NEW CULTIVARS OF ARISTATE RYEGRASS (*LOLIUM MULTIFLORUM* LAM.) AND HYBRID RYEGRASS (*LOLIUM HYBRIDUM* HAUSSKN.) RELEASED AT A.R.D.I. FUNDULEA

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ABSTRACT

Iulia – Italian ryegrass cultivar and Florin – hybrid ryegrass cultivar were registered in 1998 and they are tetraploid synthetic cultivars obtained by the polycross method. On an average, in five years and four stations located in different ecological areas, both cultivars achieved 12.4 t dry matter/ha at the first two cuttings (C_1+C_2), overyielding the Arina control with 11.7% and 17.0–17.3 t dry matter/ha during the whole vegetation period (3–5 cuttings), overyielding the same control with 10.4–12.4%. High nutritive value (70.6–72.2 digestibility coefficient, 0.95–0.98 nutritive units, 1, 325–14,000 kg calories net energy) is a main quality indicator which characterizes Iulia and Florin cultivars. Iulia is an early cultivar and Florin is a semiearly one. Both cultivars showed good adaptability to biotic and abiotic environmental conditions, very good resistance to snow mould (*Fusarium nivale)* as well as to rusts (*Puccinia* spp.) and frost.

Key words: aristate ryegrass, hybrid ryegrass, synthetical reygrass.

INTRODUCTION

The aristate ryegrass (*Lolium multiflorum* Lam.) and the hybrid ryegrass (*Lolium hybridum* Hausskn.) are forage crops which offer to farmers, in spring, the earliest quantitatively and qualitatively significant fodder. The breeding works of these species have in view the releasing of cultivars with an increased fodder yield, of a very good quality and with a good adaptability to the biotic and abiotic environmental conditions.

The introduction of polyploidy (tetraploidy) and the utilization of interspecific crossings (*Lolium multiflorum x Lolium perenne)* allowed the variability increasing for some traits useful in breeding process. The ryegrasses are dyploid species, but, by the treatment with colchicine, tetraploid forms were obtained, which entered in composition of different tetraploid cultivars.

The tetraploid cultivars achieve higher green mass yields in comparison with diploid ones and have a superior quality and a better resistance to diseases (Jones, 1991; Humphreys, 1991; Posselt, 1991; Reheul and Baert, 1991; Schitea, 1992). The aristate ryegrass, both diploid and tetraploid, presents a reduced variability for some traits such as: latency, persistence, regeneration after cutting in the second part of summer, reason for utilization of aristate ryegrass x perennial ryegrass (*Lolium multiflorum* x *Lolium perenne)* interspecific crossing.

The joining in the same genotype of the complementary useful traits from the two species was studied:

HYBRID RYEGRASS
(*Lolium hybridum* Hausskn.)

ARISTATE RYEGRASS	PERENNIAL RYEGRASS
(*Lolium multiflorum* Lam.)	(*Lolium perenne* L.)
– yield – quality	– latency; – regeneration after cutting in the second part of summer; – resistance to snow mould (*Fusarium nivale)*; - resistance to frost.

– diploid species x = 7, 2x = 14, 4x = 28 – artificial tetraploids;
– crossing at diploid level;
– crossing at tetraploid level;
– crossing at diploid -tetraploid level.

In Romania, the breeding works with aristate ryegrass started in 1968 and the following cultivars were registered: Raiar (1978), Tetraiar (1981) (Kellner et al., 1981), Arina (1987)

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(Schitea and Varga, 1988), Anca (1993), Venus (1996) (Schitea and Varga, 1997), Iulia (1999). The breeding works with hybrid ryegrass started in 1982, and the following cultivars were registered: Luky (1991), Zefir (1996), (Schitea, 1985; Schitea and Varga,1987; Schitea, 1992; Schitea and Varga, 1993, 1997; Varga et al., 1998) and Florin (1999).

The paper presents the main yielding traits, quality and adaptability of Iulia aristate ryegrass and Florin hybrid ryegrass.

