

## THE VARIABILITY OF THE MORPHOLOGICAL TRAITS OF DIPLOID 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 45 diploid red clover cultivars, as well as their impact on productivity and the quality of the forage. In the breeding programmes carry out at Cluj-Napoca, in order to improve the morphological traits responsible for green matter yields, recommend that cultivars from Central and Western Europe should be used (*subvar. intermedium*). Were noticed, within this subvariety, the cultivars originating from Switzerland (Renova, Ruttinova), because of their 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. Generally speaking, the cultivars with very good resistance to mildew powder are those from southern Europe (*subvar. praecox*); this characteristic is one of the most important goals of the breeding programmes in the origin area, given the specific climatic conditions (increased soil and air drought).

**Key words:** red clover, diploid 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 (6). 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 (7, 8, 9).

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 (3, 6).

The purpose of our research was to study the variability of the morphological and physiological traits of the diploid red clover cultivars, as well as their impact on productivity and the quality of the forage (2, 3, 5, 6).

#### MATERIAL AND METHOD

The research 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 9,5°C, respectively 9,4°C, and the total annual rainfall of 366,6 mm, respectively 547,8 mm), on a collection of 45 diploid cultivars as follows: Roxana – control; Arni, Nessonas, Bolognino, Joseph, Milo, Vignola – from South of Europe; Essex Broad Red, Gumpensteiner, Reichersberger Neu, Mercury, Merviot, Violetta, Start, Renova, Ruttinova, Cardinal, Triel, Verdi, Heges Hohenheimer, Lucrum, Nemaro, Odenwalder Rotklee, Pirat, Fox, Jonas, Rode Maasklaver, Bryza, Dajana, Parka, Raba, Viola, Taplanszentkereszti, Select – from Central and Western Europe; Krano Pajbjerg, Rajah, Jokoinen, Bjorn, Britta, Elin, Hermes II, Kora, Pallas – from North of Europe; Redqwin and Graslands Hamua – from Oceania

The sowing was done on 25<sup>th</sup> 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 that 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 the cultivars from the south of Europe were considered 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 and Szabo (4).

The results obtained were presented in average values ( $\bar{X}$ ), with the corresponding errors ( $s^-$ ), 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 diploid and 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 the variability coefficient ( $s\%$ ) was calculated for each variant and between the cultivars, using formulas suggested by literature (1).

## RESULTS AND DISCUSSIONS

The growth dynamics of the diploid cultivars in the first and second year of vegetation is presented in Table 1. In the first year, were identified 16 cultivars with significant differences as compared to the control, the highest values being obtained in the case of the Central-European cultivars Fox, Essex Broad Red and Triel. In the second year, the cultivars from Central Europe and Oceania gave the highest values, as compared to the other studied ecotypes. Out of these, the most significant differences in comparison with the control were noted in the case of the French cultivars Triel and Verdi.

Table 1

The growth dynamics (mm/day)

