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THE VARIABILITY OF THE MORPHOLOGICAL TRAITS OF TETRAPLOID RED CLOVER CULTIVARS STUDIED IN CLUJ-NAPOCA ENVIRONMENTAL CONDITIONS

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Abstract. The valuable characteristics of red clover (productivity, resistance to biotic and non-biotic factors, as well as quality) depend on a series of morphological and physiological traits which, in turn, are influenced by genetic and environmental factors. The purpose of our research, carried out at Cluj-Napoca, was to study the variability of the morphological and physiological traits of 22 tetraploid red clover cultivars, as well as their impact on productivity and the quality of the forage. In the breeding programmes carried out at Cluj-Napoca, in order to improve the morphological traits responsible for green matter yields, it is recommended that cultivars from Central and Western Europe should be used (subvar. intermedium).Within this sub-variety, the Temara cultivar originating from Switzerland was particularly noticed, because of its increased earliness and good after-cut regeneration capacity. The late North-European cultivars (var. serotinum) are valuable for increasing the leaf percentage and cold resistance. It was noticed that cold resistance is a characteristic of this variety and that there is no obvious variability among the cultivars from that area.

Key words: red clover, tetraploid cultivars, morphological traits, variability

INTRODUCTION

Red clover (*Trifolium pratense L.*), as an allogame plant, is characterized by high variability because of its heterozygosity, fixed along time by repeated open crossing. Savatti believes that the number of possible combinations in the case of individual red clover plants is practically unlimited, but the frequency of the genes inside a population is the same for coming generations as long as these are under constant pressure coming from the selection process (Savatti, 1973). If for a specific generation there appear certain factors which influence the frequency of the genes (mutations, migration, genetic drifting etc.) there will occur modifications in the genetic structure of the populations, and therefore generations which are different from their parents in what the gene frequency and genotypes are concerned (Savatti, 1998; Smith et al., 1985; Taylor and Smith, 1979).

The valuable characteristics of red clover (productivity, resistance to biotic and non-biotic factors, as well as quality) depend on a series of morphological and physiological traits which, in turn, are influenced by genetic and environmental factors. In this respect, the studies on the genetic resources originating from different areas should take into consideration the relationship

environment-plant. Foreign cultivars, formed in certain environmental conditions specific to certain areas, in new climatic and soil conditions will develop modified characteristics, as compared to those they had in their native areas. The research carried out so far outline the high variability of the production capacity of red clover, both among cultivars and within certain cultivars (Muntean, 2002; Savatti, 1973).

The purpose of our research was to study the variability of the morphological and physiological traits of the tetraploid red clover cultivars, as well as their impact on productivity and the quality of the forage (Moisa, 1996; Muntean, 2002; Panfil and Savatti, 1970; Savatti, 1973).

MATERIALS AND METHODS

The reasearch was carried out in the soil and climatic conditions specific to the experimental fields of USAMV Cluj-Napoca, between 2000-2001 (average annual temperature of 9,5ºC, respectively 9,4ºC, and the total annual rainfall of 366,6 mm, respectively 547,8 mm), on a collection of 22 tetraploid cultivars as follows: Apollo-Tetra - control, Rotra, Temara, Tetri, Kvarta, Maneta, Marcus, Maro, Tempus, Titus, Barfiola, Deben, Jubilatka, Gkt Tetra, Dacia-Tetra, Napoca-Tetra from Central and Western Europe, Betty, Fanny, Sara from North of Europe; Hayakita from Asia, Grassland Pawera and Grassland Turoua from Oceania

The sowing was done on 25th April 2000, each variant (cultivar) being sown in three repetitions, on a surface of 1 sq. m (a distance between the rows of 12.5 cm). The aspects we particularly had in view were the variability of certain morphological traits, and that of the green matter, hay and seed yields. The morphological analyses referred to: the springing and the growth dynamics, the plant height (cm), the number of internodes/stem, the number of main ramifications/stem, the number of flowers/inflorescence, seed weight, earliness, the after-cut regeneration capacity, the resistance to climatic stress and to diseases.

In the process of interpreting the experimental data we considered the cultivars from the south of Europe as belonging to the *subvar. praecox* and the ones from the north of Europe as belonging to the *var. serotinum.* Considering the fact that Central and Western European cultivars are intermediary between the early and the late clover, they were ranked in the *subvar. intermedium,* as suggested by Puia şi Szabo (1978).