MATERIALS AND METHODS

Both Iulia aristate ryegrass and Florin hybrid ryegrass are synthetic, tetraploid cultivars, released by the polycross method.

The cultivars were tested during five years (1993–1997) at A.R.D.I. Fundulea, A.R.D.S. Caracal, A.R.D.S. Secuieni under irrigation and at A.R.D.S. Târgu Mures, under dryland conditions.

Climatically, the years 1993–1997 were very different, especially as regards the rainfall, which influenced the yield level.

The experiments were performed in randomized blocks, in four repetitions, with harvesting area of 10.0 m2 from 15.0 m2 cultivated area.

RESULTS AND DISCUSSION

At the level of the whole ecological network, Florin hybrid ryegrass achieved fodder yields superior to Arina control cultivar, as follows:

- mean yield of five years and four stations was of 12.4 t dry matter/ha at the first two cuttings, with a gain of 11.7%, statistically ensured at distinctly significant level and of 17.3 t dry matter/ha during the whole vegetation period, with a gain of 12.4%, distinctly significant vs. the same Arina control cultivar;
- maximum yield, by 17.8 t dry matter/ha, was achieved at the first two cuttings, in 1995 at A.R.D.I. Fundulea, with a gain of 18.7% vs. the Arina control cultivar and 22.9 t dry matter/ha, during the whole vegetation period at A.R.D.S. Secuieni (Table 1).

At the level of the whole ecological network, Iulia aristate ryegrass cultivar achieved fodder yields superior to the Arina control cultivar, as

Table 1. Fodder yield achieved by Florin and Iulia cultivars in ecological network

Cultivars \ Years	1993	1994	1995	1996	1997	Average t/ha	Average %	Signif.
Fundulea								
LH-Florin	11.9	11.9	17.8	14.4	12.9	13.8	107.8	*
LM-Iulia	13.1	11.4	14.7	15.2	13.4	13.6	106.3	
LH-Luky	11.8	11.6	16.4	13.6	13.8	13.4	104.7	
LM-Anca	12.3	12.1	15.3	14.7	14.0	13.7	107.0	*
LM-Arina (control)	11.3	11.4	15.0	13.3	13.0	12.8	100.0	
LSD 5%	1.2	0.5	1.0	1.1	0.6	0.9	7.0	
Caracal								
LH-Florin	10.1	13.4	15.2	13.5	11.8	12.8	113.3	**
LM-Iulia	10.1	14.5	14.8	13.5	10.9	12.8	113.3	**
LH-Luky	11.0	13.7	15.0	11.7	10.9	12.5	110.0	*
LM-Anca	8.5	13.0	14.0	11.2	9.8	11.3	100.0	
LM-Arina (control)	9.1	13.0	13.3	10.6	10.7	11.3	100.0	
LSD 5%	0.6	1.2	1.0	0.6	0.7	0.8	7.0	
Secuieni								
LH-Florin	13.3	12.4	12.7	7.5	13.1	11.8	116.8	**
LM-Iulia	14.0	13.4	15.4	7.5	12.8	12.6	124.8	***
LH-Luky	13.0	10.1	13.0	8.0	13.0	11.4	112.9	**
LM-Anca	13.9	11.5	13.9	7.0	12.9	11.8	116.8	**
LM-Arina (control)	9.4	11.6	11.5	6.4	11.7	10.1	100.0	
LSD 5%	1.0	0.5	0.5	0.7	0.3	0.6	5.9	
Târgu Mureº								
LH-Florin	6.4	13.1	13.0	7.4	15.4	11.1	107.8	*
LM-Iulia	7.7	11.5	11.9	6.2	15.4	10.5	101.9	
LH-Luky	7.6	11.5	14.0	6.3	17.1	11.3	109.7	*
LM-Anca	7.3	11.5	12.9	7.5	16.8	11.2	108.7	*
LM-Arina (control)	7.0	11.5	11.6	6.6	14.8	10.3	100.0	
LSD 5%	0.5	1.0	0.7	0.7	1.2	0.8	7.8	

follows:

