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## Variability of the structural elements of the productivity and correlation dependencies between them and hay yield at ecotypes and varieties of species *Festuca pratensis* Huds. and *Festuca arundinacea* Schreber

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### ABSTRACT

The genetic diversity in 21 accessions of the two species of fescue was found by examining the variability of the structural elements of the productivity. There were established correlation dependencies between them and annual yield of dry biomass (hay yield). The study included 12 accessions of species *Festuca pratensis*. (6 Bulgarian and 4 Swiss ecotype and two varieties, serving as controls). The species *Festuca arundinacea* included 9 accessions (6 Bulgarian ecotype and three varieties, serving as controls). The evaluation of the field was carried out on 10 biomorphological traits by measurements or by visual evaluation of 30 plants per accession (10 plants x 3 randomized replications). It was found that for both species of fescue the highest variability had trait - number of culms per plant. In *Festuca arundinacea* been proven that the annual hay yield was a strong positive correlation of height in the stage of spindling and negative with the length of the flag leaf and the number of days to stage of brooming. In species *Festuca pratensis* were not established proven correlations between annual hay yield and structural elements of productivity. The results of this study gave possibilities for enrichment the information of ex situ collections of ecotypes of *Festuca pratensis* and *Festuca arundinacea*, collectors of natural habitats and the possibility to distinguish valuable genotypes in adaptability that can be successfully used in the breeding improvement work.

**Key words:** variability, correlation, hay yield, species *Festuca*

## Introduction

Biological resources of plant origin are the basis for humans and animals breeding, for balance maintenance in the biosphere and for identity preservance of our environment. An important role in this respect take forage grasses and legumes that are an integral part of the natural habitat. Their role is not limited only as a resource for feeding the pets but they are the main biological component of the natural landscape, in the construction of parks, green areas and the restoration of eroded, degraded and polluted areas.

The wild relatives of cultural forage species in permanent pastures and meadows are an important source of genetic variability for the purposes of the breeding and they are the basic background material in the improvement works at grass-feed varieties (Wilkins, 1991; Fjellheim et al., 2007). In Western Europe this wealth of variations began to be used as the main source of germplasm in the breeding of forage crops

in the early 20th century (Boller et al., 2005; Yamada et al., 2005). Stranski, (1939) indicates that the feeding problem in our country can be solved by using the opportunities provided by natural meadows and pastures, as a source of a variety of wild forage species being adapted to the conditions of the country (Guteva, 2005, 2007).

As a part of the Bulgarian collection of plant genetic resources (PGR) this forage grasses has over 5000 accessions. They are supported in live condition in the National gene bank in IPGR Sadovo and they are a part of the European Collection of forage species (Stamatova et al., 2011).

The aim of this study was to establish the variability of the structural elements of productivity and correlation dependencies between them and the yield of dry biomass at ecotypes and varieties of two species of fescue (*Festuca pratensis* and *Festuca arundinacea*).

## Materials and Methods

The study was conducted in the period 2010-2012 on the experimental field of IPGR "K. Malkov" - Sadovo. It included six Bulgarian and four Swiss ecotypes and two introduced varieties used as controls, originating in Switzerland and Germany on the species of meadow fescue (*Festuca pratensis*), respectively Preval and Cosmolit. The species tall fescue (*Festuca arundinacea*) involved six Bulgarian ecotypes, the Bulgarian (Albena) and the two Swiss varieties (Barolex and Belfine), serving as controls.

The accessions of both species were characterized by 10 bio-morphological traits after wintering. The assessment was carried out according to UPOV2002 (International Union for Protection of New Varieties of Plants) by measurement or visual evaluation of 30 individual plants - 10 plants x 3 reps pledged Latin rectangle. The length of the rows was 6 m, the area of each replication was 1.5 m<sup>2</sup>, thus for each accession were provided 4.5 m<sup>2</sup>. The agronomic evaluation of ecotypes and varieties was carried out by non-standardized experience (Latin rectangle) size of plot 6 m x 1.5 m, in three randomized replications. The total area were 27 m<sup>2</sup> of each accession in the examination.