The results were presented in average values ($\overline{X}$), with the corresponding errors ($s_{\bar{x}}$), and were statistically interpreted by using the variance analysis. The examination of the significance of the differences was done through the test of limit differences (DL). In interpreting the results, the tetraploid cultivars were grouped according to their origin areas, represented by the varieties and subvarieties they belong to. In order to estimate the variability of the studied traits we calculated the variability coefficient (s%) for each variant and between the cultivars, using formulas suggested by reference literature (Ceapoiu, 1968).

RESULTS AND DISCUSSIONS

The growth dynamics of the tetraploid cultivars in the first and second year of vegetation is presented in Table 1. In the first year, one cultivar (Gkt Tetra) was identified that was bearing significant differences as compared to the control. In the second year, few cultivars from Central

Europe and Asia gave values higher than the control. Out of these, the most significant differences were noted in the case of Temara and Hayakita cultivars.

Table 1

The growth dynamics (mm/day)

Var.	Cultivar	1st year	Difference	Significance	2nd year	Difference	Significance
1.	*Apollo-Tetra (Mt)*	*4.4*	*0.0*	-	*1.1*	*0.0*	-
2.	Rotra	4.4	0.0	-	0.8	-0.3	00
3.	Temara	4.1	-0.3	-	1.5	0.4	**
4.	Tetri	4.2	-0.2	-	0.6	-0.5	000
5.	Kvarta	5.0	0.6	-	0.8	-0.3	00
6.	Maneta	3.9	-0.5	-	0.9	-0.2	0
7.	Marcus	2.2	-2.2	000	0.8	-0.3	00
8.	Maro	3.9	-0.5	-	1.1	0.0	-
9.	Tempus	3.9	-0.5	-	0.8	-0.3	00
10.	Titus	5.0	0.6	-	0.6	-0.5	000
11.	Barfiola	2.2	-2.2	000	1.0	-0.1	-
12.	Deben	3.9	-0.5	-	1.0	-0.1	-
13.	Jubilatka	4.2	-0.2	-	1.0	-0.1	-
14.	Gkt Tetra	5.6	1.2	***	1.0	-0.1	-
15.	Dacia-Tetra	3.3	-1.1	00	1.3	0.2	*
16.	Napoca-Tetra	3.3	-1.1	00	1.1	0	-
17.	Betty	1.9	-2.5	000	0.2	-0.9	000
18.	Fanny	2.2	-2.2	000	0.5	-0.6	000
19.	Sara	2.6	-1.8	000	0.4	-0.7	000
20.	Hayakita	3.9	-0.5	-	1.4	0.3	**
21.	G. Pawera	4.4	0.0	-	0.8	-0.3	00
22.	G. Turoua	1.7	-2.7	000	0.6	-0.5	000
DL (p 5%) DL (p 1%) DL (p 0.1%)			0.7 0.9 1.2			0.2 0.3 0.5	

The average number of internodes and ramifications on the stem for the tetraploid cultivars is presented in Table 2. A comparison of the tetraploid cultivars from the point of view of their origin area shows that the Central-European ones have the most internodes/stem, being closely followed in this respect by the Asian and Northern-European ones. Among the Central-European cultivars, there were only two, Napoca-Tetra şi Marcus, which had an average number of internodes/stem bigger than that of the control (Apollo-Tetra*)*, with the differences not statistically assured. The control (Apollo-Tetra*)*, as well as the other studied Romanian cultivars (Napoca-Tetra and Dacia-Tetra) had the most main ramifications/stem. As compared to the control, the tetraploid cultivars considered for this research presented significant negative differences.

Table 3 presents the height of the red clover plants at harvest time, in the two years of growth. In the first year, the highest values were recorded for the Central-European and Asian tetraploid cultivars. From these ecological groups, there were six Central European cultivars (Rotra, Temara, Kvarta, Titus, Jubilatka and Gkt Tetra) and one from New Zealand (G. Pawera) which were better than the control (Apollo-Tetra), but the differences were not statistically assured. In the second growth year, all cultivars had negative differences, with different degrees of significance, as compared to the Romanian ones, the only exception being the Swiss cultivar *Temara*, with a not significant difference.

