and Kita 2001; Pusz 2003). In the next years *U. trichophora* was found in other places of Lower Silesia (Madej, Błaszkowski and Tadych 2001).

This pathogen could be interesting as a potential biocontrol agent of *E. crus-galli* in farming systems as was previously noticed by Tsukamoto et al. (1997).

The aim of the investigation was to study the effects of *Ustilago trichophora* on some biometric parameters of plants (plant's height, length of main root bundles and number of panicles) as well as of seeds of *Echinochloa crus-galli* (weight of 1000 grains, energy and germination capacity).

MATERIAL AND METHODS

There were performed several field studies at 5 different locations (Commune Czernica, Lower Silesia) in August - September 1999-2001. Observations of the course of the disease were carried out during the whole vegetation season and in several localities, while detailed analysis was performed in the region of Nadolice Małe near Wrocław. For purpose of this study 50 plants infected by *U. trichophora* and 50 healthy plants from four randomly selected places on one field were dug out with their roots from barley stand. The analysis concerned plants length and width of root bundles as well as the number of panicles. Moreover, seeds from collected plants were also harvested.

Seeds properties were determined according to the Polish standard (PN-R-65950:1994). Energy and capacity of seeds germination were determined on moisture filter paper using 100 seeds in four replications. The filter paper was disinfected with UV light by 20 min. before it was placed into test boxes. Test was performed at room temperature in darkness. Germination energy and capacity were determined after 4 and 7 days respectively (International Receipt of Seed's Estimate 1996). The average time of germination for one seed was estimated according to Pieper (1952).

Results were statistically evaluated according to Student *t* test.

RESULTS

During the field study in the period 1999-2001 it was noticeable that this pathogen was spreading in commune Czernica (Tab. 1). Symptoms of the presence of *U. trichophora* on tested plants were noticed just before coming into ears (July). The short and thin dark brown strokes were found on the lower part of stalks. At the turn of August and September, when the stalk dying, cortex cracking occurred, and light and later brown and dark brown clusters of spores covered with semi-transparent membrane with a small number of dun hairs. The diameter of the clusters ranged from 2 to 5 cm.

Teliospores of *U. trichophora* were of oval-spheric shape and measured from 7.5 to 12.5 μm. During microscopic observation it was found a few, loosely distributed nodules occurred on spores surface.

Healthy plants featured greater length than the infested ones. Among collected healthy barnyards grass population plants over 120 cm were most numerous. But among the infected plants the major number of plants ranged 100-140 cm in length. Mean length of healthy plants was calculated for 136.4 cm, while that of infested ones for 125.3 cm (Tab. 2).

Healthy plants had longer main root bundle than the infected ones. In the population of healthy plants 98% of barnyards grass featured main root bundle longer than 7 cm, while only 90% of infected plants could be placed within the same length range. The majority of the latter ones had the main root bundles 5-7 cm long. Compared to the healthy plants, the same main root bundle length was represented by 2% of specimens. Mean length value of root bundle in population of healthy plants was calculated for 10.1 cm, while that of disease-stricken ones for 9.1 cm (Tab. 3).

Table 1
Locations and intensification of occurrence of *Ustilago trichophora* in the Czernica commune

Locations	Years		
	1999	2000	2001
Dobrzykowice	-	+	+
Jeszkowice	+	+++	++
Krzyków	-	-	+
Nadolice Małe	+++	+++	++
Nadolice Wielkie	++	++	++

- not present; + low rate of occurrence ; ++ medium rate of occurrence; +++ high rate of occurrence

Table 2
Comparison of plant height in diseased and healthy plants

Plant height[cm]	Number of healthy plants		Number of infected plants	
	Number of specimen	%	Number of specimen	%
80-100	8	4	0	0
100-120	16	8	60	30
120-140	60	30	100	50
140-160	84	42	28	14
>160	32	16	12	6
Mean value [cm]	136.4 a		125.3 b	

