



Identification of main factors determining seed production of three *Festuca* species and its relation to potential endophyte propagation

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Aim & Scope: Our survey aims to relate main seed-production factors with observed endophyte frequency in Poland. Hypothesis is that along with seed dispersal in wild or semi-wild habitats, endophyte frequency increases, due to factors related to seed production.

Materials & Methods: Research presented below consisted from two independent experiments:

First, which took place from 2007 till 2016, were country-wide collection of grass ecotypes and cultivar's seed samples from three *Festuca* species: *F. arundinacea*, *F. pratensis* and *F. rubra* was performed. As total 534 grass ecotypes were collected in a form of plants and 126 seed samples were kindly received from breeders or seed companies. Endophyte presence was determined in plants by rapid staining method according to Saha et al. [1988], and in seeds by immunoblot procedures by Hill et al. [2002]. Endophyte occurrence were expressed as **frequency** (no. of samples with endophyte) and average **colonization** i.e. average percentage of endophytes per sample.

Second, which was established in 4 locations in Poland (Radzików, Nieznanice, Szelejewo and Leszno). Fifteen genotypes (5 per each of species mentioned above) were used. Experiment was set-up in 2014 and run three consecutive years. Plants were evaluated for following : overwintering [OW], plant growth habit [GH], mean heading start date [HE], mean flowering start date [FE], estimated biomass yield [BY], plant height [PH] (cm), steam leaf length [LL] (cm); steam leaf width [LW] (cm), number of generative stems per plant [NGS]; inflorescence length [FL] (cm); single panicle seed yield [SI] (g); seed yield of single plant [SY] (g); seed yield of plot [SP] (kg); thousand seed weight [TSW] (g);

chlorophyll contents index [CCI]. **Results of both experiments were further used to relate endophyte frequency in plants and seeds with seed-production traits.**

Results:

First experiment: Endophyte frequency both in wild plants (ecotypes) and in seeds (cultivars) were the highest in *F. pratensis* and reached 77 and 75%, respectively. Endophyte colonization of plants was at the similar level, however for seeds it was less than 24 %. Considering the lowest frequency of endophytes: in plants it has been noted for *F. arundinacea* (30%) but for seeds it was for *F. rubra* (46%). Seed colonization was also lower than observed for plants and it ranged from 8.7% for *F. rubra* to 24.3% for *F. pratensis*.

Second experiment: There was rather low contribution of traits used for analysis to plant seed yield (SY) of *F. arundinacea* and *F. pratensis*. It was high and positive for *F. rubra* for LW and high and negative for PH for *F. pratensis*. Direct contribution of FL and LW were calculated for single panicle seed yield (SI) of *F. arundinacea* and *F. pratensis*. Therefore, models designed for *F. arundinacea* and *F. pratensis* were similar but different for *F. rubra*: LW was related to SY, but not to SI.

First vs. second: high and negative correlation coefficients were calculated for SY and seed colonization of plants. Species of high LW exposed also high endophytes frequency in seeds. Relatively low seed yielding *F. pratensis* exposed the highest seed colonization rate, while for high yielding *F. rubra* and *F. arundinacea* it was almost twice lower. If calculated on the mean viable seed produced per plant, average number of seeds with endophytes per plant were comparable: 1300 for *F. arundinacea*, 1650 for *F. pratensis* and 1800 for *F. rubra*.

<i>Festuca</i> :	Ecotypes (plants):			Cultivars (seeds)		
	collected	E+ (%)		analyzed	E + (%)	
		frequency	colonization		frequency	colonization
<i>arundinacea</i>	47	29.8	22.6	22	63.6	10.6
<i>pratensis</i>	224	76.8	75.7	32	75.0	24.3
<i>rubra</i>	263	41.4	39.1	72	45.8	8.7
Total	534	55.2	45.8	126	56.3	14.5

Path representation:	Parameter values for:		
	<i>F. arundinacea</i>	<i>F. pratensis</i>	<i>F. rubra</i>
[BY] ---> [PH]	0.334 **	0.196	- 0.051
[CCI] ---> [PH]	0.674 ***	0.346	0.573 ***
[NGS] ---> [SI]	- 0.115 ns	0.220 ns	- 0.392 **
[TSW] ---> [SI]	0.108 ns	0.011 ns	0.003 ns
[FL] ---> [SI]	- 0.510 **	0.695 ***	0.281 ns
[LW] ---> [SI]	1.109 ***	0.340 **	-
[PH] ---> [SY]	- 0.384 ns	- 0.570 **	- 0.258
[SI] ---> [SY]	- 0.102 ns	0.008 ns	0.226
[LW] ---> [SY]	-	-	0.461 **

Traits:	Correlation coefficients for seeds:	
	E + (%)	
	frequency	colonization
SI	0.37 ^{ns}	-0.16 ^{ns}
SY	-0.50 ^{ns}	-0.88 **
LW	0.85 **	0.46 ^{ns}

Conclusion:

Survival of endophyte depends on the host survival strategy. However, seed infection of host plants is high energy-consuming for endophyte. Therefore, for high-seed producing hosts relatively lower endophyte seed colonization is enough for it to survive in a given environment.