Table 2

The average number of internodes and ramifications on the stem

Var	Cultivar	Number of internodes/stem			Number of ramifications/stem		
		$\overline{X}$	$s_{\overline{x}}$	s%	$\overline{X}$	$s_{\overline{x}}$	s%
	Apollo-Tetra (Mt)	*6.20*	*0.25*	*8.00*	*4.70*	*0.25*	*10.52*
1.	Rotra	4.87^{000}	0.44	20.00	2.67^{000}	0.24	21.06
2.	Temara	4.47^{000}	0.40	20.32	2.07^{000}	0.31	35.35
3.	Tetri	5.93	0.40	15.97	2.33^{000}	0.24	22.82
4.	Kvarta	5.10^{000}	0.33	10.82	2.73^{000}	0.33	34.64
5.	Maneta	5.50^{0}	0.42	19.07	2.17^{000}	0.16	18.84
6.	Marcus	6.47	0.33	8.66	2.13^{000}	0.33	34.64
7.	Maro	5.07^{000}	0.40	18.32	1.80^{000}	0.24	38.14
8.	Tempus	5.50^{0}	0.22	9.95	2.27^{000}	0.21	22.13
9.	Titus	6.10	0.57	16.66	2.53^{000}	0.33	21.65
10.	Barfiola	5.13^{00}	0.25	12.64	2.57^{000}	0.22	21.90
11.	Deben	5.80	0.30	12.90	2.10^{000}	0.14	18.84
12.	Jubilatka	5.43^{0}	0.66	21.65	4.67	0.88	32.73
13.	Gkt Tetra	5.07^{000}	0.21	9.68	2.10^{000}	0.30	34.74
14.	Dacia-Tetra	6.00	0.40	13.60	5.00	0.91	36.51
15.	Napoca-Tetra	6.50	0.28	8.88	4.70	0.75	31.57
16.	Betty	2.97^{000}	0.31	23.57	1.10^{000}	0.20	37.26
17.	Fanny	4.43^{000}	0.66	26.64	2.40^{000}	0.57	50.00
18.	Sara	5.23^{00}	0.40	19.02	2.03^{000}	0.30	34.74
19.	Hayakita	4.27^{000}	0.40	20.41	2.80^{000}	0.47	34.81
20.	G. Pawera	4.63^{000}	0.33	13.32	2.33^{000}	0.33	21.65
21.	G. Turoua	2.57^{000}	0.30	13.77	1.47^{000}	0.45	47.14
DL (p 5%)		0.62			0.41		
DL (p 1%)		0.82			0.55		
DL (p 0.1%)		1.08			0.72		

Table 3

The height of plants at harvest time (cm)

Var	Cultivar	1st year			2nd year		
		$\overline{X}$	$s_{\overline{x}}$	s%	$\overline{X}$	$s_{\overline{x}}$	s%
1.	*Apollo-Tetra (Mt)*	*36.6*	*2.8*	*12.47*	*66.3*	*1.8*	*6.45*
2.	Rotra	38.3	4.4	24.51	49.6^{000}	3.2	12.71
3.	Temara	39.6	1.7	9.54	58.3	1.6	4.94
4.	Tetri	35.6	3.1	16.23	50.3^{000}	1.8	8.71
5.	Kvarta	41.3	4.6	27.47	47.6^{000}	4.4	14.32
6.	Maneta	31.0	4.2	21.40	54.3^{00}	3.7	16.70
7.	Marcus	22.6^{00}	1.5	10.95	49.0^{000}	1.6	5.62
8.	Maro	35.6	4.4	23.06	57.0^{0}	2.1	11.34
9.	Tempus	36.3	4.2	21.37	55.0^{00}	2.9	14.09
10.	Titus	40.0	4.5	25.81	44.6^{000}	2.5	10.37
11.	Barfiola	24.0^{00}	5.0	30.17	57.6^{0}	5.9	33.76
12.	Deben	34.6	5.4	36.86	51.6^{000}	6.8	34.10
13.	Jubilatka	38.0	1.9	12.37	52.6^{00}	1.0	9.37
14.	Gkt Tetra	40.30	3.3	18.72	51.6^{000}	5.3	22.12
15.	Dacia-Tetra	32.0	2.5	15.63	70.6	2.0	8.94
16.	Napoca-Tetra	30.3	2.0	12.17	65.0	1.8	7.12
17.	Betty	20.6^{000}	4.2	23.80	26.6^{000}	1.2	11.03
18.	Fanny	24.0^{00}	4.0	20.52	39.3^{000}	2.0	9.48
19.	Sara	25.3^{0}	5.0	30.51	37.0^{000}	2.9	18.25
20.	Hayakita	34.0	3.1	17.72	55.0^{00}	2.5	12.34
21.	G. Pawera	41.3	3.3	18.47	36.6^{000}	1.4	6.34
22.	G. Turoua	16.0^{000}	3.9	27.92	30.3^{000}	2.3	13.77
DL (p 5%)		9.5			8.3		
DL (p 1%)		12.2			11.1		
DL (p 0.1%)		16.0			14.6		

