Studies upon morphological and biological traits of *Festuca rubra*, subsp. *fallax* (Poaceae)

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(Received: October 8, 1999)

Summary

Observation and measurements of some traits of *Festuca rubra* L., subsp. *fallax* (Thuill.) Hack. ecotypes were made in 1995-1997 using samples selected from natural habitats and collected in Grassland Experimental Station in Sosnowica. High differentiation of traits under study and their correlations were found. Valorized ecotypes are good material for new varieties breeding.

Key words: *Festuca rubra* subsp. *fallax*, ecotypes

INTRODUCTION

Due to the morphology of the above-ground parts, *Festuca rubra* subsp. *fallax* is very similar to *Festuca rubra* subsp. *genuina*, but it does not produce the underground stolons forming dense clusters in a sward. It occurs in all Poland, however it has the fodder meaning only on mountain areas. It usually occurs in poor habitats as regarding to nutritive components and drier ones than the creeping red fescue. This is the species characteristic for Meo-Festucetum Bartsch 1940 (Hegi, 1908; Rutkowska, 1970; Falkowski, 1982; Kozłowski and Goliński, 1997). Nowadays, the economic role of *Festuca rubra* increases, because it is useful for drying lawns and for covering lands difficult for development (Raciborski and Szafer, 1919; Lutyńska, 1994; Sawicki, 1994). It is very important for protection against erosion and shaping the landscape friendly for humans. Besides, fodder obtained from the grass contained little amounts of nitrates and nitrosoamins (Tarkowski, 1958).

The aim of the studies was the estimation of intra-species variability of *Festuca rubra* subsp. *fallax* – a taxon considered as a source of genetical material for new varieties breeding, which could be used as the first stage in re-cultivation of disturbed areas.

MATERIAL AND METHODS

Festuca rubra subsp. *fallax* ecotypes were collected in natural sandy habitats in Lublin and Biała Podlaska regions. They were accumulated on the light sandy soil in the collection of Grassland Experimental Station in Sosnowica situated 60 km north of Lublin in 1994. The main investigations were carried out in 1995-1997. Each ecotype was sown in 10 replications in rows of 30 cm distance. The biological and morphological traits presented in Tables 1 and 2, and on Figures 1 and 2 were taken into account. Number of days from April the 1st till the anthers maturity in 10% inflorescences was accepted as the beginning of flowering. Measurements were done in 25 replications using the same selected samples of given ecotype. The transverse sections (microscopic preparations) were made in 5 vegetative leaves of every ecotype and photos using microscope were taken. Obtained results were compared with Golfrood variety accepted as a control. Statistical calculations were made in Center of Informatics, University of Agriculture, Lublin applying the following mathematical methods: multi-factor variance analysis, multiple Tukey's sections and correlation.

Sums of precipitation amounted to 470, 558 and 434 mm; and mean air temperatures were 8.9, 8.7 and 7.4°C in the following years. Mean many-year precipitation was 558 mm, but the temperature achieved 7.3°C (1951-1985).

RESULTS

Number of vegetative shoots that are produced by grass during the year determines the rate of covering the area by plants and the sward density. For studied ecotypes, four ecotypes formed significantly more vegetative shoots (Barak, Biała, Garbów, Jedlanka) than standard variety, and three ones were at significantly close level. Besides, five ecotypes (Barak, Biała, Borki, Jedlanka, Luszawa) produced significantly more generative shoots than standard, which points to their ability for seed production. It is worth of mentioning that ability for all shoots formation was significantly decreased in the third year of investigations (fourth year of cultivation). Converse tendencies were observed by Sawicki (1994) in *Festuca rubra* subsp. *genuina*. As regarding to the shoot height, twelve ecotypes were significantly higher to the standard, but only five of them had significantly longer inflorescences. Statistically significant differences between years of study were not found as regarding to plant's height and inflorescence's length (Table 1).

Table 1.

Characteristics of investigated *Festuca rubra* subsp. *fallax* (Thuill.) Hack. population.
Mean of 1995-1997.

