



Breeding and Genetic Improvement for a Net-Zero Future

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Expected genetic gain of the most important traits in the breeding process of the meadow fescue

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Meadow fescue (*Festuca pratensis* Huds.) is an important perennial forage grass for animal feed production on grasslands and pastures, with high yield potential and good-quality biomass. During the breeding process, it is often necessary to predict, based on the results of the initial selection cycles, how much a certain trait can be improved. To that end, it is necessary to determine the expected genetic gain (ΔGe), a parameter that tells us how much a trait can be improved by breeding it alone in the following period. Individual plants for hybridization, to obtain progeny by the method of Comstock and Robinson, were selected completely randomly. To examine the obtained progeny, the study was performed in an experimental field of the Institute for Forage Crops, in two replications. The experiment was set up according to the Nested Design I, with sets within the replications. In cv. Kruševački 21 (K-21), 60 full-sib progeny were studied in two sets, while in the cv. Pradel a total of 39 full-sib progeny were studied. Within each full-sib progeny, 60 plants were analyzed.

In both cultivars, the highest expected genetic gain was determined for the number of generative and vegetative tillers per plant and dry matter yield per plant. The least success can be achieved by improving the heading date and crude protein content in the 1st cut in cv. K-21, and in cv. Pradel for traits leaf length and crude protein content in the 1st cut.

By breeding individual traits, based on the obtained results, a large genetic gain is expected in many studied traits. Considering the existence of correlations between the most important agronomic traits, it is observed that often, by breeding one trait, a negative response is encountered in another trait. For this reason, the expected indirect genetic gain from selection was calculated, i.e., the effect of breeding one trait on other ordered traits. In the cv. K-21, achieving the expected genetic gain in plant height, would lead to a decrease in dry matter yield and leaf length. By creating later cultivars, the result would be a cultivar with a smaller number of generative tillers and a lower protein content in the first cut. Successful breeding for increased crude protein content in the first cut of 9.9 gkg⁻¹ would result in a significant reduction in dry matter yield, followed by a reduction in the number of vegetative and generative tillers, but also earlier maturity. In cv. Pradel, a positive effect of the selection of individual traits on other studied traits was recorded for most of the traits. The only realization of the expected genetic gain in the increase in leaf length would result in a decrease in the number of vegetative tillers per plant.

Expected genetic gain (ΔGe) of the most important traits of meadow fescue

Traits	Heading date*	Plant height (cm)	Leaf length (cm)	No veg. tillers	No gen. tillers	DMY ($gplant^{-1}$)	CP 1 st cut (gkg^{-1})
K-21							
Heading date*	2.58 (9.06%)	0.02	2.23	0.59	-2.28	0.89	-1.57
Plant height (cm)	0.07	9.11 (10.02%)	-5.68	3.91	10.17	-3.80	3.49
Leaf length (cm)	3.81	-3.14	4.32 (13.88%)	0.58	-0.12	2.73	1.09
No veg. tillers	4.35	9.24	2.46	21.36 (34.66%)	4.24	2.74	-4.28
No gen. tillers	-30.98	44.79	-0.98	7.90	62.94 (28.17%)	27.97	-21.59
DMY ($gplant^{-1}$)	20.37	-27.99	36.31	8.51	46.81	55.49 (18.45%)	-44.82
CP 1 st cut (gkg^{-1})	-0.45	0.33	0.19	-0.17	-0.46	-0.57	9.9 (8.78%)
Pradel							
Heading date*	5.64 (13.45%)	5.42	1.74	5.30	4.03	0.704	4.37
Plant height (cm)	11.50	11.56 (11.43%)	4.94	6.35	2.81	10.55	6.82
Leaf length (cm)	1.52	2.03	1.38 (5.61%)	-2.20	2.19	0.69	0.79
No veg. tillers	39.14	22.07	-18.55	42.87 (45.59%)	37.11	21.35	-8.24
No gen. tillers	81.93	26.93	50.84	102.21	115.88 (45.93%)	98.09	22.27
DMY ($gplant^{-1}$)	12.66	89.22	14.18	51.97	86.69	97.96 (40.34%)	71.13
CP 1 st cut (gkg^{-1})	0.97	0.71	0.20	0.25	0.24	0.88	10.1 (7.46%)

* Number of days from April 1st

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