The yields of the fresh and dry biomass (hay yield) were calculated by the undergrowth, years and average values of the studies period for both species of fescue. The first cutting were done in May, when all the accessions have entered into stage brooming, second - a month later and the third - in September, coinciding with the time winterizing. At the time of harvest of each undergrowth directly by weighing method was determined the fresh yield (m1) of each plot and was separated an average sample of 0.5 kg (m2), which was dried to constant weight (m3). From the resulting value for the hay yield of the average sample (m3) by applying a simple rule triple was obtained the hay yield of each plot (m4):

$$m4 = m1 * m3 / m2 \quad \text{kg/9m}^2$$

The value of m4 was used for recalculation of the yield per unit area - kg/da.

The correlation and variation coefficients were defined according to Genchev et al. (1975). According to Dimova & Marinkov (1999), when the correlation coefficient (r) is from 0 to 0.33, the correlation is weak. When (r) is in the range of 0.34 to 0.66 - there is medium correlation; in the range of 0.67 to 0.99 - there is strong correlation. The correlation may be weak, medium, strong, positive or negative. The degree of variability of the investigated traits presented by variation coefficient (VC%) was indicated according to the scheme of Mamaev (Shamov, 1998; Petrova, 2015): 7% - very low; 7.1 to 12.0% - low; 12.1 - 20.0% - medium; 20.1 - 40.0% - higher; over 40.1% - very high.

All statistical analyses were performed with the statistic program SPSS 13.0 for Windows.

## Results

Characterization of forage grasses by morphological and physiological traits is important in determining the direction of use, winter resistance and durability. The breakdown into groups of similarity of morphological characteristics is helpful to establish the optimal collection of forage grasses with multiple use - forage (hay and pasture) for decorative purposes, to combat erosion and as energy species.

### Analysis of variability

In the three years of study at the species *Festuca arundinacea* (Table 1) the traits height in the stages of spindling and brooming, and length of leading stem were characterized by a very low degree of variability both within and between the studied ecotypes and varieties - from VC=2.43% in ecotype Dragomirovo (92E0045) for height in the stage of brooming to VC=6.65% - variety Barolex, height in the stage of spindling. The exception only occurs in variety Albena of height in the stage of brooming where the variability was low (VC=7.40%). The traits of panicle length, length and width of flag leaf showed a wide range of variation values from very low to medium. The very low values were from VC=4.93% at ecotype Bansko (A7E0011) to VC=6.48% at ecotype Gumoshnik (A6E0035) for width of flag leaf. The low values covered by VC=8.11% to VC=12.02% in ecotype Dragomirovo (92E0045), which were respectively length of panicle and flag leaf. The values of the coefficient of variation of varieties Belfine (VC=12.77%) and Barolex (VC=15.51%) defined the limit of medium variation. They were calculated for length of flag leaf. Compared with all tested traits, the number of culms per plant was distinguished with the highest degree of variability within and between ecotypes and varieties. It was a medium of four accessions, which limits variations were VC=14.48% (variety Barolex) to VC=19.72% (Gumoshnik (A6E0035)). Five accessions were characterized by a high degree, the boundaries were VC=20.68% (Trigrad (A6E0037)) to VC=25.37% (Chokmanovo (A6E0042)). The natural ecotype Dragomirovo (92E0045) was characterized by the lowest grass cover stages of spindling (52.2 cm) and brooming (97.9 cm), the lowest leading stem (122.7 cm) but with the longest (18.3 cm) and the widest flag leaf (0.74 cm). Ecotype Arapovski manastir (A6E0036) had the highest grass cover stages of spindling (64.4 cm) and brooming (112.9 cm), the highest leading stem (141.2 cm), the largest number of culms per plant (93.6), but the most narrow flag leaf (0.65 cm). The longest panicle was measured at ecotype Gumoshnik (28.4 cm), and the shortest - in variety Belfine (23.4 cm). Variety Albena was differed with the shortest flag leaf (15.8 cm). Variety Barolex had the lowest number of culms per plant (77.8).