No	Ecotypes acc. to origin	Number of shoots in tuft		Plant height	Inflores- cence length	Beginning of flower- ing (days from 1 st April)	Mass of 1000 seeds
		Vegetative	Generative				
1	Annobór	490, b	213, c	60.3, c	6.1, c	66, c	0.76, c
2	Annówka	311, c	188, c	64.0, c	7.2, c	68, c	0.95, c
3	Barak	594, a	259, a	71.7, a	8.4, c	72, c	1.01, a

No	Ecotypes acc. to origin	Number of shoots in tuft		Plant height	Inflore- scence length	Beginning of flowe- ring (days from 1 st April)	Mass of 1000 seeds
		Vegetative	Generative				
4	Białka	609, a	270, a	89.0, a	14.2, a	66, c	1.11, a
5	Borki	570, b	256, a	79.3, a	8.4, c	72, c	1.04, a
6	Garbów	637, a	221, c	79.3, a	11.6, a	70, c	1.15, a
7	Jedlanka	996, a	357, a	89.4, a	13.8, a	73, a	0.95, c
8	Leszkowice	473, b	221, c	85.6, a	10.3, a	75, a	1.09, a
9	Luszcza	548, b	258, a	82.7, a	11.4, a	75, a	1.09, a
10	Michów	423, c	188, c	73.1, a	6.7, c	72, c	0.67, b
11	Ostrówek	402, c	164, c	77.2, a	7.4, c	74, a	1.04, a
12	Rokitno	412, c	172, c	27.4, b	8.7, c	68, c	1.10, a
13	Tarkawica	355, c	160, b	87.1, a	8.3, c	69, c	0.98, a
14	Tchórzew	358, c	136, b	78.3, a	7.5, c	67, c	0.72, b
15	Wisznice	341, c	138, b	72.5, a	9.3, c	67, c	0.94, c
16	Golfrood cv. - model	530	196	62.7	7.4	68	0.85
Mean for the years	1995	520	205	75.3	9.5	72	0.99
	1996	561	278	77.8	8.8	67	0.97
	1997	428	155	75.9	9.2	72	0.94
Variability scope 1995-1997		195-1213	87-354	58-93	6.3-17.2	64-78	0.58-1.24
Variability coefficient (%)		38.4	36.4	12.7	28.8	2.7	18.7
LSD ($\alpha \leq 0,05$)							
Ecotypes		59	32	7.2	2.7	5	0.12
Years		33	15	n.s.	n.s.	2	n.s.

a – significantly better trait than in model variety

b – significantly worse trait than in model variety

c – no significant differences between ecotype and model trait

Among collected ecotypes, only four ecotypes flowered significantly later than standard variety. Besides, it was noticed that the period of beginning of flowering in 1996 was significantly shorter. One can suppose that it was due to quite high air temperatures and slightly higher precipitations than in the previous years. It is worth of mentioning that nine ecotypes were characterized by higher 1000-kernel weight (Table 1).

Taking into account the leaf dimensions, only two ecotypes had longer leaves (Garbów, Leszkowice), and two other (Annobór, Tchórzew) had significantly wider ones than standard variety.

Studied ecotypes were characterized by straight structure (nine ecotypes) and gray-green to dark-green color. Only few of them had worse winter survival and were weakly infected by fungus *Erysiphe graminis* DC (Table 2). Such traits as: number of shoots, inflorescence length and leaf length were characterized by the highest variability coefficients, which points to their relatively good breeding plasticity.

Table 2.

Characteristics of investigated *Festuca rubra* subsp. *fallax* (Thuill.) Hack. population.
Mean of 1995-1997.

No	Ecotypes acc. to origin	Length of leaf	Width of leaf	Color*	Type**	Overwintering scale 9 ⁰ 1991	Disease infection scale 9 ⁰ 1991
1	Annobór	24.1, c	2.47, a	g	erect	8	8
2	Annówka	24.8, c	1.83, b	dg	slope	8	7
3	Barak	20.2, c	1.64, b	g	slope	8	8
4	Biała	19.0, c	1.72, b	gg	erect	7	8
5	Borki	21.5, c	1.53, b	dg	erect	7	7
6	Garbów	27.8, a	1.47, b	dg	erect	8	7
7	Jedlanka	23.4, c	1.82, b	g	erect	7	7
8	Leszkowice	27.2, a	1.76, b	dg	slope	8	7
9	Lusza	25.1, c	1.60, b	gg	erect	8	8
10	Michów	23.5, c	1.33, b	gg	slope	7	8
11	Ostrówek	13.4, c	1.40, b	g	slope	8	7
12	Rokitno	14.6, b	1.73, b	gg	erect	8	7
13	Tarkawica	13.5, b	1.50, b	gg	erect	8	7
14	Tchórzew	15.0, b	2.37, a	dg	slope	7	8
15	Wisznice	19.4, c	1.93, c	g	erect	8	7
16	Golfrood cv. - model	21.5	1.93	dg	erect	8	8
Mean for the years	1995	21.7	1.78	-	-	-	-
	1996	20.4	1.78				
	1997	20.8	1.71				
Variability scope 1995-1997		10.2-39.0	1.3-2.9	-	-	-	-
Variability coefficient (%)		28.7	20.7	-	-	-	-
LSD ($\alpha \leq 0,05$)							
Ecotypes		4.1	0.03	-	-	-	-
Years		n.s.	n.s.				

