ORIGINAL ARTICLE

The occurrence of *Erysiphe trifolii* on *Lathyrus pratensis* in a foothill area of South Bohemia

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Abstract

The aim of small-site experiments carried out in the foothills of the Šumava Mts. was to determine the effect of the etiological agent powdery mildew (*Erysiphe trifolii*) on meadow peavine (*Lathyrus pratensis*). Over three consecutive years, we observed a whitish to grey-white soft cover of mycelium on the meadow peavine during the vegetation period. This characteristic symptom of the disease was observed on the plants during summer and autumn. In a plot trial with permanent grassland we evaluated the following management systems: i) mulched, ii) fallow, iii) mown stands, and iv) pasture stands grazed by cattle. We evaluated the total number of *Lathyrus pratensis* plants as well as the number of the plants attacked by *Erysiphe trifolii*. The three-year investigation of *Lathyrus pratensis* yielded statistical evidence that the most significant growth of the fungal disease was recorded in fallow stands (68.9%), while the lowest occurrence of the disease (4.4%) was found in the pasture stands grazed by cattle.

Key words: permanent grasslands; grassland management; meadow peavine; powdery mildew; mycelium

INTRODUCTION

The genus *Lathyrus* (Leguminosae; Papilionoideae) is the largest genus in the tribe Fabaeae and exhibits an intriguing extratropical distribution

(Kenicer et al. 2005). The meadow peavine (*Lathyrus pratensis* L.) is an important meadow legume in Central Europe, very abundant in some suitably managed meadows. It is most extensive in mesotrophic meadows and pastures classified as *Cynosurion* (Tx., 1947). *Lathyrus pratensis* is also abundant in deciduous forests (Jantunen et al. 2001) and holding covers. Although the *Lathyrus pratensis* is a very abundant leguminose, little attention has been devoted to possibilities of its stabilisation in meadows and to its general health conditions.

Different types of grassland exploitation can affect the coverage of *Lathyrus pratensis*.

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Hejzman and Gaisler (2005) reported increasing coverage of *Lathyrus pratensis* after three years under no management swards in mountain altitudes. Grazing can result in a reduction in the dominance of tall graminoids, a reduction in the abundance of taller, grazing-sensitive herbs, for example clumped and climbing plants, such as *Lathyrus pratensis*, and an increase in grazing-tolerant species, e.g. smaller rosette herb growth forms such as *Leontodon hispidus* and shorter rhizomatous or stoloniferous graminoids (Mitchley and Willems 1995). On the other hand, after a six-year abandonment of pasture, coverage of *Lathyrus pratensis* decreased (Stránská 2004). Nitrogen fertilisation did not decrease *Lathyrus pratensis* coverage, even in doses between 100 and 200 kg N ha⁻¹ (Mrkvička and Veselá 1997). Legumes increase grass productivity because of an increase in the plant-available N-pool in the soil profile (Oelmann et al. 2007), and the presence of *Lathyrus pratensis* also can increase the biodiversity of grassland areas; for instance, *Lathyrus pratensis* is the host plant of the butterfly *Leptidea sinapis* (Friberg and Wiklund 2009).

Legumes, including *Lathyrus pratensis*, can improve the quality and voluntary intake of grassland biomass or intake of hay and in turn, growth and senescence, leaf area and sward type can influence the health status of *Lathyrus pratensis* plants. The powdery mildew fungus (*Erysiphe trifolii* Grev.) often attacks legumes in swards, particularly in summer and autumn. *Vicia cracca* has also been mentioned as a host for *Erysiphe trifolii* (Heluta 2004). *Lathyrus pratensis* can be used as good quality fodder and as breed legumes, but this quality can be affected by fungi attack and by its general health status. The nutritive value of legumes is significantly affected also by the sequence of cut and by its growth stages.

Erysiphe trifolii fungus attacks the leaves, stem and pods of *Lathyrus pratensis* plants, mainly its leaves, on which it forms a whitish mycelium covering. The pathogen spreads by conidia which are sized 28–40 × 16–22 µm. In the autumn, dark cleistothecia sporocarps occur, 90–125 µm in diam., with 5 to 10 asci, containing 3 to 4 ascospores (20–25 × 10–15 µm) (Hoffmann and Schmutterer 1983).

The aim of this study was to determine the effects of grassland management on the presence of *Lathyrus pratensis* and the extent of damage to it caused by *Erysiphe trifolii* Grev.