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**Table 1.** Structural elements of productivity at *Festuca arundinacea*, average values for years of study (2010-2012y.)

Accession	Height in stage		Length		Flag leaf		number of culms per plant
	spindling cm	brooming cm	leading stem cm	panicle cm	length cm	width cm	
Albena mean±SEM	63.4±1.2	107.2±1.3	138.6±1.1	24.0±0.7	15.8±0.6	0.68±0.02	78.8±5.1
range	15	19	15	9	7	0.2	68
VC%	7.40	4.78	2.99	10.83	13.95	10.77	25.12
Barolex mean±SEM	55.6±1.0	99.5±1.4	124.4±1.7	24.5±0.6	17.4±0.7	0.73±0.01	77.8±2.9
range	13	19	19	8	9	0.2	41
VC%	6.65	5.43	5.40	8.81	15.51	6.30	14.40
Belfine mean±SEM	55.5±0.9	99.8±1.0	123.2±1.5	23.4±0.5	17.5±0.6	0.67±0.01	81.4±4.6
range	12	13	16	6	7	0.1	52
VC%	6.45	4.00	4.63	9.06	12.77	5.59	21.88
A7E0011 mean±SEM	61.6±0.8	108.5±1.6	135.4±2.1	25.1±0.7	17.7±0.5	0.7±0.01	85.6±3.5
range	9	25	24	10	7	0.1	49
VC%	4.86	5.73	5.90	11.34	10.73	4.93	15.73
A6E0035 mean±SEM	59.4±1.0	108.1±1.3	138.2±1.2	28.4±0.5	16.9±0.6	0.71±0.01	90.0±4.6
range	15	15	16	6	7	0.2	56
VC%	6.27	4.81	3.44	6.30	12.75	6.48	19.72
A6E0036 mean±SEM	64.4±0.7	112.9±1.0	141.2±1.0	26.9±0.4	16.6±0.4	0.65±0.01	93.6±5.3
range	10	14	15	5	4	0.2	64
VC%	4.18	3.40	2.68	5.79	10.27	7.90	22.04
A6E0037 mean±SEM	58.4±0.8	107.1±1.2	133.4±1.9	24.7±0.6	17.0±0.4	0.71±0.01	86.6±4.6
range	11	16	26	8	5	0.1	65
VC%	5.53	4.17	5.40	8.78	9.11	4.91	20.68
A6E0042 mean±SEM	59.2±0.7	109.4±0.9	139.6±0.9	27.3±0.5	17.6±0.5	0.73±0.01	82.8±5.4
range	9	10	9	6	6	0.1	63
VC%	4.40	3.31	2.48	6.44	11.08	4.96	25.37
92E0045 mean±SEM	52.2±2.1	97.9±0.6	122.7±0.8	24.7±0.5	18.3±0.6	0.74±0.01	82.0±3.1
range	9	8	13	7	7	0.1	34
VC%	5.72	2.43	2.66	8.11	12.02	5.70	14.53

Analysis of the results (Table 2) was showed that in the three years of study of ecotypes and varieties of species *Festuca pratensis*, the trait height in the stage of spindling fluctuated between 41.6 cm and 65.0 cm. The variation coefficients reflecting the degree of variability both within and between the accessions were from very low to medium. Very low values was ranged from VC=5.30% of variety Cosmolit to VC=7.06% at ecotype Pamporovo (98E0008), low - from VC=7.31% of variety Preval to VC =11.30% in ecotype Kjustendil (98E0020) and only ecotype Orizare (A7E0005) was observed medium coefficient of variation VC=14.12%. The height of the grass composition stage of brooming was ranged from 75.1 cm to 92.6 cm. In stage of brooming were observed very low and low values of the coefficients of variation in ecotypes and varieties. Very low