• The numbers followed by the same letter are not significantly different according to Student *t* test ($P < 0,05$)

Table 3
Comparison of the length of main root bundles in healthy and infected plants

Root bundle length [cm]	Number of healthy plants		Number of infected plants	
	Number of specimens	%	Number of specimens	%
5-7	4	2	20	10
7-10	64	32	100	50
>10	132	66	80	40
Mean value [cm]	10.1 a		9.1 a	

• The numbers followed by the same letter are not significantly different according to Student *t* test ($P < 0,05$)

Non-infected plants produced more panicles than disease-stricken plants (Tab. 4). Among tested uninfected plants, 39 were found to produce three to six panicles, while only seven produced more than six panicles. The majority of disease-stricken plants formed one or two panicles. Average number of panicles was 4.06 and 2.3 for healthy and for infected plants, respectively.

Table 4
Comparison of the number of panicles in healthy and disease-stricken plants

Number of panicles	Number of healthy plants		Number of infected plants	
	Number of specimens	%	Number of specimens	%
1-2	16	8	128	64
3-6	156	78	64	32
>6	28	14	8	4
Mean value	4.06 a		2.3 b	

• The numbers followed by the same letter are not significantly different according to Student *t* test (P< 0,05)

Table 5
Seed's characteristics in *Echinochloa crus-galli* infected and uninfected by *Ustilago trichophora*

Seed's charatcteristics	The seeds collected from *Echinochloa crus-galli* infected by *Ustilago trichophora*	The seeds collected from *Echinochloa crus-galli* uninfected by *Ustilago trichophora*
weight of 1000 grain [g]	0.9 a	1.4 b
energy of germination [%]	9 a	31 b
germination capacity [%]	16 a	71b
germination rate in days	10.6 a	9.6 b

• The numbers followed by the same letter are not significantly different according to Student *t* test (P< 0,05)

The weight of 1000 seeds from plants infected by *U. trichophora* amounted to 0.9 g, and to 1.4 g in non-infected *E. crus-galli* (Tab. 5). The energy of germination of seeds picked from infected plants was found at the level of 9%, while from non-infected at ones 31%. The germination capacity of seeds amounted to 71% and 16% for healthy and infected samples, respectively.

The average time of germination of seeds came up to 10.6 days in the case of the plants infected by *U. trichophora*. This parameter reached the value of 9.6 days in non-infected plants.

SUMMARY

During the field study (1999-2001) it was noticeable that this pathogen of barnyards grass was spreading in Lower Silesia. As a result of infestation with *Ustilago trichophora*, the specimens of barnyards grass were lower, they displayed poorer tillering and produced less panicles than healthy plants. The seeds from bunches of *Echinochloa crus-galli* infected by *U. trichophora* were characterized with lower weight, energy and germination capacity than the seeds picked from non-infected plants.

Acknowledgement. I would like to thank Professor Dr Stanisław Pietr for his help with English translation and substantial suggesting.

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Wpływ lokalnej populacji *Ustilago trichophora* na *Echinochloa crus-galli*

Streszczenie

Ustilago trichophora jest grzybem patogenicznym porażającym trawy z rodzaju *Echinochloa*. Celem przeprowadzonych badań było określenie wpływu *U. trichophora* na wzrost i rozwój *Echinochloe crus-galli* oraz na wartość siewną nasion. Określono masę tysiąca nasion, energię i zdolność kiełkowania.

W wyniku porażenia przez *Ustilago trichophora,* rośliny chwastnicy jednostronnej były niższe, słabiej się krzewiły oraz wytwarzały mniejszą liczbę wiech niż rośliny zdrowe. Nasiona zebrane z wiech chwastnic porażonych przez *Ustilago trichophora* cechowały się mniejszym ciężarem, mniejszą energią i zdolnością kiełkowania niż nasiona zebrane z roślin nie porażonych przez tego patogena.