• mean yield of five years and four stations was of 12.4 t dry matter/ha at the first two cuttings, with a gain of 11.7%, statistically ensured at distinctly significant level and of 17.0 t dry matter/ha during the whole vegetation period, with a gain of 10.4%, distinctly significant vs. the same Arina control cultivar (Tables 2 and 3);

• maximum yield, by 15.4 t dry matter/ha, was achieved at the first two cuttings, in 1995 at A.R.D.S. Secuieni, with a gain of 33.9% vs. the Arina control cultivar and 26 t dry matter/ha, during the whole vegetation period at A.R.D.S. Secuieni, too;

Florin and Iulia cultivars offer a fodder with a very good nutritive value (Table 4):

• 70.6–72.2% digestibility coefficient, exceeding the Arina cultivar with 7.6–10.1%, average on five years;

• 1325–1388 kcalories net energy, exceeding the Arina control cultivar with 8.7–13.9%;

• 0.95–0.98 nutritive units, exceeding the same control cultivar with 10.4–14.0%;

Table 2. Fodder yield achieved by Florin and Iulia cultivars in different ecological areas, 1993–1997 average (first + second cutting)

Cultivar	Dry matter, t/ha				Average		Signif.
	Fundulea	Caracal	Secuieni	Târgu Mureº	t/ha	%	
LH-Florin	13.8	12.8	11.8	11.0	12.4	111.7	*
LM-Iulia	13.6	12.7	12.6	10.6	12.4	111.7	*
LH-Luky	13.5	12.6	11.4	11.3	12.2	109.9	*
LM-Anca	13.7	11.3	11.8	11.2	12.0	108.1	
LM-Arina (control)	12.8	11.3	10.1	10.3	11.1	100.0	
LSD 5%	0.9	0.8	0.6	0.8	0.8	7.2	

LM = *Lolium multiflorum*
LH = *Lolium hybridum*

Table 3. Fodder yield achieved by Florin and Iulia cultivars in a hilly region, 1993–1997 average

Cultivars	Dry matter total yield				Average		Signif.
	Secuieni		Târgu Mureº				
	t/ha	%	t/ha	%	t/ha	%	
LH-Florin	19.8	113.8	14.8	111.3	17.3	112.4	**
LM-Iulia	20.2	116.1	13.8	103.8	17.0	110.0	**
LH-Luky	18.8	108.1	14.4	108.3	16.6	107.8	
Lm-Anca	19.3	111.0	14.6	109.8	17.0	110.4	**
Lm-Arina (control)	17.4	100.0	13.3	100.0	15.4	100.0	
LSD 5%	1.0	5.7	1.5	12.8	1.3	8.4	

LM = *Lolium multiflorum*
LH = *Lolium hybridum*

Table 4. Nutritive value of fodder obtained by Iulia and Florin cultivars

Years / Cultivars	1993	1994	1995	1996	1997	Average	
						t/ha	%
Digestibility coefficient							
LH-Florin	74	68	75	70	74	72.2	110.1
LM- Iulia	72	68	72	70	71	70.6	107.6
LH-Luky	67	65	74	72	75	70.6	107.6
LM-Anca	68	69	69	70	71	69.4	105.8
LM-Arina	63	60	60	68	67	65.6	100.0
Net energy							
LH-Florin	1474	1226	1522	1300	1419	1388	113.9
LM-Iulia	1426	1262	1412	1412	1308	1325	108.7
LH-Luky	1236	1236	1471	1471	1434	1353	111.0
LM-Anca	1280	1319	1318	1318	1324	1312	107.6
LM-Arina	1162	1073	1349	1349	1231	1219	100.0
Nutritive units							
LH-Florin	1.04	0.87	1.08	0.91	1.00	0.98	114.0
Lm-Iulia	1.02	0.89	1.00	0.92	0.93	0.95	110.4
LH-Luky	0.88	0.86	1.04	0.97	1.01	0.95	110.4
LM-Anca	0.91	0.93	0.93	0.92	0.94	0.93	108.1
LM-Arina	0.82	0.76	0.95	0.89	0.87	0.86	100.0