values were in the range of VC=2.99% of ecotype Rila Monastery (98E0012) to VC=7.02%. ecotype in Orizare (A7E0005), low - from VC=7.38% at ecotype Grandval (A600215) to VC=11.49% for ecotype Kjustendil (98E0020). In the trait length of leading stem, it was from 90.9 cm to 115.8 cm. There was a very low variability of the accessions from VC=3.81% of ecotype Rila Monastery (98E0012) to VC=6.78% of ecotype Brandösch (A8141/06), except ecotype Kjustendil (98E0020), the value of the coefficient of variation was low - VC=7.32%. The length of the panicle had values of the variation coefficients from low to high. Low values were in the range of VC=7.95% at ecotype Maritza (A7E0008) to VC=10.69% for variety Cosmolit, medium - from VC=12.31% in ecotype Orizare (A7E0005) to VC=17.03% in ecotype Grandval (A600215).

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**Table 2.** Structural elements of productivity at *Festuca pratensis*, average values for years of study (2010-2012).

Accession	Height in stage		Length		Flag leaf		number of culms per plant
	spindling cm	brooming cm	leading stem cm	panicle cm	length cm	width cm	
A5E0001	51.2±1.5	82.9±2.8	103.0±2.0	21.5±0.9	14.7±0.7	0.44±0.02	70.7±5.7
mean±SEM	15	29	24	9	7	0.1	46
range	9.02	10.60	6.17	12.50	15.89	10.90	23.51
VC%							
A7E0005	51.4±2.3	83.3±1.8	105.9±1.6	23.1±0.9	15.4±0.7	0.49±0.02	113.6±6.7
mean±SEM	20	19	18	8	7	0.2	62
range	14.12	7.02	4.77	12.31	14.24	12.54	18.55
VC%							
A7E0008	52.3±0.9	84.2±1.4	115.2±1.8	23.4±0.6	17.3±0.8	0.53±0.01	84.3±8.61
mean±SEM	8	14	17	6	8	0.1	83
range	5.32	5.45	4.99	7.95	15.11	5.02	32.32
VC%							
98E0012	45.6±1.4	82.1±0.75	108.1±1.30	21.2±0.8	16.0±0.5	0.52±0.01	60.7±4.71
mean±SEM	13	7	11	7	5	0.1	41
range	9.80	2.99	3.81	12.68	9.66	6.72	24.56
VC%							
98E0020	49.4±1.8	85.1±3.1	109.1±2.5	22.1±1.4	15.5±0.5	0.51±0.01	59.3±5.04
mean±SEM	17	26	22	13	5	0.1	44
range	11.30	11.49	7.32	20.10	10.73	4.13	26.90
VC%							
98E0008	54.4±1.2	88.8±2.5	112.8±1.9	23.1±1.1	18.5±0.9	0.53±0.01	60.7±3.1
mean±SEM	12	24	20	8	10	0.1	31
range	7.06	9.01	5.37	14.90	14.97	7.96	16.18
VC%							
A6000215	41.6±1.1	75.1±1.8	90.9±1.8	18.4±1.0	13.7±0.50	0.52±0.01	62.2±3.2
mean±SEM	13	19	20	10	5	0.1	33
range	8.61	7.38	6.40	17.03	11.97	6.72	16.49
VC%							
A8214/03	65.0±1.6	92.6±2.9	115.8±2.5	21.9±0.6	17.2±0.8	0.57±0.01	60.9±2.3
mean±SEM	16	25	19	6	8	0.1	23
range	7.84	10.00	6.74	9.35	14.45	7.29	11.76
VC							
A8131/06	59.1±2.1	91.7±1.7	115.0±1.7	21.1±0.9	16.5±0.60	0.52±0.01	50.8±1.7
mean±SEM	17	17	16	8	7	0.1	16
range	11.04	5.92	4.66	12.79	11.94	6.72	10.65
VC%							
A8141/06	49.2±1.4	87.6±1.6	105.1±2.3	20.4±0.9	16.7±1.3	0.49±0.02	43.7±2.6
mean±SEM	16	19	25	9	14	0.2	22
range	9.23	5.65	6.78	13.26	25.10	10.54	19.15
VC%							
Preval	49.4±1.1	80.7±1.3	104.5±1.9	21.2±1.0	14.7±0.5	0.50±0.01	75.7±7.9
mean±SEM	12	13	17	11	4	0.1	74
range	7.31	5.01	5.60	14.50	10.29	6.66	32.88
VC%							
Cosmolit	54.6±0.9	84.7±1.7	112.3±1.4	21.6±0.7	16.2±0.5	0.52±0.01	75.8±5.8
mean±SEM	9	18	15	10	6	0.1	58
range	5.30	6.27	3.97	10.69	10.33	8.11	24.33
VC%							