| Var. | Cultivar            | 1 <sup>st</sup> year | Difference | Significance | 2 <sup>nd</sup> year | Difference | Significance |
|------|---------------------|----------------------|------------|--------------|----------------------|------------|--------------|
| 1.   | Roxana (Mt)         | 1.9                  | 0.0        | -            | 0.8                  | 0.0        | -            |
| 2.   | Arni                | 3.3                  | 1.4        | ***          | 0.7                  | -0.1       | 0            |
| 3.   | Nessonas            | 3.3                  | 1.4        | ***          | 0.8                  | 0.0        | -            |
| 4.   | Bolognino           | 1.7                  | -0.2       | -            | 0.3                  | -0.5       | 000          |
| 5.   | Joseph              | 3.1                  | 1.2        | ***          | 0.7                  | -0.1       | 0            |
| 6.   | Milo                | 2.2                  | 0.3        | -            | 1.3                  | 0.5        | ***          |
| 7.   | Vignola             | 2.2                  | 0.3        | -            | 1.1                  | 0.3        | **           |
| 8.   | Essex Broad Red     | 3.9                  | 2.0        | ***          | 1.1                  | 0.3        | **           |
| 9.   | Gumpen-Steiner      | 2.2                  | 0.3        | -            | 0.9                  | 0.1        | *            |
| 10.  | Reichersberger Neu  | 2                    | 0.1        | -            | 1.4                  | 0.6        | ***          |
| 11.  | Mercury             | 2.2                  | 0.3        | -            | 0.7                  | -0.1       | 0            |
| 12.  | Merviot             | 1.8                  | -0.1       | -            | 0.8                  | 0.0        | -            |
| 13.  | Violetta            | 2.2                  | 0.3        | -            | 0.9                  | 0.1        | *            |
| 14.  | Start               | 3.3                  | 1.4        | ***          | 1.0                  | 0.2        | **           |
| 15.  | Renova              | 3.3                  | 1.4        | ***          | 1.5                  | 0.7        | ***          |
| 16.  | Ruttinova           | 2.4                  | 0.5        | *            | 1.3                  | 0.5        | ***          |
| 17.  | Cardinal            | 2.2                  | 0.3        | -            | 0.9                  | 0.1        | *            |
| 18.  | Triel               | 3.9                  | 2.0        | ***          | 1.7                  | 0.9        | ***          |
| 19.  | Verdi               | 1.8                  | -0.1       | -            | 1.5                  | 0.7        | ***          |
| 20.  | Heges Hohenheimer   | 3.3                  | 1.4        | ***          | 1.2                  | 0.4        | ***          |
| 21.  | Lucrum              | 3.3                  | 1.4        | ***          | 0.8                  | 0.0        | -            |
| 22.  | Nemaro              | 3.9                  | 2.0        | ***          | 1.0                  | 0.2        | **           |
| 23.  | Odenwalder Rotklee  | 3.9                  | 2.0        | ***          | 0.9                  | 0.1        | *            |
| 24.  | Pirat               | 2.8                  | 0.9        | ***          | 1.0                  | 0.2        | **           |
| 25.  | Fox                 | 4.4                  | 2.5        | ***          | 1.0                  | 0.2        | **           |
| 26.  | Jonas               | 2.8                  | 0.9        | ***          | 1.0                  | 0.2        | **           |
| 27.  | Rode Maasklaver     | 1.8                  | -0.1       | -            | 1.0                  | 0.2        | **           |
| 28.  | Bryza               | 2.1                  | 0.2        | -            | 1.0                  | 0.2        | **           |
| 29.  | Dajana              | 2                    | 0.1        | -            | 0.7                  | -0.1       | 0            |
| 30.  | Parka               | 2.2                  | 0.3        | -            | 1.0                  | 0.2        | **           |
| 31.  | Raba                | 1.9                  | 0.0        | -            | 0.4                  | -0.4       | 000          |
| 32.  | Viola               | 1.4                  | -0.5       | 0            | 1.1                  | 0.3        | **           |
| 33.  | Taplanszentkereszti | 2.8                  | 0.9        | ***          | 0.7                  | -0.1       | 0            |
| 34.  | Select              | 2                    | 0.1        | -            | 0.8                  | 0.0        | -            |
| 35.  | Krano Pajbjerg      | 1.9                  | 0.0        | -            | 0.7                  | -0.1       | 0            |
| 36.  | Rajah               | 2.2                  | 0.3        | -            | 0.4                  | -0.4       | 000          |
| 37.  | Jokoinen            | 1.7                  | -0.2       | -            | 0.4                  | -0.4       | 000          |
| 38.  | Bjorn               | 1.9                  | 0.0        | -            | 0.5                  | -0.3       | 00           |
| 39.  | Britta              | 2.3                  | 0.4        | -            | 0.6                  | -0.2       | 00           |

|             |                 |     |      |     |     |      |     |
|-------------|-----------------|-----|------|-----|-----|------|-----|
| 40.         | Elin            | 1.6 | -0.3 | -   | 0.5 | -0.3 | 000 |
| 41.         | Hermes II       | 1.7 | -0.2 | -   | 0.8 | 0.0  | -   |
| 42.         | Kora            | 1.7 | -0.2 | -   | 0.5 | -0.3 | 00  |
| 43.         | Pallas          | 1.7 | -0.2 | -   | 0.6 | -0.2 | 00  |
| 44.         | Redqwin         | 3.3 | 1.4  | *** | 0.8 | 0.0  | -   |
| 45.         | Graslands Hamua | 2.2 | 0.3  | -   | 1.0 | 0.2  | **  |
| DL(p 5%)    |                 | 0.5 |      |     | 0.1 |      |     |
| DL (p 1%)   |                 | 0.6 |      |     | 0.2 |      |     |
| DI (p 0.1%) |                 | 0.8 |      |     | 0.4 |      |     |

The average number of internodes and ramifications on the stem for the diploid cultivars is presented in Table 2.