The percentage of leaves, the average number of flowers/inflorescence and the seed weight are presented in Table 4. The highest values in what the leaf weight is concerned were obtained from the cultivars of Northern origin (the late type), especially Betty and Fanny, with very significant differences as compared to the control. The biggest number of flowers/inflorescence was recorded in the case of the Central European cultivars (Tempus and Titus), the differences were not statistically assured. The highest values of the weight of one thousand seeds came from the Central-European cultivars Rotra, Tempus and Gkt Tetra.

Table 4

The percentage of leaves, the average number of flowers/inflorescence and the seed weight

Var	Cultivar	Percentage of leaves (%)			Number of flowers/inflorescence			Weight of 1000 seeds		
		$\overline{X}$	Diff	Semnif.	$\overline{X}$	$s_{\overline{x}}$	s%	$\overline{X}$	Diff	Semnif.
1.	*Apollo-Tetra (Mt)*	*38*	*0*	-	*114.7*	*5.5*	*8.45*	*2.1*	*0*	-
2.	Rotra	44	6	*	98.7	10.5	15.07	2.3	0.2	-
3.	Temara	40	2	-	127.2	8.9	16.89	1.8	-0.3	-
4.	Tetri	48	10	***	89.9	5.5	8.69	1.9	-0.2	-
5.	Kvarta	50	12	***	115.6	8.4	17.49	1.7	-0.4	-
6.	Maneta	46	8	**	92.4	21.5	42.24	2.2	0.1	-
7.	Marcus	46	8	**	84.6	7.1	12.53	1.7	-0.4	-
8.	Maro	48	10	***	97.1	2.1	3.91	1.7	-0.4	-
9.	Tempus	44	6	*	141.5	17.0	30.70	2.3	0.2	-
10.	Titus	40	2	-	146.5	15.9	26.90	1.6	-0.5	0
11.	Barfiola	50	12	***	73.1	2.1	5.72	2.2	0.1	-
12.	Deben	48	10	***	94.2	18.2	33.76	2	-0.1	-
13.	Jubilatka	40	2	-	93.4	5.5	10.25	1.7	-0.4	-
14.	Gkt Tetra	36	-2	-	87.3	19.8	39.53	2.5	0.4	-
15.	Dacia-Tetra	40	2	-	97.4	6.1	11.68	1.8	-0.3	-
16.	Napoca-Tetra	40	2	-	96.5	12.2	22.31	1.4	-0.7	0
17.	Betty	48	10	***	116.6	10.3	12.40	1.2	-0.9	00
18.	Fanny	48	10	***	120.0	8.0	15.93	2	-0.1	
19.	Sara	44	6	*	129.5	7.2	9.71	2	-0.1	
20.	Hayakita	38	0	-	64.5^{0}	6.3	17.18	1.9	-0.2	
21.	G. Pawera	40	2	-	76.3	22.9	52.48	2.2	0.1	
22.	G. Turoua	35	-3	-	88.8	12.3	19.97	1.5	-0.6	0
DL (p 5%)			5.6		47.6				0.5	
DL (p 1%)			7.2		59.4				0.8	
DL (p 0.1%)			9.4		74.8				1.2	

Table 5 presents the earliness of the tetraploid red clover cultivars. For the study of this trait, the date of the flowering (year 1) and the dates of the first and second cut (year 2) were taken into consideration. Out of the studied cultivars, the earliest ones were Hayakita, Titus and Deben which flowered, in the first year, ten days earlier than the control. In the second year Temara and Hayakita were harvested one week earlier at the first and second cut, compared to the control.

