Factors affecting seed yield in selected *Festuca* species

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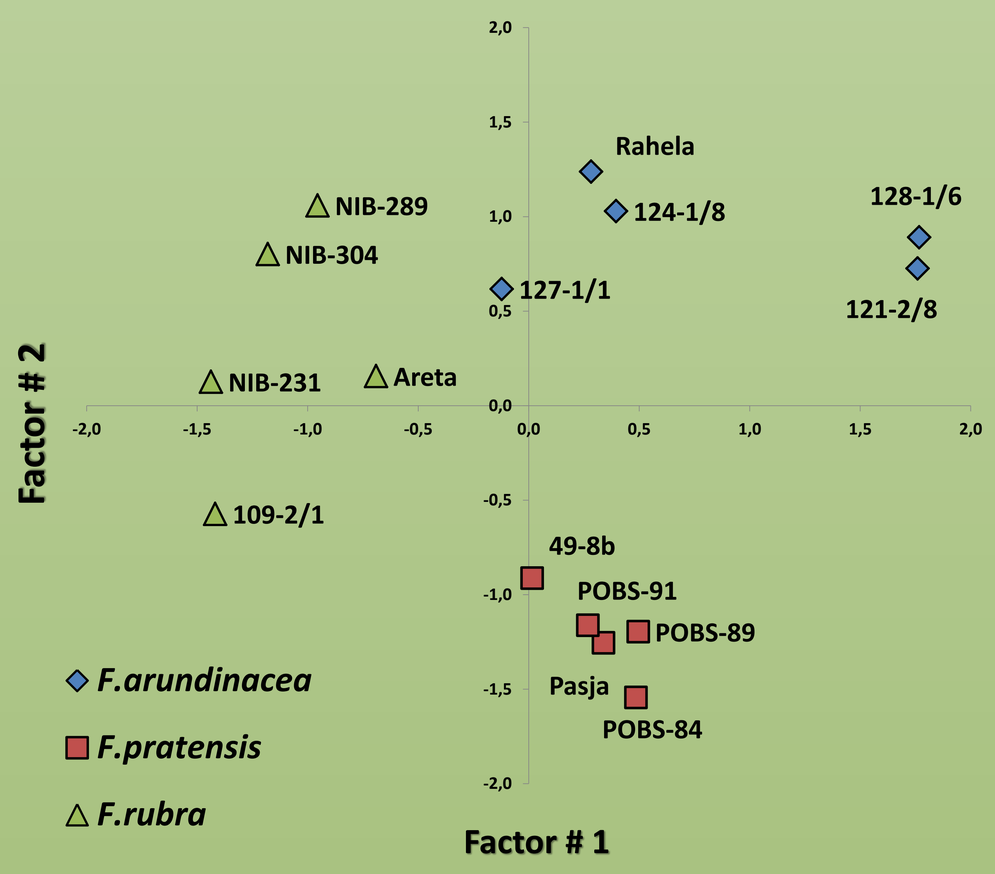
Introduction: Seed production is one of the important steps in plant breeding since the commercial value of cultivar is often determined by its seed yield capacity. Although seed yield is a complex trait and affected by agricultural practices as well as environmental factors, traits related to seed production reveal considerable genetic variation, prerequisite for improvement by direct or indirect selection. The basic factors contributing to seed yield in grasses are the number of inflorescences produced per plant, the number of florets produced per inflorescence (or head size), the proportion of florets which set seed (or seed setting) and individual seed weight. To improve our knowledge on the main seed yield components in major Festuca species, experiment has been established in 2014 to define relations between the set of phenotypic characters measured and observed in three Festuca species with plant seed yield**.**