Table 2

The average number of internodes and ramifications on the stem

| Var | Cultivar           | Number of internodes/stem |               |       | Number of ramifications/stem |               |       |
|-----|--------------------|---------------------------|---------------|-------|------------------------------|---------------|-------|
|     |                    | $\bar{X}$                 | $s_{\bar{x}}$ | s%    | $\bar{X}$                    | $s_{\bar{x}}$ | s%    |
| 1.  | Roxana (Mt.)       | 4.83                      | 0.30          | 15.57 | 2.20                         | 0.30          | 34.74 |
| 2.  | Arni               | 5.27                      | 0.40          | 19.44 | 2.63*                        | 0.37          | 29.88 |
| 3.  | Nessonas           | 5.93***                   | 0.37          | 14.42 | 3.10***                      | 0.20          | 15.97 |
| 4.  | Bolognino          | 6.17***                   | 0.73          | 26.50 | 4.30***                      | 0.87          | 44.30 |
| 5.  | Joseph             | 4.43                      | 0.29          | 12.83 | 1.83                         | 0.25          | 28.57 |
| 6.  | Milo               | 4.60                      | 0.24          | 11.90 | 2.17                         | 0.20          | 20.32 |
| 7.  | Vignola            | 4.73                      | 0.37          | 17.43 | 3.43***                      | 0.24          | 16.11 |
| 8.  | Essex Broad Red    | 4.60                      | 0.18          | 11.19 | 2.93***                      | 0.32          | 34.90 |
| 9.  | Gumpensteiner      | 4.73                      | 0.37          | 17.43 | 1.80                         | 0.20          | 24.84 |
| 10. | Reichersberger Neu | 5.27                      | 0.20          | 8.60  | 2.73*                        | 0.20          | 15.97 |
| 11. | Mercury            | 4.07 <sup>00</sup>        | 0.20          | 11.77 | 1.43 <sup>000</sup>          | 0.24          | 39.12 |
| 12. | Merviot            | 4.33                      | 0.10          | 8.94  | 1.60 <sup>00</sup>           | 0.40          | 28.74 |
| 13. | Violetta           | 4.93                      | 0.33          | 12.37 | 2.57                         | 0.33          | 24.74 |
| 14. | Start              | 5.20                      | 0.30          | 9.52  | 2.07                         | 0.25          | 22.22 |
| 15. | Renova             | 4.47                      | 0.40          | 19.44 | 3.58***                      | 0.20          | 16.54 |
| 16. | Ruttinova          | 4.53                      | 0.38          | 19.23 | 2.00                         | 0.20          | 20.32 |
| 17. | Cardinal           | 7.17***                   | 0.48          | 13.20 | 2.13                         | 0.54          | 61.23 |
| 18. | Triel              | 5.07                      | 0.24          | 9.78  | 2.93***                      | 0.41          | 27.21 |
| 19. | Verdi              | 5.33                      | 0.37          | 16.09 | 1.87                         | 0.49          | 49.79 |
| 20. | Heges Hohenheimer  | 5.93***                   | 0.30          | 14.42 | 2.20                         | 0.37          | 46.48 |
| 21. | Lucrum             | 5.20                      | 0.37          | 16.09 | 3.93***                      | 0.48          | 26.08 |
| 22. | Nemaro             | 6.27***                   | 0.41          | 18.88 | 3.07***                      | 0.49          | 34.23 |
| 23. | Odenwalder Rotklee | 4.53                      | 0.44          | 25.00 | 3.10***                      | 0.66          | 46.35 |
| 24. | Pirat              | 4.63                      | 0.28          | 12.83 | 2.33                         | 0.24          | 21.06 |
| 25. | Fox                | 5.20                      | 0.37          | 17.43 | 2.43                         | 0.64          | 51.64 |
| 26. | Jonas              | 5.40*                     | 0.37          | 13.49 | 2.93***                      | 0.20          | 15.97 |
| 27. | Rode Maasklaver    | 4.80                      | 0.26          | 16.08 | 3.13***                      | 0.20          | 15.97 |
| 28. | Bryza              | 5.27                      | 0.20          | 8.60  | 1.53 <sup>00</sup>           | 0.26          | 45.78 |
| 29. | Dajana             | 4.80                      | 0.20          | 9.32  | 3.33***                      | 0.24          | 16.11 |
| 30. | Parka              | 4.00 <sup>00</sup>        | 0.46          | 28.16 | 2.63*                        | 0.25          | 21.06 |
| 31. | Raba               | 6.00***                   | 0.37          | 14.42 | 2.67*                        | 0.26          | 30.23 |
| 32. | Viola              | 5.33                      | 0.40          | 16.56 | 3.33***                      | 0.40          | 26.30 |
| 33. | Taplanszentkereszt | 4.83                      | 0.31          | 14.14 | 2.60                         | 0.24          | 21.06 |
| 34. | Select             | 4.93                      | 0.62          | 29.16 | 2.80**                       | 0.24          | 21.06 |
| 35. | Krano Pajbjerg     | 6.93***                   | 0.45          | 14.28 | 2.93***                      | 0.37          | 29.88 |
| 36. | Rajah              | 4.63                      | 0.75          | 31.58 | 4.00***                      | 0.44          | 25.48 |
| 37. | Jokoinen           | 4.07 <sup>00</sup>        | 0.49          | 17.67 | 2.07                         | 0.55          | 61.27 |
| 38. | Bjorn              | 5.07                      | 0.37          | 16.09 | 2.13                         | 0.37          | 38.03 |
| 39. | Britta             | 5.33                      | 0.24          | 10.14 | 1.87                         | 0.37          | 46.48 |