The re-growth capacity (height of the plants and percentage of plants with flowers one month after the cut) is presented in Table 6. One month after the first cut, all foreign cultivars were smaller in height than the Romanian ones (Apollo Tetra, Dacia Tetra and Napoca Tetra), which shows the fact that these latest ones have a better regeneration capacity One month after the cut, the Northern-European cultivars had not flowered yet and the other ecotypes had medium flowering percentages which varied between 1.0% and 4.3%. Among the Central European

cultivars, the Swiss one - Temara - was remarked for its rich flowering, with very significant differences as compared to the control.

Table 5

The earliness

Var.	Cultivar	Date of the flowering		Date of first cut (50% plants with flowers)		Date of second cut (50% plants with flowers)	
		$\overline{X}$	Diff (zile)	$\overline{X}$	Diff (zile)	$\overline{X}$	Diff (zile)
1.	*Apollo-Tetra (Mt)*	*22.07*	*0*	*4.06*	*0*	*9.07*	*0*
2.	Rotra	21.07	-1	6.06	2	11.07	2
3.	Temara	14.07	-8	22.05	-12	1.07	-8
4.	Tetri	20.07	-2	20.06	16	20.08	42
5.	Kvarta	16.07	-6	6.06	2	13.07	4
6.	Maneta	29.07	7	8.06	4	20.07	11
7.	Marcus	7.08	16	4.06	0	16.07	7
8.	Maro	21.07	-1	30.05	-4	5.07	-4
9.	Tempus	14.07	-8	6.06	2	11.07	2
10.	Titus	12.07	-10	8.06	4	20.07	11
11.	Barfiola	27.07	5	5.06	1	12.07	3
12.	Deben	12.07	-10	2.06	-2	9.07	0
13.	Jubilatka	14.07	-8	2.06	-2	7.07	-2
14.	Gkt Tetra	20.07	-2	4.06	0	9.07	0
15.	Dacia-Tetra	8.08	17	4.06	0	9.07	0
16.	Napoca-Tetra	18.07	-4	4.06	0	9.07	0
17.	Betty	22.08	30	15.06	11	30.07	21
18.	Fanny	20.08	28	15.06	11	10.08	31
19.	Sara	17.08	25	15.06	11	10.08	31
20.	Hayakita	11.07	-11	25.05	-9	2.07	-7
21.	G. Pawera	28.07	6	28.05	-6	12.07	3
22.	G. Turoua	1.08	10	4.06	0	22.07	13

Table 6

The re-growth capacity

Var.	Cultivar	Height of plants (cm) (one month after harvest)			Plants with flowers (%) (one month after harvest)		
		$\overline{X}$	$s_{\overline{x}}$	s%	$\overline{X}$	Difference	Significance
1.	*Apollo-Tetra (Mt)*	*47.6*	*1.3*	*9.97*	*4.3*	*0.0*	-
1.	Rotra	39.3	2.5	19.70	2.3	-2.0	-
2.	Temara	50.0	1.4	7.66	33.3	29.0	***
3.	Tetri	33.3^{00}	1.2	13.50	0.7	-3.6	-
4.	Kvarta	40.3	2.9	22.20	3.3	-1.0	-
1.	Maneta	39.6	2.7	25.89	0.6	-3.7	-
1.	Marcus	28.6^{000}	0.9	8.71	0.0	-4.3	-
1.	Maro	35.6^{0}	1.3	17.58	2.3	-2.0	-
2.	Tempus	43.3	2.3	21.84	1.0	-3.3	-
3.	Titus	34.0^{00}	1.9	16.07	0.0	-4.3	-
4.	Barfiola	32.6^{00}	4.3	52.33	1.0	-3.3	-
2.	Deben	39.6	5.2	52.86	0.0	-4.3	-
3.	Jubilatka	33.3^{00}	0.6	14.52	1.6	-2.7	-
4.	Gkt Tetra	39.0	4.0	34.29	0.6	-3.7	-
5.	Dacia-Tetra	54.0	1.5	13.86	2.3	-2.0	-
6.	Napoca-Tetra	50.6	1.4	11.04	2.3	-2.0	-
7.	Betty	32.6^{00}	1.5	17.10	5.0	0.7	-
8.	Fanny	25.3^{000}	1.3	14.69	0.0	-4.3	-
9.	Sara	27.6^{000}	2.2	28.29	0.6	-3.7	-
10.	Hayakita	40.6	1.8	19.13	3.3	-1.0	-
11.	G. Pawera	27.3^{000}	1.0	9.83	0.0	-4.3	-
12.	G. Turoua	23.3^{000}	1.8	21.34	0.0	-4.3	-
DL (p 5%)		9.6			10.7		
DL (p 1%)		12.8			14.3		
DL (p 0.1%)		16.8			18.7		

