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Problems of fusarioses in selected grass species

Bohumila Voženílková* & František Klimeš

University of South Bohemia, Faculty of Agriculture,
Studentská 13, CZ-370 05 České Budějovice, Czech Republic
**vozenil@zf.jcu.cz*

Abstract
In the years 1999–2000 we observed the spread and harmful effects of pathogenic fungi causing the dying of some grass species in permanent grass stands. The most common and frequent cause of the dying (winter freezing injury) is the fungus *Microdochium nivale* known also as *Fusarium nivale*, or *Gerlachia nivalis* (imperfect stage) – snow mould. The evaluation was carried out in dominant species (*Deschampsia cespitosa, Festuca rubra, Holcus mollis)* in permanent grass stands in the central part of the Bohemian Forest (locality Zhůří; 1150–1180 m a.s.l.). The experiment involved three treatments: (1) mulched stand (mulched only once in a year), (2) unharvested stand (fallow land) and (3) mown stand (mown once in a year). The phytopathological evaluation took place during the vegetation periods of 1999–2000 at three particular times (May, June, July). Our investigation has shown the most considerable development of the fungi of the genus *Fusarium* in the unharvested stand with serious decline of *Festuca rubra*, which deteriorates the conditions for subsequent fodder crops. On the other hand, the mown stand showed the least extent of fungi-attacked dominant grass species. The least occurrence of harmful *Fusarium* sp. div. disease (fusariosis) was found in *Deschampsia cespitosa* whereas the most serious damage occurred in *Festuca rubra*. From the viewpoint of temporal dynamics of fungal disease, the increase took place at the beginning of the second (1999) and first (2000) decade of May. In the tested dominant grasses we determined the genus *Fusarium* as the cause of fungal disease. Apart from further undetermined species, *Microdochium nivale* and *Fusarium solani* were the most frequent species.

Key words: Deschampsia cespitosa, Festuca rubra, Holcus mollis, Fusarium sp. div.

Introduction

At present, many different activities are compared with respect to their influence on nature and all its components, the main criteria being landscape stability in all aspects of its management. Investigations focus mainly on such types of vegetation that support sustained landscape functionality high stability and typical character. Permanent grass stands belong to the most stable vegetation types as they contribute to landscape formation and conservation mainly through their non-production functions. They belong to the biologically most active and productive phytocenoses with a fast biomass turnover and a high rate of biogeochemical cycling of elements (Klimeš & Květ 1997a).

The last years have witnessed considerable decline of interest in mountain meadows management. From the often inappropriate intensive management of some areas at the time of the former agrarian boom we have moved in the opposite direction – to abandonment of many originally cultivated areas (Klimeš & Květ 1997b).

Maintainance of the current quality of anthropogenically conditioned meadow communities depends on specific ways of their management. Fallow land instead of a regular mowing or grazing régime can cause a wide range of undesirable changes. The possible consequences

can be soil degradation, chemical changes in the soil solution, changes in nutrient concentrations, and organic matter content at soil surface. Soil water régime will also change, as well as the composition of the vegetation cover. There is a threat of succession towards forest and thus of an irreversible doom of meadows and pastures: without them the Bohemian Forest would lose its specific character, beauty and a landscape element whose value is comparable to that of woodlands and primary non-forested areas (KLIMEŠ 1997).

The remaining anthropogenic non-forested areas in the Bohemian Forest depend on human management. On selected managed sites this means preservation of favourable conditions for sustainable reproduction of the genetic pool of mountain grassland biota (KLIMEŠ & KVĚT 1997a).

The experimental mountain meadow site described by MAŠKOVÁ & al. (2001) hosts at present mesophytic meadow communities all over the experimental area. These communities are characteristic of anthropogenic non-forested areas in the Kvilda plains and belong to the phytocenological alliance *Polygono – Trisetion*, the association *Cardaminopsio halleri – Agrostietum.*

We concentrated on the spread and harmfulness of pathogenic fungi causing damage to and death of some grass species (*Deschampsia cespitosa* (L.) P. Beauv., *Festuca rubra* L., *Holcus mollis* L.). The most common harmful agent is the fungus *Microdochium nivale* (Fr.: Fr.) Samuels et I. C. Hallet, of the order *Hypocreales*, class *Ascomycetes*, known better as *Fusarium nivale* (Fr.) Sorauer or *Gerlachia nivalis* (Ces. Ex Berl. et Voglino) W. Gams et E. Müller (imperfect stage) – snow mould (CAGAŠ 1998). According to SCHUMANN & BACKHAUS (1988), this species is dominant in the development of fusarioses occurring on the shoots of *Lolium multiflorum* Lam. var. *multiflorum* from the start of the growing season to the second grass cut. SNIJDERS & WINKELHORST (1996) investigated a grass turf in western Europe and proved that it was not the snow mould *(Microdochium nivale)* but other species of *Fusarium (F. cerealis* (Cooke) Sacc., *F. graminearum* Schwabe, *F. culmorum* (Wm. G. Sm.) Sacc. and *F. acuminatum* (Ellis et Everh.) that were causing serious damage to grassland in areas where *Lolium perenne* L. and *Festuca rubra* L. were dominant.