|             |                  |                   |      |       |       |      |       |
|-------------|------------------|-------------------|------|-------|-------|------|-------|
| 40.         | Elin             | 5.73***           | 0.40 | 15.97 | 2.53  | 0.50 | 43.85 |
| 41.         | Hermes II        | 5.93***           | 0.20 | 9.64  | 2.63* | 0.37 | 34.47 |
| 42.         | Kora             | 4.43              | 0.40 | 20.32 | 2.20  | 0.37 | 38.03 |
| 43.         | Pallas           | 5.67**            | 0.20 | 7.71  | 2.53  | 0.24 | 21.06 |
| 44.         | Redqwin          | 4.27 <sup>0</sup> | 0.33 | 13.32 | 2.57  | 0.33 | 21.65 |
| 45.         | Grasslands Hamua | 4.87              | 0.20 | 9.31  | 1.87  | 0.37 | 38.03 |
| DL (p 5%)   |                  | 0.51              |      | 0.41  |       |      |       |
| DL (p 1%)   |                  | 0.68              |      | 0.54  |       |      |       |
| DL (p 0.1%) |                  | 0.88              |      | 0.69  |       |      |       |

Table 3

The height of plants at harvest time (cm)

| Va<br>r | Cultivar            | 1 <sup>st</sup> year |               |       | 2 <sup>nd</sup> year |               |       |
|---------|---------------------|----------------------|---------------|-------|----------------------|---------------|-------|
|         |                     | $\bar{X}$            | $s_{\bar{x}}$ | s%    | $\bar{X}$            | $s_{\bar{x}}$ | s%    |
| 1.      | Roxana (Mt.)        | 19.6                 | 1.9           | 17.82 | 52.0                 | 1.4           | 6.77  |
| 2.      | Arni                | 27.3                 | 1.4           | 14.78 | 45.3                 | 2.7           | 9.57  |
| 3.      | Nessonas            | 31.3*                | 1.6           | 12.56 | 43.0 <sup>0</sup>    | 3.4           | 11.56 |
| 4.      | Bolognino           | 17.0                 | 2.2           | 25.36 | 30.0 <sup>000</sup>  | 2.1           | 15.67 |
| 5.      | Joseph              | 27.6                 | 2.1           | 18.74 | 46.0                 | 1.5           | 5.18  |
| 6.      | Milo                | 22.3                 | 2.0           | 19.45 | 59.3                 | 4.6           | 14.01 |
| 7.      | Vignola             | 23.6                 | 2.0           | 17.52 | 57.3                 | 1.5           | 4.64  |
| 8.      | Essex Broad Red     | 33.0**               | 2.3           | 20.54 | 59.6                 | 2.9           | 12.06 |
| 9.      | Gumpensteiner       | 20.6                 | 2.2           | 23.65 | 49.3                 | 2.1           | 6.55  |
| 10.     | Reichersberger Neu  | 19.6                 | 2.0           | 19.52 | 63.3**               | 1.2           | 3.45  |
| 11.     | Mercury             | 22.0                 | 1.5           | 11.56 | 44.6                 | 0.6           | 2.43  |
| 12.     | Merviot             | 17.6                 | 1.4           | 13.58 | 54.3                 | 2.1           | 9.12  |
| 13.     | Violetta            | 21.3                 | 1.4           | 12.36 | 50.6                 | 1.8           | 7.20  |
| 14.     | Start               | 27.6                 | 1.5           | 11.50 | 57.3                 | 2.1           | 5.82  |
| 15.     | Renova              | 25.5                 | 2.0           | 17.63 | 56.6                 | 3.2           | 9.77  |
| 16.     | Ruttinova           | 23.6                 | 2.1           | 18.55 | 51.6                 | 1.6           | 5.58  |
| 17.     | Cardinal            | 22.0                 | 0.6           | 9.85  | 49.6                 | 0.9           | 2.84  |