Table 7 presents the frequency of mildew powder and the cold resistance. Given the climatic conditions which were favourable to the pathogen *Erysiphe trifolii* (strong drought) the mildew-powder occurred more frequently in all the cultivar groups. Generally speaking, the tetraploid cultivars originating from cold and wet regions (*var. Serotinum)* were the least resistant to mildew powder. On the other hand, unlike the Romanian tetraploids created at the USAMV Cluj-Napoca, all the foreign cultivars suffered from more frequent attacks of mildew powder, most often statistically assured.

The cold resistance of the cultivars used for this research was determined by analysing the percentages of surviving plants in the climatic conditions of the winter between the first and the second year of the second experimental cycle, which were favourable to this procedure. The area covered with plants at the beginning of the winter (year 1) was considered as 100%. At the end of the winter (year 2), we determined the surface containing living plants and the percentage it represented as compared to the initial area. The North-European cultivars proved to have the best cold-resistance. This is due to the efforts made in their origin countries (Sweden, Denmark, Finland) for increasing it, the cold resistance being a limitative factor of red clover cultures in all the areas with tough winters.

Table 7

Frequency of mildew powder (%) and cold resistance (% of surviving plants at the end of winter)

Var.	Cultivar	Frequency of mildew powder	Difference	Significance	Surviving plants (%)	Difference	Significance
1.	*Apollo-Tetra (Mt)*	*1.6*	*0.0*	-	*53.3*	*0.0*	-
2.	Rotra	11.6	10.0	-	70.0	16.7	-
3.	Temara	46.6	45.0	***	46.6	-6.7	-
4.	Tetri	43.3	41.7	***	70.0	16.7	-
5.	Kvarta	18.3	16.7	**	63.3	10.0	-
6.	Maneta	25.6	24.0	***	43.3	-10.0	-
7.	Marcus	16.6	15.0	**	45.0	-8.3	-
8.	Maro	20.0	18.4	***	58.3	5.0	-
9.	Tempus	7.6	6.0	-	68.3	15.0	-
10.	Titus	20.0	18.4	***	66.6	13.3	-
11.	Barfiola	2.6	1.0	-	60.0	6.7	-
12.	Deben	5.0	3.4	-	66.6	13.3	-
13.	Jubilatka	0.6	-1.0	-	70.0	16.7	-
14.	Gkt Tetra	18.3	16.7	**	38.3	-15.0	-
15.	Dacia-Tetra	0.0	-1.6	-	70.0	16.7	-
16.	Napoca-Tetra	3.3	1.7	-	63.3	10.0	-
17.	Betty	8.3	6.7	-	58.3	5.0	-
18.	Fanny	33.3	31.7	***	56.6	3.3	-
19.	Sara	20.0	18.4	***	66.6	13.3	-
20.	Hayakita	9.3	7.7	-	45.0	-8.3	-
21.	G. Pawera	23.3	21.7	***	70.0	16.7	-
22.	G. Turoua	7.3	5.7	-	33.3	-20.0	-
DL (p 5%) DL (p 1%) DL (p 0.1%)			10.0 13.4 17.6			21.5 28.8 37.8	

CONCLUSIONS

A wide range of the variability of the main traits of the studied tetraploid red clover cultivars was noticed, which allows us to identify valuable genitors for the breeding programmes.

Making a comparison between the average growth rhythm of the red clover plants in the two years of vegetation, the conclusion was that in the first year the daily gain was bigger than in

the second year. The variability of this trait was high in both years. The Central-European cultivars (*subvar. intermedium*) had the highest daily gains, both in the first and the second year of growth.

Generally speaking, the average number of internodes per stem was bigger in the case of late and semi-late cultivars (*var. serotinum*). The variability of this trait was average.