High value was observed only in ecotype Kjustendil (98E0020) with a variation coefficient VC = 20.10%.

There were measured the shortest panicle 18.4 cm, and the longest – 23.4 cm. The length of the flag leaf fluctuated

between 13.7 cm and 18.5 cm. The variation of the trait was showed relatively low levels of VC=9.66% at ecotype Rila Monastery (98E0012) to VC=11.97% in ecotype Grandval (A6000215), medium- from VC=14.24% in ecotype Orizare

(A7E0005) to VC=15.89% in ecotype Detelina (A5E0001) and only ecotype Brandösch (A8141/06) it was high value - VC=25.10%. The width of flag leaf was ranged from 0.44 cm to 0.57 cm. This was a sign of very low variability of VC=4.13% at ecotype Kjustendil (98E0020) to VC=6.72% in ecotypes Rila Monastery (98E0012), Grandval (A6000215) and Fahy (A8131/06), with low - from VC=7.29% at ecotype Marbach (A8214/03) to VC=10.90% in ecotype Detelina (A5E0001) and only ecotype Orizare (A7E0005) with the medium VC=12.54%. The number of culms pre plant in individual accessions was also unstable scar and varied most of the measured traits. With low variation within the population were Swiss ecotypes Fahy ((A8131/06), VC=10.65%) and Marbach ((A8214/03), VC=11.76%), with a medium - from VC=16.18 ecotype% in Pamporovo (98E0008) to VC=19.15% in ecotype Brandösch (A8141/06) and high variability - from VC=23.51% in ecotype Detelina (A5E0001) to VC=32.88% in variety Preval. The Swiss ecotype Marbach (A8214/03) was characterized by the high grass cover stages of spindling (65.0 cm) and brooming (92.6 cm), the highest leading stem (115.8 cm) and widest flag leaf (0.57 cm). The Swiss ecotype Grandval (A600215) had the lowest grass cover stages of spindling (41.6 cm) and brooming (75.1 cm), the lowest leading stem (90.9 cm), the shortest panicle (18.4 cm) and the shortest flag leaf (13.7 cm). The lowest number of culms per plant had the Swiss ecotype Brandösch (A8141/06) – 43.7. The Bulgarian ecotypes were occupied an intermediate position values in some of the studied traits. Compared with the other Bulgarian accessions, ecotype Rila Monastery (98E0012) had the lowest grass cover stages of spindling (45.6 cm) and brooming (82.1 cm), and the shortest panicle (21.2 cm). With the shortest leading stem (103.0 cm) and with the shortest (14.7 cm) and most narrow (0.44 cm) flag leaf was characterized ecotype Detelina (A5E0001). The lowest number of culms per plant had ecotype Kjustendil (98E0020) – 59.3. Ecotype Pamporovo (98E0008) was the highest in the stages of spindling (54.4 cm) and brooming (88.8 cm). It had the longest flag leaf (18.5 cm), compared to all involved in the study accessions. The longest leading stem (115.2 cm) had ecotype Maritza (A7E0008), that was measured the longest panicle (23.4 cm), compared to all accessions. Equal width flag leaf showed both ecotypes (Pamporovo and Maritza) – 0.53 cm. The largest number of culms per plant had ecotype Orizare (A7E0005), compared to all involved in the study accessions – 113.6.

