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Phytopathological aspects of phytocoenological structure of grasslands with respect to their management

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Abstract
This communication summarizes the knowledge of the effects of fungal diseases on the species composition and spatial structure of permanent grasslands at the foothills and in central parts of the Bohemian Forest. Unsuitable management such as grassland fallow, or its mulching, reduce the cover percentage of plant species of good forage quality and promote the spreading of species of a poorer quality. These changes of sward structure and species composition are indirectly connected with the occurrence of various pathogens of grasses and legumes. Unmown or mulched swards with a higher proportion of old and standing dead plant parts provide favourable conditions for infestations by pathogens. In unmown swards a significantly more frequent occurrence was recorded of fungal diseases caused by *Monographella nivalis* (Schaffnit) E. Müll. var. *nivalis* and *Epichloë typhina* (Pers.) Tul. et C. Tul. attacking Rough-stalked Meadow Grass (*Poa trivialis* L.), Yorkshire Fog (*Holcus lanatus* L.) and Red Fescue (*Festuca rubra* L.). The meadow legumes, especially Meadow Vetchling (*Lathyrus pratensis* L.), were infested by *Microsphaera trifolii* (Grev.) U. Braun. The results thus point to the need of studying the phytocoenological dynamics and species variety in grasslands in an interaction with pratotechnical measures and infestation of constituent plant species by pathogenic fungi.

Keywords: mountain grasslands, spatial structure, management, pathogenic fungi, *Monographella nivalis*

The structure of grassland plant communities is never stable. The distribution pattern of individuals and populations, their density, cover degree, population size and occurrence of particular species in the communities are subject to continuous changes. Apart from these growth-induced changes, the composition of a grassland community also reflects the environmental variability within the broader habitat (Květ et al. 1996, Klimeš 1997, 2001).

Analyses of the botanical composition of grasslands in the Bohemian Forest (Šumava Mountains, localities Lenora, 805 m a.s.l. and Zhůří, 1170 m a.s.l.) and in its foothills (locality Rojov, 850 m a.s.l.) have proved that lack of harvesting leads to a degradation of sward composition. Grazed or mown + grazed swards have a species composition of a good forage quality, being dominated by *Poa pratensis* L.*, Festuca pratensis* Huds.*, Dactylis glomerata* L.*, Lolium perenne* L. and *Trifolium repens* L. Unmown swards are dominated by *Festuca rubra* L.*, Agropyron repens* L. and *Urtica dioica* L. Simpson's index of species diversity is often significantly higher in mown or grazed swards than in unmown ones (Kobes et al., 2009).

Processes involved in phytocoenological dynamics of grassland communities are often associated with infestations of certain plant species by pathogens. This is particularly true

of community changes which are due to sudden extremes or fluctuations of habitat conditions, and are linked, to some extent, with ecological succession and some cyclic and adaptive processes (Chapman 1996, Klimeš 1997, 2001, Čermák et al. 2000a, Voženílková & Čermák 1999, Voženílková & Klimeš 2001a, 2001b). Practically all grassland plant species can be damaged by diseases of virus, bacterial and, especially, fungal origin (Voženílková 2000a). The severity of damage to each plant species is closely associated with the ecological conditions and/or their sudden changes at each respective site (Turek & Klimeš 1984, Klimeš 1997, 2001, Klimeš et al. 1998), age structure of individual species populations (Klimeš 1999), competition within the respective community (Klimeš 1988, 1999) and the management and use of grassland stands (Klimeš 1997, 2001, Voženílková & Čermák 1999, Voženílková & Klimeš 2001a, Voženílková et al. 2007, 2008). Important in this respect is also the infestation pressure of the environment (Voženílková 2000b), functioning of disease vectors (Voženílková 2000a) as well as the natural resistance of certain ecotypes or varieties, which can be strengthened by breeding (Chapman 1996). Decisive are also the plant life cycles in a grassland community, namely the potential or actual perennial character of individual populations (Klimeš 1997).

In some species, e.g., Meadow Vetchling (*Lathyrus pratensis* L.), it is their poor resistance to fungal diseases (apart from seed-coat hardness) that has prevented their introduction into cultivation, in spite of repeated effort (Turek & Klimeš 1984, Klimeš 1997, 2001). The occurrence of Meadow Vetchling and other climbing legumes is bound to a low-impact management of grassland stands (mowing or grazing 1–2 times in a year). In such stands, older plants tend to become infested on a large scale especially by the mildew *Microsphaera trifolii* (Grev.) U. Braun (Klimeš et al. 2006, Voženílková et al. 2007). An evaluation of the variability of legume cover in permanent grasslands has proved a strong impact of their management on the cover dynamics of legume species. Climbing legumes are acceptably represented in the total legume cover in swards mown once in a year (Klimeš 1999).