Table 5. Performances of Florin and Iulia cultivars, mean values of four stations and five years (1993–1997) (first + second cutting)

Cultivar	Dry matter		Nutritive units		
	t/ha	%	NU	NU/ha	%
LH-Florin	12.4	111.7	0.98	12,152	127.3
LM-Iulia	12.4	111.7	0.95	11,780	123.4
LH-Luky	12.2	109.9	0.95	11,590	121.4
LM-Anca	12.0	108.1	0.93	11,160	116.9
LM-Arina	11.1	100.0	0.86	9,546	100.0

LM = *Lolium multiflorum*; LH = *Lolium hybridum*

Table 6. Main traits of the new aristate ryegrass and hybrid ryegrass cultivars

Specification	LM–Arina	LM–Anca	LH–Luky	LH–Florin	LM–Iulia
Vigour (notes)	2	2.0	2.5	2.5	2.0
Regeneration ability (notes)	3	2.5	2.5	2.0	2.0
Frost resistance (notes)	1.5	2.0	1.0	2.0	2.0
Resistance to snow mould (notes)	3	2.5	2.0	2.0	2.0
Resistance to rusts (notes)	2.3	2.0	2.5	2.0	2.0
Precocity (± days vs. Arina)	control	+4.0	+7.0	+5.0	+4.0

The genetical progress achieved by Florin and Iulia cultivars is clearly emphasized when their value is expressed by the nutritive unit quantity /surface unit (Table 5):

• Florin cultivar achieved, on an average of five years and four stations, 12,152 NU/ha at the first two cuttings, with a gain of 27.3% vs. Arina cultivar, 10.4% vs. Anca cultivar and 5.9% vs. Luky cultivar;

• Iulia cultivar achieved, during 1993–1997, a mean yield of 11,780 NU/ha at the first two cuttings, with a gain of 23.4% vs. Arina cultivar and 6% vs. Anca cultivar.

Phenotypically, both Iulia aristate ryegrass and Florin hybrid ryegrass are uniform, but, genotypically, they are diverse in order to prevent the genetical vulnerability. Iulia cultivar consists of ten clones and Florin cultivar is close to a multilinear type. Both cultivars have in common the adaptability to the abiotic and biotic environmental conditions (Table 6), a very good regeneration ability, quoted by 2, a very good resistance to frost (notes 1-2) and to snow mould and rusts, a high resistance degree superior to Arina control cultivar.

The heading time of both cultivars is with 4-7 days later than of Arina cultivar, which allows the cultivation in the same farm and their exploitation in a green conveyer.

CONCLUSIONS

Iulia aristate ryegrass and Florin hybrid ryegrass cultivars, registered in 1999, have marked an important progress in breeding of these two ryegrass species.

The good adaptability of the new cultivars to the biotic and abiotic environmental conditions have resulted in increased and relatively constant fodder yields (12.4 t dry matter/ha) at the first two cuttings, or 11,780–12,150 nutritive units/ha.

The new cultivars bring an important progress as regards the fodder nutritive value, over 70% digestibility coefficient, 0.95-0.98 nutritive units and 1,325–1,388 kcalories net energy.

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Table 1. Reproduction ability of the *E. integriceps* recent generations, as compared with multiannual average (1970-2000) and with the specific years: favourable (1986) and unfavourable (1989).

Natural generation of *E. integriceps*	Prolificacy (egg/female)		
	under field conditions	under controlled conditions	
		average	maximum/female
1970-2000	40.2	57.9	311
1986	56.3	71.3	298
1989	18.8	27.1	87
1996	47.1	69.9	302
1997	46.6	68.6	197
1998	37.5	53.8	209
1999	38.8	54.5	219
2000	39.3	55.7	208

Table 2. Prolificacy level of some *E. integriceps* populations (fertile females), from generations with different fat body levels, collected from the field, at the beginning of migration and studied under controlled conditions.