MATERIAL AND METHODS

The occurrence of *Erysiphe trifolii* and the extent of its attack on *Lathyrus pratensis* were evaluated in a permanent grassland in the Šumava Mts. foothills (the Rojovský ridge) near the town of Kaplice, during the period 2004–06. The experimental site is situated at an altitude of 655 m a.s.l. (Table 1). The occurrence and extent of the fungal attack on *Lathyrus pratensis* was evaluated in the experimental grassland under different management regimes (mown, grazed, mulched, combined management, and fallow) and with different management intensities – (i) mulched stands (mulched once), (ii) fallow stands, (iii) mown stands (mown 1, 2 or 3 times yearly), and iv) grazed stands (used as pasture 2, 3 or 4 times yearly), and with each crop intensity without fertilisation or fertilised by 100 kg N ha⁻¹ + PK (Table 2). In total, 17 variables were tested (Table 2).

The stands investigated had been under different management regimes since 2000. The changes in the coverage and distribution in all the experimental variants of climbing clover plants, including *Lathyrus pratensis*, were observed. The experiments were carried out on the permanent grassland used for grazing, with the dominant species *Phleum pratense*, *Festuca pratensis*, *Trisetum flavescens*, *Lolium perenne*, and *Trifolium repens*, pertaining to *Lolio-Cynosuretum* association. Permanent grassland around the experimental sites was grazed by meat cattle breeds 3 to 4 times per year, or mown once per year and grazed also once per year. The trial was designed using the randomised block method, with blocks of grazed variants and cut variants back-to-back at the same sward type.

During the vegetation period we observed a whitish to grey-white cover of mycelium on the leaves of *Lathyrus pratensis*. These symptoms, typical of *Erysiphe trifolii*, occurred in the observed area during late summer and during autumn. Phytopathological analysis of plants with the symptoms of *Erysiphe* fungi attack was carried out monthly during the whole vegetation period between 25 April and 10 October. The observation of particular variants was accomplished in four repetitions, the size of the small plots being 30 m² (4 × 30 m²). We evaluated the total number of individual plants (*Lathyrus pratensis*) and the number of the plants attacked by *Erysiphe trifolii*. The method of assessing the symptoms was based on Dixon and Doodson (1971). *Erysiphe trifolii* occurrence on *Lathyrus*

pratensis was statistically processed (using the analysis of variance with resulting Fischer test in Statistica program). Selected markers of the fodder quality (content of crude protein, crude

fibre and mineral nutrients P, K, Ca, and Mg) of the above-ground biomass were evaluated in an accredited laboratory using standard analytical procedures.

Table 1. Characterisation of experimental site and climatic characteristics of experimental period

Site characteristics								
Catastral unit					Kaplice – Velký Chuchelec			
Elevation					655 m a.s.l.			
GPS Location					48°45'26'' N, 14°26'51'' E			
Soil depth					Very deep			
Soil sort					Loamy			
Soil type					Kambisoil illimerised, with skelet			
Climatic characteristics								
Average monthly temperatures					Monthly precipitation total			
Month	50-year average	2004	2005	2006	50-year average	2004	2005	2006
I	–3.20	–3.6	–1.1	–5.7	29.0	42.3	24.3	44.9
II	–1.90	0.8	–4.7	–2.9	32.0	52.1	41.6	17.7
III	1.90	1.7	0.4	0.0	33.0	69.7	34.1	85.8
IV	6.30	8.0	8.9	7.6	54.0	70.1	96.2	74.3
V	11.60	11.0	12.9	12.1	79.0	89.0	80.1	106.8
VI	14.60	15.0	16.8	16.5	97.0	165.4	75.0	161.8
VII	16.50	16.8	17.9	21.4	122.0	80.4	146.7	59.4
VIII	15.70	18.4	16.0	14.5	88.0	36.0	161.7	166.8
IX	12.20	13.2	14.3	15.3	62.0	43.0	62.4	10.2
X	6.90	9.4	9.1	9.6	49.0	50.8	32.3	8.6
XI	1.70	2.4	2.0	4.9	34.0	58.4	27.3	17.9
XII	–1.70	–1.9	–1.9	1.5	36.0	6.2	24.9	25.8
Per vegetation	12.82	13.73	14.47	14.57	502.0	483.9	622.1	579.3
Per year	6.70	7.60	7.55	7.90	715.0	763.4	806.6	780.0