*g - green, dg - dark green, gg - gray green

Table 3.

Correlation coefficients of the compared ecotypes characteristics of *Festuca rubra*
subsp. *fallax*. Mean of 1995-1997.

	x_2	x_3	x_4	x_5	x_6	x_7	x_8
x_1 No of generative shoots	0.7739**	0.3649*	0.4208**	0.1845	0.2424	0.0534	0.1608
x_2 No of vegetative shoots		0.4072**	0.5668**	0.1868	0.2501	0.0843	0.0133
x_3 Plant height			0.7139*	0.3271*	0.0641	0.3185*	0.1724
x_4 Inflorescence length				0.4525**	0.1897	0.1817	0.1421
x_5 1000-kernel weight					0.0038	0.2726	0.1739
x_6 Leaf length						0.0589	0.2264
x_7 Leaf width							0.3532*
x_8 Beginning of flowering							-

All found correlation were of positive character. Dependencies between number of generative and vegetative shoots (0.77) as well as between plant's height and inflorescence length (0.71) were characterized by the highest correlation coefficients. Those correlations make easy to breed new varieties (Table 3). Among five photos of vegetative leaf section of every ecotype, only the best ecotype was selected and presented on Fig. 1. Usually five ribs occurred on the leaf surface, but they were different as regarding to their structure. In standard variety, slight stress of ribs 6 and 7 (ecotype 16) was found. In ecotypes 2, 7 and 13 (Annówka, Jedlanka, Tarkawica) 8 to 9 ribs were distinguished. Similar differentiation of transverse sections of vegetative leaves in *Festuca rubra* subsp. *fallax* was given by Hegi (1908). Leaves of that grass have some traits of xerothermal structure, which makes possible to adapt the species to the development in dry habitat.

Fig. 1. Transverse sections of leaves from vegetative shoots of *Festuca rubra* subsp. *fallax* (Thuill.) Hack.; 15x.

Numbers explanation is given in Tables 1 and 2.

CONCLUSIONS

1. Ecotypes collected are the rich genetical material as a source of initial materials for new species breeding.
2. The breeding progress can be the most easily obtained in a direction of cluster tillering rate, and obtention of forms with different earliness classes is the most difficult.
3. 1000-grain weight is quite variable, therefore studies upon that factor influence on prolificacy of forms and seedlings development should be continued.
4. Morphological structure of vegetative leaves of *Festuca rubra* subsp. *fallax* is variable because 5 to 9 ribs occur on the leaf blade. Moreover, morphological accommodation of a leaf to live under conditions of reduced water supply is clear, which should be reflected in agricultural recommendations.

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Badania cech morfologicznych i biologicznych *Festuca rubra* subsp. *fallax* (Poaceae)

Streszczenie

W pracy przedstawiono wyniki badań ekotypów kostrzewy czerwonej kępowej zgromadzonych w Łąkarskiej Stacji Doświadczalnej w Sosnowicy. Analizowano następujące cechy roślin: liczbę pędów wegetatywnych i generatywnych, wysokość roślin, termin kwitnienia i długość kwiatostanu, masę 1000 nasion, długość i szerokość liści na pędach wegetatywnych, kolor roślin, pokrój, przetrzymywanie oraz odporność na choroby. Z przeprowadzonych badań wynika, że zgromadzone ekotypy stanowią dośyć zróżnicowany materiał nadający się do wykorzystania w hodowli nowych odmian. Najłatwiej byłoby uzyskać postęp hodowlany w kierunku rozkrzewienia kępy, zaś najtrudniej w kierunku zróżnicowania klas wczesności wynikających z terminu kwitnienia traw. Masa tysiąca nasion była cechą zmienną, co wiąże się z plennością. Liście wszystkich badanych ekotypów charakteryzowały się budową kseromorficzną lecz liczba żeberk była cechą mało stabilną.