On the other hand, modern breeding for resistance can naturally overcome the impact of the above-mentioned limitations on grassland use and management. This can be demonstrated on the Red Clover (*Trifolium pratense* L.) variety "Tábor", bred at the stations of Větrov and Červený Dvůr in South Bohemia (Czech Republic). This clover variety is extraordinarily resistant against the mildew *Microsphaera trifolii*. This fact has, among others, a high value for feeding the livestock (Čermák et al. 2000b).

The infestation of grassland plant species by diseases has several negative consequences for the environment, in addition to those for both the quality and quantity of the forage produced (Klimeš et al. 2004, Voženílková & Klimeš 2001a). For example, the low resistance of the Rough-stalked Meadow-grass (*Poa trivialis* L.) and Yorkshire Fog (*Holcus lanatus* L.) to fungal attack (especially by *Monographella nivalis* (Schaffnit) E. Müll. var. *nivalis*, *Epichloë typhina* (Pers.) Tul. et C. Tul., and others) results in a fluctuating occurrence of an attacked plant species: its rapid retreat from seriously infested swards in which it was dominant, results in the formation of large gaps in the sward. Such gaps are liable to erosion and/or weed colonization till the sward canopy closes itself again (Klimeš 1988, 2001, Klimeš & Voženílková 2001). The danger of gap formation in grassland stands is accentuated especially by a high level of nitrogen fertilization in interaction with the course of weather in each year, e.g., an excessively long-lasting snow cover, high rainfall, or rise of groundwater table (Klimeš 1988, 1997, 2001, Chapman 1996, Voženílková 2000a, 2001).

Direct grassland management impact on the intensity of infestation of dominant grass species by the snow mould *Monographella nivalis* can be exemplified by the results of a parallel monitoring of the phytocoenological dynamics and development of fungal pathogens in selected permanent grasslands in the central Bohemian Forest (Šumava National

Park and Biosphere Reserve, association Trifolio-Festucetum rubrae, altitude 1170 m, locality Zhůří). The differentiated treatments of this grassland included its mowing (1× a year) or mulching (1× a year) or no management (fallow) (Voženílková & Čermák 1999, Voženílková and Klimeš 2001a, Voženílková et al. 2006a,b). These experimental studies accomplished in small-plot experiments (with 3 replicates) have shown that all three grass species monitored (*Deschampsia cespitosa* L.*, Festuca rubra*, and *Holcus mollis* L.*)* were the most severely infested by *Fusarium* spp. in the unmanaged sward. Here, *Festuca rubra* was strongly suppressed by the fungal infestation, which deteriorated the forage quality of this grassland stand. By contrast, in the mown stand the dominant grasses were the least infested. The least damaging occurrence of fusarioses was recorded in *Deschampsia cespitosa* while the damage to *Festuca rubra* was relatively the most severe. As to the seasonal dynamics of the fusarioses, their highest incidence was recorded at the beginning of the second and first decades of May, in 1999 and 2000, respectively. *Monographella nivalis* var. *nivalis* and *Fusarium solani* were identified as the disease-causing fungi. *Puccinia perplexans* Plowr. was identified on *Alopecurus pratensis* L. and *Ranunculus acer* L. in the mown stand (Voženílková, 2000c).

The above results point to the need for studying the phytocoenological dynamics of grassland communities alongside with plant pathological analyses of the important constituent species. This approach facilitates an experimental solution of numerous pratotechnical and ecological problems. Such multidisciplinary studies can also reveal in greater depth the complicated causal relationships in grassland communities, as a basis for harmonizing their production and non-production functions.

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References

Chapman G.P., 1996: *The Biology of Grasses.* CAB Int., Wallingford, 273 pp.

Čermák B., Voženílková B. & Kadlec J., 2000a: Mykotoxiny v krmivu [Mycotoxins in feed]. In: *Ochrana zvířat a welfare*, Opařil, M., Novák, P., Latini, J. (eds) October 31, 2000, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Rep., 158–161 (in Czech).

Čermák B., Voženílková B., Kadlec J. & Podkówka W., 2000b: Fungi diseases of selected grasses under various methods of their management. In: *Mycotoxins and Dioxins and the Environment*, ATR Bydgoszcz, Poland, 181–184.

Klimeš F., 1988: Uplatnění dočasných pratocenóz v biologickém boji s *Agropyron repens* a *Rumex crispus* [The employment of temporary grass growths in biological inhibition of *Agropyron repens* and *Rumex crispus*]. *Rostlinná Výroba*, **2**: 169–177.

Klimeš F., 1997: The development of biodiversity of grasslands with different trophic regimes. *Grassland Science in Europe*, **2**: 329–334.

Klimeš F., 1999: Phytocoenological relationships in pasture stands. *Rostlinná výroba*, 45: 205–211.

Klimeš F., 2001: *Lukařství a pastvinářství. Biodiagnostika a speciální pratotechnika*. [*Meadow and Pasture Management. Biodiagnostics and Special Pratotechnics*]. JU ZF České Budějovice, 117 pp. (in Czech).

Klimeš F., Bošina H., Ekert M. & Mitas V., 1998: Methodological aspects of bioindication of grassland water regime. *Rostlinná Výroba*, **12**: 565–568.