Material and Methods

The spread and harmfulness of pathogenic fungi suppressing dominant species of grasses (*Deschampsia cespitosa, Festuca rubra, Holcus mollis*) was observed mainly from the phytopathological viewpoint. The experimental investigation itself was carried out in 1999–2000. The experimental site (Zhůří in the Šumava NP) is situated at 1150–1180 m a.s.l. In our experiments, we tested three treatments (K – mowing, M – mulching, L – unharvested stand). Mowing was accomplished on July 10, 1999, and July 15, 2000. Mulching was on July 11, 1999, and July 14, 2000. Observations of each treatment were carried out in three replicate plots (3×30 m^2).

Phytopathological analysis of plants with symptoms indicating attack by *Fusarium* fungi was carried out in all treatments and replicates in May, June and July i.e. before mowing or mulching). In this experiment, we applied the method of symptoms evaluation in plants according to DIXON & DODDSON (1971). The isolation, cultivation and determination of the fungi of the genus *Fusarium* was performed regularly at each sampling time, on agar nutrient media (2% potato-glucose agar and SNA- Synthetischer nährstoffarmer Agar), according to GERLACH & NIRENBERG (1982) and FASSATIOVÁ (1979).

The basic meteorological data during the observation period were summarized by KVĚT & al. (1999, 2000).

Results and Discussion

On the experimental site at Zhůří, we observed grasses dominant in permanent grass stands attacked by fungi of the genus *Fusarium*. Of the dominant grasses, we concentrated on *Deschampsia cespitosa, Festuca rubra* and *Holcus mollis*.

Quality assessment was accomplished in each treatment and replicate at 10 points where we always evaluated ten plants according to the following scale (Dixon & Doodson 1971):

i) healthy plant, no symptoms of attack (0%);
ii) moderate symptoms of attack (1–20%);
iii) medium symptoms of attack (20–50%);
iv) strong symptoms of attack (50–75%);
v) withering or dead plant (75–100%).

Table 1. – Damage to dominant grass species attacked by *Fusarium* sp. div. fungi (percentages of attacked plants).

Grass species	1999									2000								
	Mown			Fallow			Mulched			Mown			Fallow			Mulched		
	May	June	July	May	June	July	May	June	July	May	June	July	May	June	July	May	June	July
Deschampsia cespitosa	4.8	3.2	1.4	24.7	20.0	19.7	14.9	11.2	4.0	11.5	2.7	4.0	21.9	17.6	11.8	9.5	10.4	12.5
Festuca rubra	15.3	7.5	4.8	65.6	56.1	49.5	35.3	28.0	15.5	19.0	7.2	8.4	60.9	53.4	49.1	20.7	13.7	16.0
Holcus mollis	6.2	3.1	2.0	29.3	22.1	18.4	20.3	28.0	15.5	12.8	6.5	6.6	23.2	24.1	19.8	15.4	15.5	11.2

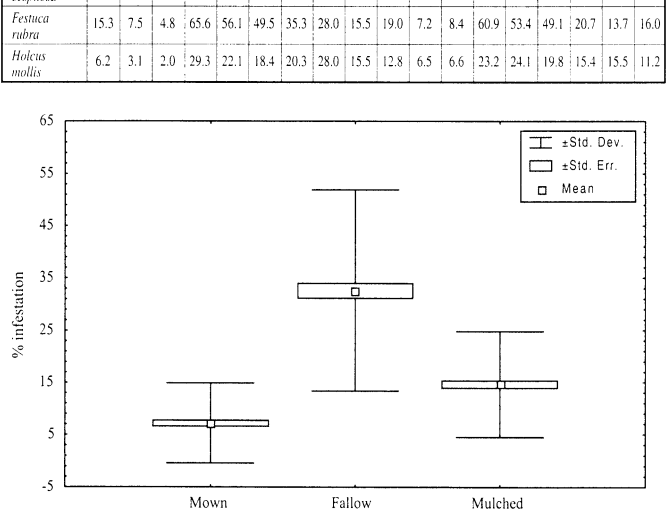

Fig. 1. – The effect of different treatment on reduction of the *Fusarium* fungi.