RESULTS AND DISCUSSION

In permanent grassland (*Lolio-Cynosuretum* association) under different management regimes, and in the same grassland on fallow land we observed a different development and spread of climbing as well as non-climbing clover plants including *Lathyrus pratensis* during the seven-year period of differentiated management. More frequent harvesting caused the development of non-climbing clover plants, mainly of *Trifolium repens*. On the other hand, extensive utilisation of stands and the fallow-land variant brought about a higher occurrence of climbing clover

plants (*Lathyrus pratensis* and *Vicia cracca*). The projective dominance of *Lathyrus pratensis* reached 6–18% D and the number of plants per 30 m²-area was within 6–15 plants (groups of browse, Table 2). In the more frequently harvested stands, the representation of *Lathyrus pratensis* was lower and young sprouts prevailed in the mown stand. On the other hand, in fallow stands, which were cut or grazed once or twice yearly (extensive stands), the plants were older, in the growth stage of flowering and ripening of pods, and occurred mainly in the higher floor of stands together with tall grasses.

Table 2. Number of *Lathyrus pratensis* plants on an area of 30 m² at different regimes and intensity of grassland management during the period 2004–06

Variants	Years, average number of plants			
	2004	2005	2006	$\bar{x}$
Mowing 1x*	13.0	11.0	10.0	11.33
Mulching 1x	11.5	11.0	11.5	11.33
Fallow stand	14.5	13.5	15.0	14.33
Mulching 1x + Mowing1x	8.7	5.5	7.5	7.23
Mowing 2x/0	7.0	5.7	6.0	6.23
Mowing 2x/NPK	6.7	6.0	6.0	6.23
Mowing 3x/0	2.2	2.2	2.0	2.13
Mowing 3x/NPK	3.0	2.7	2.5	2.73
Mulching 1x + grazing 1x	4.5	5.0	4.5	4.67
Mowing 1x + grazing 1x/0	2.5	2.0	3.0	2.50
Mowing 1x + grazing 1x/NPK	3.2	3.2	3.5	3.30
Grazing 2x/0	2.5	2.0	2.0	2.17
Grazing 2x/NPK	1.5	1.7	1.7	1.63
Grazing 3x/0	1.5	1.2	2.0	1.57
Grazing 3x/NPK	2.2	1.7	2.0	1.97
Grazing 4x/0	1.5	1.0	1.0	1.17
Grazing 4x/NPK	1.5	1.2	1.0	1.23

* One to four harvests per year, 0 – no fertilisation, NPK – stand fertilised with 100 kg N/ha + PK

Table 3. Number of *Lathyrus pratensis* plants attacked by *Erysiphe trifolii* on the area of 30 m² at different regimes and intensity of grassland management during the period 2004–06

Variants*	Average number of attacked plants by <i>Erysiphe trifolii</i>			Share of attacked plants (%)			
	2004	2005	2006	2004	2005	2006	$\bar{x}$
Mowing 1x	7.0	0.5	3.5	53.8	4.5	35.0	31.1
Mulching 1x	6.7	0.5	4.0	58.7	4.5	43.5	35.4
Fallow stand	10.0	1.2	8.0	69.0	9.3	63.3	47.1
Mulching 1x + Mowing1x	4.2	0.2	3.0	48.6	4.5	40.0	30.6
Mowing 2x/0	3.0	0.2	2.0	43.0	4.3	33.3	26.6
Mowing 2x/NPK	3.0	0.2	1.5	44.4	4.2	25.0	24.4
Mowing 3x/0	0.5	0.0	0.5	22.2	0.0	25.0	15.9
Mowing 3x/NPK	0.7	0.0	0.2	25.0	0.0	8.0	10.4
Mulching 1x + grazing 1x	1.7	0.0	1.5	39.0	0.0	33.3	23.7
Mowing 1x + grazing 1x/0	0.7	0.0	0.5	30.0	0.0	16.7	14.9
Mowing 1x + grazing 1x/NPK	0.7	0.0	0.7	23.1	0.0	20.0	14.0
Grazing 2x/0	0.7	0.0	0.3	30.0	0.0	15.0	14.3
Grazing 2x/NPK	0.5	0.0	0.5	33.3	0.0	29.4	20.9
Grazing 3x/0	0.2	0.0	0.5	16.7	0.0	25.0	12.8
Grazing 3x/NPK	0.5	0.0	0.2	22.2	0.0	10.0	10.9
Grazing 4x/0	0.2	0.0	0.0	16.7	0.0	0.0	4.4
Grazing 4x/NPK	0.2	0.0	0.0	16.7	0.0	0.0	4.4

Table 4. Analysis of variance of the number of meadow peavine plants attacked by *Erysiphe trifolii* on the area of 30 m² at different methods and intensity of grassland management during 2004 to 2006