### Correlations

Using correlation analysis were established links between bio-morphological and economic traits in both species of fescue. In *Festuca arundinacea*, the three-year period of study, the correlation coefficient ( $r$ ) was in the range of 0.67

to 0.99, which is considered a strong correlation (Dimova & Marinkov, 1999) (Table 3). The annual yield of dry biomass (hay yield) had a proven positive correlation of height in the stage of spindling ( $r=0.813^{**}$ ) and negatively with the length of flag leaf ( $r=-0.802^{**}$ ) and the number of days to stage of brooming ( $r=-0.752^*$ ). The height in the stage of spindling had a proven positive correlation with height in the stage of brooming ( $r=0.896^{**}$ ) and the length of the leading stem ( $r=0.887^{**}$ ), but negatively with the number of days to stage of brooming ( $r=-0.898^{**}$ ) and the length of the flag leaf ( $r=-0.750^*$ ). The height in the stage of brooming had proven positive correlation with the length of the leading stem ( $r=0.967^{**}$ ) and the number of culms per plant ( $r=0.690^*$ ), but negatively with the number of days to stage of brooming ( $r=-0.903^{**}$ ). The length of the leading stem had proven negative correlation with the number of days to stage of brooming ( $r=-0.905^{**}$ ). The length of panicle had proven positive depending on the number of culms per plant ( $r=0.673^*$ ). Both growth habit in the stages spindling and brooming had proven positive correlation ( $r=0.894^{**}$ ). The analysis of the results was showed that at the species *Festuca pratensis* for the three year period of the study (Table 4), the height in the stage of spindling was demonstrated a strong positive correlation with the height in the stage of brooming ( $r=0.877^{**}$ ) and the length of the leading stem ( $r=0.794^{**}$ ) and in a medium positive depending on the length of flag leaf ( $r=0.610^*$ ). The height in the stage of brooming was demonstrated strong positive correlation with the lengths of the leading stem ( $r=0.823^{**}$ ) and flag leaf ( $r=0.776^{**}$ ). The length of the leading stem had a proven strong positive correlation with the lengths of panicle ( $r=0.719^{**}$ ) and flag leaf ( $r=0.814^{**}$ ). The length of the panicle had medium positive correlation with the length of flag leaf ( $r=0.608^*$ ). Both growth habit had strong positive correlation ( $r=0.953^{**}$ ). In the species *Festuca pratensis* were not established proven correlations between the annual yield of dry biomass (hay yield) and structural elements of productivity. There were medium positive between yield and traits: lengths of the leading stem ( $r=0.385$ ) and panicle ( $r=0.433$ ), and number of culms per plant ( $r=0.415$ ). There were medium negative correlations between yield and traits: number of days to stage of brooming ( $r=-0.562$ ), growth habit in the stages of spindling ( $r=-0.402$ ) and brooming ( $r=-0.513$ ). Other bio-morphological traits had shown poor correlation with yield.

### DISCUSSION

In the perennial cross-pollinating forage grass crops, devising and implementing breeding programs require



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**Table 3.** Correlation coefficients between study bio-morphological and economic traits (annual production of dry biomass - hay) at *Festuca arundinacea*, 2010-2012.

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	
1,000	<b>**0,896</b>	<b>**0,887</b>	0,329	<b>*-0,750</b>	-0,666	-0,469	<b>**0,898</b>	-0,397	0,251	<b>**0,813</b>	<b>X1</b>
	1,000	<b>**0,967</b>	0,617	-0,530	-0,458	<b>*0,690</b>	<b>**0,903</b>	0,256	0,224	0,564	<b>X2</b>
		1,000	0,648	-0,598	-0,371	0,568	<b>**0,905</b>	0,129	0,033	0,661	<b>X3</b>
			1,000	-0,054	0,078	<b>*0,673</b>	-0,379	-0,297	-0,241	-0,014	<b>X4</b>
				1,000	0,633	-0,159	0,641	-0,047	0,170	<b>**0,802</b>	<b>X5</b>
					1,000	-0,406	0,427	-0,260	-0,272	-0,515	<b>X6</b>
						1,000	-0,533	-0,008	0,255	-0,022	<b>X7</b>
							1,000	-0,355	-0,296	<b>*0,752</b>	<b>X8</b>
								1,000	<b>**0,894</b>	0,341	<b>X9</b>
									1,000	0,078	<b>X10</b>
										1,000	<b>X11</b>