Fat body	Generation	Prolificacy (egg/female)	
		average	maximum
23.4	1989-1990	32.1	97
22.5	1972-1973	33.4	127
26.5	1971-1972	46.4	148
27.9	1977-1978	67.5	186
28.0	1984-1985	83.6	210
29.7	1985-1986	95.3	234
29.8	1994-1995	104.7	246

Table 3. Level and stages of fat body diminution at *E. integriceps* (multigeneration average).

Stages	Fat body level		Diminution	
	limits	average	limits	average
Diapause beginning	33.03-37.58	35.69	0	0

End of diapause	21.97-27.64	25.43	24.57-36.33	27.39
End of oviposition	8.12-10.39	8.78	66.50-78.69	74.43

Table 4. Mortality registered at the *Eurygaster integriceps* populations, during diapause in different generations, from Romanian area

E. integriceps natural population	Mortality (%)	
	Limits in counties	Total area (mean)
2000-2001	4.6-35.7	8.7
1995-1996	3.7-36.4	10.2
2001-2002	5.1-32.3	12.7
1985-1988	3.8-41.2	14.8
1999-2000	4.8-97.6	24.5
1973-1974	11.6-85.0	39.5
1988-1989	17.5-68.4	48.2

Table 5. Fat body value at *Eurygaster integriceps* populations, established on female groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population		Fat body (%)	
	limits	average	limits	average
below 0.110	3.7-7.7	5.6	26.2-26.6	26.4
0.111-0.118	7.6-23.1	13.3	26.5-28.8	28.7
0.119-0.126	15.9-24.7	19.7	32.8-33.5	33.6
0.127-0.134	32.5-34.8	33.7	34.9-36.4	35.4
over 0.145	22.4-30.8	28.6	35.7-39.8	38.7

Table 6. Fat body value at *Eurygaster integriceps* populations, established on male groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population		Fat body (%)	
	limits	average	limits	average
below 0.105	7.0-19.7	12.3	25.3-26.7	26.2
0.106-0.113	16.8-19.9	17.3	27.2-28.5	27.7
0.114-0.121	20.3-29.5	23.7	29.4-33.8	31.5
0.122-0.129	19.2-32.7	28.5	31.2-35.5	32.6
over 0.130	15.5-23.9	19.4	31.4-36.6	33.8

Table 7. Mortality (%) registered at *Eurygaster integriceps* female populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.4	17-22	20.4	59-64	61.3
28.7	13-15	12.9	43-54	47.6
33.6	9-17	12.5	41-52	46.2
35.4	4-11	6.6	29-34	33.6
38.7	4-7	5.8	26-35	30.9

Table 8. Mortality (%) registered at *Eurygaster integriceps* male populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.2	22-31	22.6	62-71	67.1
27.7	11-24	20.4	53-62	57.4
31.5	12-19	14.3	39-47	44.0
32.6	9-18	12.7	30-44	37.6
33.8	5-14	9.1	24-45	32.3

Table 9. Sterility and prolificacy registered at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Females sterility (%)		Mean prolificacy (egg/female)		
	limits	aver-age	limits	aver-age	maxi-mum
26.4	100	100	0	0	0
28.7	60-72	63.5	4.1-6.6	5.4	42
33.6	54-63	57.3	16.2-22.8	19.5	78
35.4	35-44	39.1	26.4-33.1	30.3	135
38.7	25-32	29.8	38.9-51.7	45.8	194

Table 10. Multiplication index at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Multiplication index (egg/female)	
	limits	average
26.4	0	0
28.7	0.37–2.47	1.54
33.6	4.54–9.62	6.95
35.4	28.57–40.18	35.22
38.7	49.38–64.83	56.47