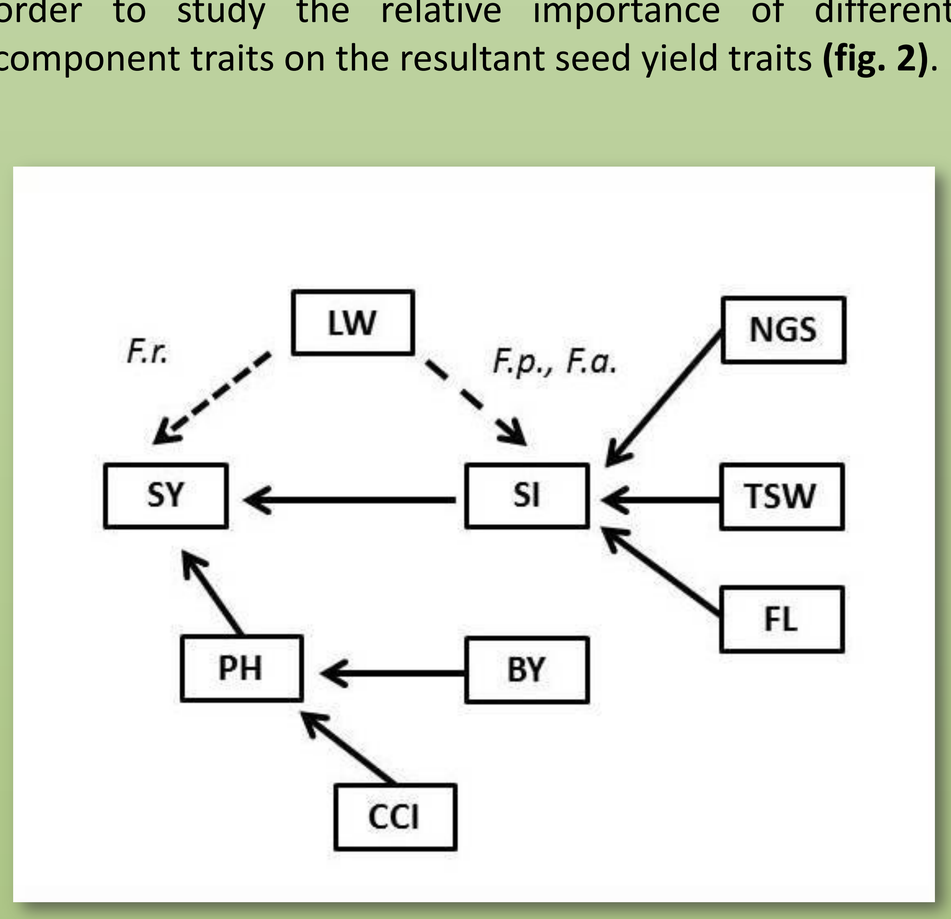
Materials & methods: Field experiment has been set-up in 2014 in four locations in Poland: Radzików, Szelejewo, Leszno and Nieznanice. Fifteen genotypes, 5 per species of tall fescue (*Festuca arundinacea* Schreb.), meadow fescue (*Festuca pratensis* Huds.) and red fescue (*Festuca rubra* L.) were tested during **two years** for 15 traits directly and indirectly related with seed yield. In each location three replications were used with 50 individuals per replication. Following traits were measured and observed:
overwintering [**OW**], in scale 1 – 9, where 1 – plants completely destroyed, 9 – plants vigorous;
plant growth habit [**GH**], in scale 1 – 9, where 1 – plants completely flat, 9 – plants erect;
mean heading start date [**HE**], number of days from the 1-st of April to that moment when on 30% of spaced plants on plot 'emerged' tillers were visible;
mean flowering start date [**FE**], number of days from the 1-st of April to that moment when on 30% of spaced plants on plot at least single anthers were visible;
estimated biomass yield [**BY**], in scale 1 – 9, where 1 – the lowest yield, 9 – the highest yield;
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**], measured with CCM200 Plus.
STATISTICA ver.12 [StatSoft, Inc. (2014)] software was used for calculations and analysis.

Results:

The wast majority (84%) of variation of tested genotypes was described by two factors **(fig. 1)**. Traits as FE, PH, LL, LW, NGS, SI, FL and CCI contributed to factor #1 (51.8% of total variation), while OW, BY, SY and SP – with factor # 2 (32.3%). As it could be expected, placement of genotypes in OX-OY axis space separated them according to species. Distances between genotypes on plot were related to variability in each species.



Following model was used to perform SEPATH analysis, in order to study the relative importance of different component traits on the resultant seed yield traits **(fig. 2)**.



There was rather low contribution of traits used for analysis to plant seed yield (**SY**) of tall and meadow fescue. It was high for red fescue for **LW** and **SI**.
Direct contribution of **FL** and **LW** were calculated for single panicle seed yield (**SI**) of tall and meadow fescue.
Therefore, models designed for meadow and tall fescues were similar but different for red fescue: **LW** was related to **SY**, but not to **SI**.

Tall fescue (*Festuca arundinacea* Schreb.)

Meadow fescue (*Festuca pratensis* Huds.)

Red fescue (*Festuca rubra* L.)

Path representation:	Parameter values for:		
	F. arundinacea	*F. pratensis*	*F. rubra*
[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 **
Statistics:			
discrepancy function value:	7.00	4.12	3.74
Chi-square	133.1	78.2	71.1
p	0,00	0,00	0,00
RMS standardized residual	0.47	0.24	0.24

Conclusion:

- Leaf width is the important determinant of seed yield, and depending on species, it is related to panicle or plant seed yield.
- Breeders should not only select for increased size of reproductive system but also for some vegetative traits, with possible enhancement of forage production.

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