Klimeš F. & Voženílková B., 2001: Dynamics of species richness of extensive pastures in different zones of landscape relief. *Grassland Science in Europe*, **6**: 324–326.

Klimeš F., Kolář L., Kobes M., Kužel S. & Voženílková B., 2004: A possibility to control groundwater contamination with nitrates by suitable grassland management. *Collection of Scientific Papers, Faculty of Agriculture in České Budějovice, Series for Crop Sciences*, **21**: 41–43.

Klimeš F., Kobes M., Voženílková B., Květ J. & Suchý K., 2006: Influence of management on the representation of legumes in permanent grasslands. *Grassland Science in Europe*, **11**: 288–290.

Kobes M., Frelich J., Šlachta M., Voženílková B. & Suchý K., 2009: Botanical diversity and nitrate leaching with different styles of grassland management. *Grassland Science in Europe*, **14**: 140–143.

Květ J., Tetter M., Klimeš F. & Suchý K., 1996: Grassland productivity as a basis for agricultural use of the Lužnice floodplain. In: *Floodplain Ecology and Management*, Prach K., Jeník J. & Large A.R.G. (eds) Amsterdam. SPB Academic Publishing: 245–249.

Turek F. & Klimeš F., 1984: Uplatnění a stabilita jetelovin v intenzivních travních porostech ve vyšších polohách [The role and stability of legumes in intensive grasslands at higher altitudes]. *Rostlinná Výroba*, **2**: 177–183.

Voženílková B., 2000a: The extent of attack of selected grass species by the *Fusarium* fungi. In: *International Conference Ecophysiology of Plant Production Processes in Stress Conditions*, September 12–14, 2000, Račková dolina, Slovakia, 53.

Voženílková B., 2000b: Vliv rozdílného ošetření travních porostů na potlačení hub rodu *Fusarium*. [The effect of different methods of cultivation on reduction of the *Fusarium* fungi.] In: *XV. Czech and Slovak Conference on Plant Protection*, Šafránková, I., Salvet, V., Šefrová, H., (eds) September 12–14, 2000, Brno, 215–216.

Voženílková B., 2000c: Výskyt *Puccinia perplexans* na psárce luční při různém způsobu obhospodařování travních porostů [The occurrence of *Puccinia perplexans* on the grass *Alopecurus pratensis* under various methods of cultivation of grass swards]. *Collection of Scientific Papers, Faculty of Agriculture in České Budějovice, Series for Crop Sciences*, **17**: 105–109.

Voženílková B., 2001: Onemocnění vybraných druhů trav houbami rodu *Fusarium* [Infestation of selected grass species by fungi of the genus *Fusarium*]. In: *Aktuality šumavského výzkumu*, Mánek J. (ed.) April 2–4, 2001, Srní, 45 (in Czech).

Voženílková B. & Čermák B., 1999: Fungi diseases of selected grasses under various methods of their management. *Collection of Scientific Papers, Faculty of Agriculture in České Budějovice, Series for Crop Sciences*, **17**: 117–122.

Voženílková B. & Klimeš F., 2001a: The extent of damage of dominant grass species attacked by *Fusarium* spp. fungi. In: *13th International Reinhardsbrunn Symposium*. May 14–18, 2001, Friedrichroda, Germany, 63.

Voženílková B. & Klimeš F., 2001b: Problems of fusarioses in selected grass species. *Silva Gabreta*, **7**: 131–136.

Voženílková B., Klimeš F. & Kobes M., 2006a: Napadení *Festuca rubra* houbami rodu *Fusarium* [The attack of *Festuca rubra* by *Fusarium* fungi]. In: *Šetrné čerpání přírodních zdrojů a údržba krajiny pomocí chovu krav bez tržní produkce mléka* [*Sustainable Exploitation of Natural Resources and Landscape Maintenance by Suckling Cow Keeping*]. Bjelka, M. (ed.) November 9, 2006, VÚCHS Rapotín, 13–16 (in Czech).

Voženílková B., Klimeš F., Kobes M. & 2006b: Syntetické pojetí pratoekologických, fytocenologických a fytopatologických aspektů při rozvíjení multifunkčního uplatnění horských travinných cenóz [Synthetic approach to pratoecological, phytocoenological and phytopathological aspects in the design of multifunctional use of mountain grasslands, in Czech]. In: *Agroregion*, Kobes, M. (ed.) August 24–25, 2006, České Budějovice, 146–149 (in Czech).

Voženílková B., Kobes M., Klimeš F., Čermák B. & Ptáčníková V., 2007: Das Vorkommen von Mehltaupilz auf der Wiesen-Platterbse (*Lathyrus pratensis* L.). *Gesunde Pflanzen*, **59**: 179–182.

Voženílková B., Marková J., Klimeš F., Květ J. & Mašková Z., 2008: The influence of mountain meadow management on the occurence of *Puccinia perplexans* Plow. *Journal of Plant Diseases and Protection*, **4**: 167–171.

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