Variability source	Sum of squares	Df effect	MS effect	F	p-level
Variant (A)	596.79	16	37.30	99.25**	0.000
Year (B)	173.80	2	86.90	231.23**	0.000
Repetition (C)	2.23	3	0.74	0.23	0.876
Error	57.50	153	0.37	–	–

Table 5. Average number of *Lathyrus pratensis* plants attacked by *Erysiphe trifolii* on an area of 30 m², by different methods and intensity of grassland management with designing homogeneous groups at probability level $P_{0.05}$

Variant	Average number of infected plants by <i>Erysiphe trifolii</i>	Homogeneous groups at probability level $P_{0.05}$ (Fischer's LSD test)					
		1	2	3	4	5	6
Fallow stand	6.2	**					
Mulching 1x	3.5		**				
Mowing 1x	3.7		**				
Mulching 1x + Mowing 1x	2.0			**			
Mowing 2x/0	1.5				**		
Mowing 2x/NPK	1.8				**		
Mulching 1x + grazing 1x	1.8					**	
Mowing 1x + grazing 1x/NPK	0.0						**
Mowing 1x + grazing 1x/0	0.2						**
Grazing 2x/NPK	0.3						**
Grazing 2x/0	0.3						**
Mowing 3x/0	0.3						**
Mowing 3x/NPK	0.3						**
Grazing 3x/0	0.5						**
Grazing 3x/NPK	0.5						**
Grazing 4x/0	0.8						**
Grazing 4x/NPK	0.8						**
Year							
2004	2.1	**					
2006	1.9		**				
2005	0.8			**			

Table 6. Selected markers of fodder quality of overground biomass of *Lathyrus pratensis* L. in dry matter

Year	Selected markers of fodder quality (g kg ⁻¹)					
	Crude protein	Crude fibre	P	K	Ca	Mg
2004	228.5	170.1	4.8	28.8	12.4	2.5
2005	233.7	161.8	4.1	29.7	11.4	2.4
2006	229.1	190.0	4.2	25.3	12.3	2.1
$\bar{x}$	230.4	174.0	4.4	27.9	12.0	3.3

Our findings were in agreement with those of Hoffmann and Schmutterer (1983), who also found the first symptoms of the disease on the surface of green assimilating leaves of *Lathyrus pratensis*, in the form of whitish mycelium. The strongest influence of the investigated pathogen was found at the end of summer and during autumn, as was also found by Čača et al. (1990).

A higher proportion of attacked plants was found in the extensive stands (Tables 2, 4 and 5), mown or mulched once per year, and in fallow stands. In these stands, the faster spread of *Erysiphe trifolii* is made possible by the more frequent occurrence of *Lathyrus pratensis* plants, a more favourable phenophase and the location of the plants in stands, and longer periods between harvests or even a non-harvest regime. In the grazed stands, *Lathyrus pratensis* plants displayed better health compared with the mown stands at the same frequency of harvesting.

The influence of a particular year (climatic conditions) on the spread of *Erysiphe trifolii* was also very strong – the occurrence of the attacked plants in the stands was high (up to 68.9%, fallow land, Table 3) in 2004, whereas in 2005 it was minimal (between zero and 9.2%) and most variants did not display any infestation on *Lathyrus pratensis* plants at all. In 2006 the rate of *Erysiphe trifolii* was higher than in 2005, and the stronger spread was recorded mainly in September (63.3%, fallow land, Table 3).

The lowest rate of *Erysiphe trifolii* attack during the whole experimental period was found in grazed stands – between zero and 33.3% (Table 3).

The occurrence of *Erysiphe trifolii* rose with lack of precipitation and higher temperatures, mainly in July and August (in 2006), whereas a more humid climate, i.e. more precipitation and lower temperatures, inhibited the development of the disease (2005 and August 2006, Tables 1 and 3).

The differences detected in the number of attacked *Lathyrus pratensis* plants in stands with different management regimes are statistically highly significant (Tables 4 and 5). The differences in management were responsible for the infestation variability in 27.8% ($F = 99.25^{**}$), and the year in 64.2% ($F = 231.23^{**}$).

Lathyrus pratensis has an excellent fodder composition. It is characterised by a high concentration of nitrogen compounds and calcium and a low level of crude fibre (Table 6) in its biomass in comparison with other meadow legumes and herbs. *Lathyrus pratensis* had an even higher

level of nitrogen compounds in comparison with red clover (*Trifolium pratense* L.) varieties with a nitrogen compound content of 168–181 g kg⁻¹ dry matter (Drobná and Jančovič 2006).

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