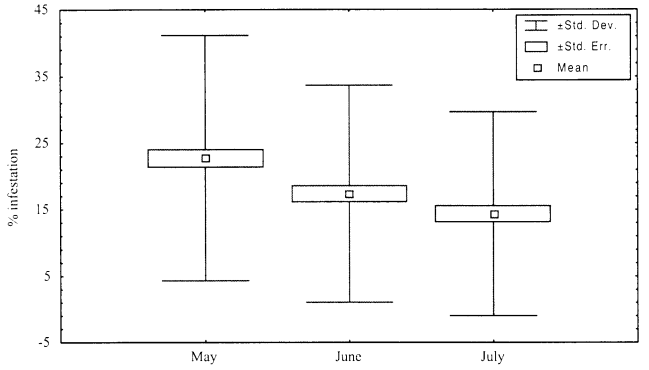

Fig. 2. – The development of the *Fusarium* fungi on selected grass species depending on the evaluation date.

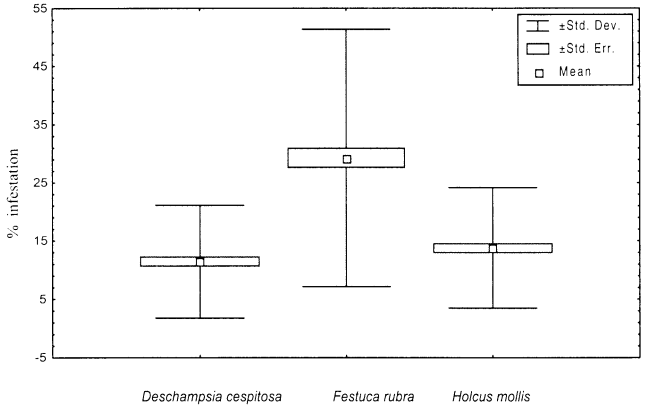

Fig. 3. – The extent of attack of selected grass species by the *Fusarium* fungi.

During the entire vegetation period, we observed the development of fusarioses on the selected grasses. The strongest impact of fungus infestation was recorded at the beginning of the second decade of May in 1999 and of the first May decade in 2000. Statistical evaluation

was made by means of non-parametric Kruskal-Wallis test, and the influence of both sampling date and treatment was highly significant in *Festuca rubra, Deschampsia cespitosa* and *Holcus mollis*. For the assessment of differences between particular categories we used Tukey HSD test. As to the date of evaluation, a statistically highly significant difference was found between the first (May), second (June) and third (July) assessments of quality in all observed grasses (Fig. 2). In the experimental area, where we observed possible influences of various types of management on the occurrence of fusarioses in grass stands, statistically highly significant differences were recorded between the following treatments: mulching and mowing, mulching and fallow land, and mowing and fallow land. Total differences between individual treatments applied to the grass stand were highly statistically significant (Fig. 1, Table 1).

During the observation of the attack of *Fusarium* fungi on selected grass species, considerable statistical differences existed between the extent of attack on *Deschampsia cespitosa* and *Festuca rubra,* and also on *Festuca rubra* and *Holcus mollis*. The least extent of fusarioses was recorded in *Deschampsia cespitosa* whereas the most serious damage was found in *Festuca rubra,* especially in unharvested stands (Fig. 3).

In these stands, *Festuca rubra* also exhibited the most serious decline of occurrence: from the original cover degree of 30–40% to only 3–6%. In mulched stands of *Festuca rubra,* its moderate retreat was also recorded, approximately to 20–30%, owing to the attack of infection. The increased attack by fusarioses found in mulched and mainly unharvested *Festuca rubra* stands deteriorates the conditions for subsequent fodder production. The retreat of *Festuca rubra* in the observed stands was serious mainly with respect to the fact that this species represents the only cultural grass in the cenoses of interest.

Also Snijders & Winkelhorst (1996) found serious damage caused by *Fusarium* fungi to grass stands dominated by *Festuca rubra*.

The entire evaluation of differences between particular years (1999 and 2000) was statistically non-significant.

In the dominants from the mulched, unharvested and mown stands tested *in vitro*, we determined the agens causing fungal diseases – fungi of the genus *Fusarium*. Apart from other unidentified species, *Microdochium nivale* and *Fusarium solani* (Mart.) Sacc., identified by J. Hýsek and M. Zemánková, at the Research Institute of Crop Production Division of Plant Medicine in Praha–Ruzyně belonged to the most numerous species.

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