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# Occurrence and harmfulness of ergot (*Claviceps purpurea* (Fr.) Tul.) in cereal crops of Lithuania

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The incidence of ergot was observed in 13–49 commercial fields of winter rye, winter triticale and spring barley in different regions of Lithuania annually over the period of 1996–2000. During this period, 65.9, 40.3 and 11.6% of the total area under observation were affected by ergot, respectively. On average 4.0, 4.7 and 4.0% of ears were with sclerotia in the affected area. In the spring barley variety test trials, the incidence of ergot was assessed in 1996. The variety 'Baronesse' was significantly more susceptible than 'Alsa', 'Aidas' and 'Ūla'. Ergots significantly reduced the number of kernel per ear and absolute weight of grain in winter rye crops.

**Key words:** *Claviceps purpurea*, ergot, sclerotia, winter rye, winter triticale, spring barley, variety

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## INTRODUCTION

In Lithuania, the cereals and grasses are grown on the major part of the agricultural land in Lithuania. They belong to the family *Poaceae*, and the majority of their disease causative agents are common. Ergot (*Claviceps purpurea* (Fr.) Tul. is one of the most harmful and common diseases [1].

Over the period 1979–1983, 71 species and forms of cultivated and wild *Pocea* family plants affected by *Claviceps purpurea* (Fr.) Tul. were collected in different regions of Lithuania. The disease was found in 2 cereal species; 14 cultivated and 29 wild grasses; 4 major grass weeds, 17 introduction and ornamental plants, 3 interspecific grass hybrids and 2 tetraploid plants. It was established that grass species were most severely infected by ergot [2]. At the same time ergot control measures were prepared for perennial grasses grown for seed production [3].

In the 1990s the incidence of ergot, especially in cereals, increased considerably as a result of a higher number of small farms and natural pastures and because of a sharp reduction in the use of chemical plant protection measures.

Another reason is that new highly productive and ergot-susceptible varieties were introduced on the market. Hybrid, tetraploid varieties and male sterile lines of rye are especially susceptible to *Claviceps purpurea* [4–6]. Cultivation of triticale, a new ergot-susceptible crop, has been started in many countries recently [7–8]. The infection with *C. purpurea* is most

severe on the varieties with a long flowering period [9]. The ergot of barley is an endemic disease in Canada [10–11] and very important in the USA [12]. Male sterile wheat, as well as other cereal species, are very susceptible to ergot [13].

The task of this study was to evaluate the occurrence and harmfulness of ergot on the main cereal crops in Lithuania.

## MATERIALS AND METHODS

This study was carried out at the Lithuanian Institute of Agriculture and in different regions of Lithuania over the period of 1996–2000. According to our methodology specialists of the State Plant Protection Station annually assessed the ergot incidence in commercial fields at the ripening growth stage (GS 87–89) of cereals. Raw data were generalized at the Department of Plant Protection of LIA. The incidence of ergot and percentage of infected ears were determined in winter rye (*Secale cereale* L.), winter triticale (*Triticosecale* With.) and spring barley (*Hordeum vulgare* L.).

Ergot of spring barley was assessed in the variety test trial in 1996–1999.

With a view of estimating the effect of ergot on the number of grain, kernel weight per ear and thousand kernel weight of rye, the ears with different incidence of ergot were collected and evaluated.

The number of grain per ear, the weight of grain per ear, thousand kernel weight were found to have

equal variances and distributions and were analysed by ANOVA. Significance of differences among varieties of spring barley was determined using the Duncan test. A relationship between the sclerotia weight per ear and kernel weight was determined by linear regression and correlation analysis.

## RESULTS AND DISCUSSION

Our experimental findings revealed the ergot of cereals (*Claviceps purpurea* (Fr.) Tul.) to be widespread in Lithuania. In 1996 it was determined on 13, in 1997 on 15, in 1998 on 23, in 1999 on 25 and in 2000 on 23 commercial fields of winter rye in 8–12 districts of the country. Observations of winter triticale were started in 1997 and were conducted in 3, 4, 5 and 9 fields every year respectively. Observations of ergot in spring barley were conducted in 1997 on 8, in 1998 on 6, in 1999 on 4 and in 2000 on 17 commercial fields.

During the period 1996–2000, out of 2797 hectares of winter rye under observation as many as 1842 hectares (or 65.9%) were ergot-infected (Table 1). During a four-year period, on average 40.3% of investigated triticale area and 11.6% of spring barley area were affected by ergot.

In different years, depending on meteorological conditions and plant species, development of ergot was quite different. The disease developed more abundantly during a wet season. The first half of June is typical when anthesis occurs in winter cereals and in the end of June – beginning of July in the spring cereal-growing fields of Lithuania. May and beginning of June in 1996 were warm and wet. The winter rye anthesis development was early (early June) and fast. Conditions for *C. purpurea* infections in winter rye were unfavourable. Plants affected by ergot were found only on 36.8% of the investigated area. In winter rye and triticale stands the largest area of ergot-affected ears was recorded in 1997 and 1998. In 1997 at anthesis development of winter cereals (middle of June) the weather was rather cool and wet and favourable for *C. purpurea* infections. In the affected area 4.4% of rye ears and 5.5% of triticale ears were with sclerotia. In 1998 a high incidence of ergot in cereals resulted from wet weather before anthesis development. Sclerotia of *C. purpurea* were found on 6.5% of rye and 4.7% of triticale ears. Tetraploid winter rye varieties ‘Veresen’ and ‘Rūkai’ were more susceptible to ergot. Rye infection with ergot in 1996, 1999 and 2000 and triticale in 1999–2000 was less severe than the mean over several years.