X1 - height in stage of spindling; X2 - height in stage of brooming; X3 – length of leading stem; X4 – length of panicle; X5 - length flag leaf; X6 - width flag leaf; X7 - number of culms per plant; X8 - number of days to stage of brooming; X9 - growth habit in stage of spindling - visual assessment; X10 - growth habit in stage of brooming - visual assessment; X11 - annual yield of dry biomass (hay yield).

**Table 4.** Correlation coefficients between study bio-morphological and economic traits (annual production of dry biomass - hay) at *Festuca pratensis*, 2010-2012.

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	
1,000	<b>**0,877</b>	<b>**0,794</b>	0,469	<b>*0,610</b>	0,414	-0,048	-0,576	-0,023	0,015	0,296	<b>X1</b>
	1,000	<b>**0,823</b>	0,446	<b>**0,776</b>	0,364	-0,324	-0,409	0,051	0,045	0,175	<b>X2</b>
		1,000	<b>**0,719</b>	<b>**0,814</b>	0,453	-0,027	-0,224	0,059	-0,006	0,385	<b>X3</b>
			1,000	<b>*0,608</b>	0,071	0,505	0,032	0,457	0,339	0,433	<b>X4</b>
				1,000	0,498	-0,206	-0,003	0,273	0,182	0,006	<b>X5</b>
					1,000	-0,199	-0,025	0,247	0,273	-0,305	<b>X6</b>
						1,000	-0,049	0,344	0,274	0,415	<b>X7</b>
							1,000	0,363	0,365	-0,562	<b>X8</b>
								1,000	<b>**0,953</b>	-0,402	<b>X9</b>
									1,000	-0,513	<b>X10</b>
										1,000	<b>X11</b>

\*\*Correlation is significant at the 0,01 level, \* Correlation is significant at the 0,05 level

X1 - height in stage of spindling; X2 - height in stage of brooming; X3 – length of leading stem; X4 – length of panicle; X5 - length flag leaf; X6 - width flag leaf; X7 - number of culms per plant; X8 - number of days to stage of brooming; X9 - growth habit in stage of spindling - visual assessment; X10 - growth habit in stage of brooming - visual assessment; X11 - annual yield of dry biomass (hay yield).

information as to the size and nature of the genetic variation for the various characteristics and their genetic relationship (Majidi et al., 2009). In the present study, the results gave possibilities for enrichment of information in ex situ collections of ecotypes of *Festuca pratensis* and *Festuca arundinacea*, collectors of natural habitats and the possibility to distinguish valuable genotypes in adaptability that can be successfully used in the breeding improvement work.

In the species *Festuca arundinacea* the traits height in the stages of spindling and brooming, and length of leading stem were characterized by a very low degree of variability both within and between the studied ecotypes and varieties. The traits of panicle length, length and width of flag leaf showed a wide range of variation values from very low to medium. Compared with all tested traits for both species of fescue, the trait number of culms per plant was distinguished with the highest degree of variability within and between ecotypes and varieties.

In the species *Festuca pratensis*, the variation coefficients of trait height in the stage of spindling were from very low to medium. The traits of stage of brooming and length of leading were observed very low and low values of the coefficients of variation. The length of the panicle, length of the flag leaf and number of culms per plant had values of the variation coefficients from low to high. The width of flag leaf showed a wide range of variation values from very low to medium.

In the species *Festuca arundinacea*, the annual hay yield had a proven strong positive correlation of height in the stage of spindling and strong negatively with the length of flag leaf and the number of days to stage of brooming.

In the species *Festuca pratensis* were not established proven correlations between the annual hay yield and structural elements of productivity.

Except as forage resources, low accessions are suitable for the usage of a component in grass mixtures to create green areas and parks.

Expanding the usability of high accessions may include cultivation as a bio energy resources.

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