The height of the plants is influenced by the number of internodes and their length, but also by the year of vegetation, their origin geographic area and the climatic conditions. The height of the clover plants in the first year of growth was smaller than in the second year. On the other hand, the variability of plant height was much smaller in the second year, with a tendency to reduce the differences. In both years of vegetation, the highest values in what the plant height was concerned came from the Central- European and Asian cultivars (*var. subnudum*).

The highest values of the average number of ramifications per stem were obtained in the case of the Central- European and Asian cultivars (*var. subnudum*), which proves the fact that this trait is not influenced by the ecologic conditions in which the cultivar has developed.

The leaf weight per plant, determined by the size and number of leaves, is a very important indicator of the red clover productivity and nutritive value. Within the tetraploid germplasm of red clover studied at Cluj-Napoca the highest values were noticed in the case of late cultivars, of North-European origin (*var. serotinum*); these could be introduced as initial material in the breeding programmes for increasing the leaf weight of the native cultivars.

Taking into consideration the low seed yield of the tetraploids, as compared to the diploids they come from, improving the elements of the seed yield (the number of flowers/ inflorescence, the number of ramifications/ stem, the number of inflorescences/ plant, the percentage of flowering and the weight of one thousand seeds) has become one of the main goals of breeding tetraploid cultivars.

For the red clover germplasm taken into consideration, the average number of flowers per inflorescence had high variability, and the weight of one thousand seeds had average variability. The highest values of the number of flowers/ inflorescence and of the weight of one thousand seeds came from the cultivars belonging to *subvar. intermedium* (the Central-European groups). These could be therefore used as genitors for increasing the seed yield.

Within the red clover germplasm, the earliest cultivars, were those from Switzerland. The differences in earliness between the studied cultivars were bigger in the second year of growth and more obvious after the first cut. The latest cultivars were the North-European ones (*var. serotinum*); they only flowered randomly in the first year and in the second year they were the last to be harvested, both for the first and the second cut.

The capacity for vegetative regeneration of the tetraploid red clover cultivars has high variability. The fact that the generative capacity had high variability within the germplasm studied at Cluj-Napoca can be considered a positive aspect in the process of identifying genitors in this respect. Like in the case of earliness, the best regeneration capacity was noticed in the case of the Swiss cultivars, which had the highest values for plant height and for the flowering percentage at one month after the harvest.

The best cold resistance was noticed for the genotypes belonging to *var. serotinum*. It was noticed that cold resistance is characteristic to some groups of ecotypes (North-European) and there is no obvious variability among the cultivars belonging to the same ecotype.

The cultivars with very good resistance to mildew powder are the Romanian tetraploids created at the USAMV Cluj-Napoca (*subvar. intermedium*); this characteristic is an important goal of the breeding programmes of red clover in the Cluj-Napoca area.

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REZUMAT

VARIABILITATEA CARACTERELOR MORFOLOGICE LA SOIURI TETRAPLOIDE DE TRIFOI ROŞU, STUDIATE IN CONDIŢIILE ECOLOGICE DE LA CLUJ-NAPOCA

Însuşirile valoroase ale trifoiului roşu (productivitatea, rezistența la factorii biotici şi abiotici, precum şi calitatea) sunt dependente de o multitudine de însuşiri morfologice şi fiziologice, care sunt sub influența unor factori genetici şi de mediu. În studiul efectuat la Cluj-Napoca, s-a urmărit variabilitatea însuşirilor morfologice şi fiziologice la 22 de cultivare tetraploide de trifoi roşu şi implicaţiile acestora asupra capacităţii de producţie şi a calităţii furajului. În ameliorarea trifoiului roşu la Cluj-Napoca, pentru îmbunătăţirea însuşirilor morfologice responsabile pentru producţia de masă verde se recomandă utilizarea cultivarelor din Centrul şi Vestul Europei (*subvar. intermedium*). Din cadrul acestei subvarietăţi s-a remarcat îndeosebi cultivarul Temara din Elveţia, printr-o precocitate sporită şi o bună capacitate de regenerare după coasă. Soiurile tardive nord-europene (*var. serotinum*) sunt valoroase pentru ridicarea procentului de frunze şi pentru sporirea rezistenţei la iernare. S-a constatat că rezistența la iernare constituie o caracteristică a acestei varietăţi, neexistând o variabilitate evidentă între cultivarele din zona respectivă.