The largest area of ergot-affected ears and the highest ear infection with the disease were recorded

Table 1. The occurrence of *Claviceps purpurea* in cereals

Years	Total area ha	Area with ergot		Affected ears %
		ha	%	
<i>Secale cereale</i>				
1996	591	215	36.8	2.6
1997	638	565	88.6	4.4
1998	532	418	78.6	6.5
1999	530	317	59.8	2.9
2000	506	327	64.6	2.0
1996–2000	2797	1842	65.9	4.0
<i>Triticosecale</i>				
1997	88	88	100	5.5
1998	88	62	70.4	4.7
1999	92	5	5.4	0.6
2000	146	12	8.2	0.6
1997–2000	414	167	40.3	4.7
<i>Hordeum vulgare</i>				
1997	248	191	77.0	4.1
1998	170	6	3.5	0.2
1999	679	0	0	0
2000	598	0	0	0
1997–2000	1695	197	11.6	4.0

in spring barley stands in 1997. The rainy weather during June was favourable for the development of ergot. In 1999 and 2000, conditions for the spread of ergot in spring cereals were extremely unfavourable, and no infected ears of barley were found.

In winter wheat the development of ergot was very low. During the period of our investigations we found very few ears affected by ergot. Ergot on oats has not yet been identified in Lithuania.

In the variety test trial of spring barley conducted in Dotnuva, ergot was found only in 1996. When the wet and cool weather was dominant at anthesis development of spring barley (end of July in 1996), in the stands of the variety ‘Aidas’ there were 6.6%, ‘Alsa’ – 3.2%, ‘Baronesse’ – 10.8%, ‘Ūla’ – 1.5% ergot-affected ears. The variety ‘Baronesse’ was significantly ( $P < 0.05$  and  $P < 0.01$ ) more susceptible than the other three varieties. The spring barley variety ‘Aidas’ was significantly more susceptible than ‘Ūla’ ( $P < 0.05$  and  $P < 0.01$ ) and ‘Alsa’ ( $P < 0.05$ ). ‘Ūla’ was low in ergot, suggesting this variety to bear some resistance.

In special trials we studied the influence of the number of sclerotia per ear on the number of grains as well as kernel weight per ear and thousand kernel weight. When the number of sclerotia per ear increased to 5, the number of winter rye grains decreased by 53% as compared to healthy ears (Table 2). Ergot reduced not only the number of grain per ear, but also the absolute weight of the kernel. Even one sclerotia per ear significantly reduced the number of grain and the kernel weight per ear.

Table 2. The influence of ergot on the number of grain and weight of kernel per ear of winter rye

Dotnuva, 1998				
Number of sclerotia per ear	Sclerotia weight per ear, g	Number of grains per ear	Kernel weight per ear, g	1,000 kernel weight, g
0	0	45.9	2.148	46.83
1	0.197	36.6	1.619	44.17
2	0.237	30.0	1.162	39.16
3	0.274	26.1	0.956	36.34
4	0.372	26.8	0.954	35.67
5	0.422	21.6	0.810	37.59
LSD <sub>05</sub>	X	±4.016	±0.181	±3.824
LSD <sub>01</sub>	X	±5.363	±0.242	±5.106

When two and more sclerotia per ear were found, a thousand kernel weight significantly declined compared with healthy ears.

Sclerotia weight per ear negatively correlated with kernel weight per ear and thousand kernel weight. A strong correlation was determined between sclerotia weight and kernel weight per ear ( $r = -0.770$ ;  $P < 0.01$ ). The correlation between sclerotia weight per ear and thousand kernel weight was medium ( $r = -0.558$ ;  $P < 0.01$ ).

This study suggests that ergot occurs to some extent every year on cereals in Lithuania. The disease is generally more prevalent in rye and triticale than in other cereals. Completely ergot-resistant commercial varieties of cereals are not yet known. It is necessary to continue investigations on ergot harmfulness and its control.

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#### SKALSIŲ (*CLAVICEPS PURPUREA* (FR.) TUL.) PLITIMAS IR ŽALA JAVAMS (*POACEAE*) LIETUVOJE

#### S a n t r a k a

Nuo 1996 iki 2000 m. buvo stebėtas varpinių javų pasėlių užsikrėtimas skalsėmis (*Claviceps purpurea* (Fr.) Tul.). Tyrimų metais įvertinti žieminių rugių ir kvietrugių bei vasarinių miežių 13–49 laukai. Vidutiniškai 1996–2000 m. skalsėmis buvo užsikrėtę 65,9% žieminių rugių pasėlių, 1997–2000 m. – 40,3% žieminių kvietrugių ir 11,6% vasarinių miežių pasėlių. Užsikrėtusiuose rugių ir kvietrugių bei miežių pasėliuose buvo rasta atitinkamai 4,0; 4,7 ir 4,0% skalsėtų varpų. Skirtingose vasarinių miežių veislėse, skalsės išplito tik 1996-aisiais. Vyraujant vėsiems ir lietingiems orams augalų žydėjimo metu, 'Baronesse' veislės miežiai iš esmės buvo jautresni skalsėms nei 'Ūla', 'Alsa' ar 'Aidas'. Nustatyta, kad skalsės sumažina rugių varpoje esančių grūdų skaičių ir jų masę.