| 18.     | Triel               | 35.0***              | 0.6           | 8.56  | 60.3*                | 0.3           | 0.95  |
| 19.     | Verdi               | 18.3                 | 0.4           | 10.24 | 58.3                 | 1.9           | 5.51  |
| 20.     | Heges Hohenheimer   | 24.5                 | 2.7           | 26.97 | 57.3                 | 4.6           | 20.10 |
| 21.     | Lucrum              | 27.3                 | 2.6           | 24.81 | 42.3 <sup>0</sup>    | 4.3           | 16.55 |
| 22.     | Nemaro              | 32.0**               | 2.3           | 20.54 | 51.6                 | 1.9           | 8.87  |
| 23.     | Odenwalder Rotklee  | 36.6***              | 2.1           | 19.74 | 49.0                 | 3.3           | 15.28 |
| 24.     | Pirat               | 26.0                 | 2.2           | 24.07 | 55.6                 | 2.5           | 11.32 |
| 25.     | Fox                 | 34.5**               | 0.4           | 7.48  | 56.3                 | 1.4           | 1.45  |
| 26.     | Jonas               | 24.6                 | 1.4           | 14.52 | 58.3                 | 2.6           | 7.95  |
| 27.     | Rode Maasklaver     | 18.0                 | 2.1           | 20.36 | 52.6                 | 2.0           | 9.30  |
| 28.     | Bryza               | 21.3                 | 1.4           | 14.85 | 52.0                 | 2.6           | 8.00  |
| 29.     | Dajana              | 19.0                 | 3.8           | 33.25 | 45.6                 | 3.6           | 18.90 |
| 30.     | Parka               | 20.3                 | 2.0           | 21.15 | 58.6                 | 1.6           | 7.57  |
| 31.     | Raba                | 17.6                 | 2.1           | 25.41 | 30.3 <sup>000</sup>  | 2.9           | 14.38 |
| 32.     | Viola               | 14.0                 | 2.0           | 23.14 | 60.6*                | 1.5           | 4.40  |
| 33.     | Taplanszentkereszti | 27.6                 | 2.1           | 22.71 | 49.0                 | 4.3           | 14.25 |
| 34.     | Select              | 20.0                 | 2.0           | 21.87 | 51.6                 | 3.5           | 16.40 |
| 35.     | Krano Pajbjerg      | 18.3                 | 2.3           | 25.63 | 48.0                 | 1.7           | 5.69  |
| 36.     | Rajah               | 21.0                 | 2.4           | 23.87 | 37.6 <sup>000</sup>  | 2.6           | 15.52 |
| 37.     | Jokoinen            | 17.0                 | 2.6           | 26.72 | 31.0 <sup>000</sup>  | 1.8           | 14.36 |
| 38.     | Bjorn               | 18.0                 | 2.3           | 26.57 | 41.0 <sup>00</sup>   | 1.5           | 6.45  |
| 39.     | Britta              | 23.6                 | 2.0           | 22.17 | 48.3                 | 1.7           | 6.03  |
| 40.     | Elin                | 16.0                 | 3.5           | 29.34 | 42.0 <sup>0</sup>    | 0.8           | 3.95  |

|             |                  |      |     |       |                   |     |       |
|-------------|------------------|------|-----|-------|-------------------|-----|-------|
| 41.         | Hermes II        | 17.0 | 1.9 | 20.24 | 47.3              | 0.6 | 5.02  |
| 42.         | Kora             | 17.6 | 1.9 | 19.54 | 43.6 <sup>0</sup> | 0.6 | 2.43  |
| 43.         | Pallas           | 17.3 | 2.1 | 24.17 | 44.6              | 3.5 | 12.38 |
| 44.         | Redqwin          | 27.3 | 1.2 | 14.21 | 47.0              | 0.6 | 2.08  |
| 45.         | Grasslands Hamua | 22.0 | 2.1 | 18.22 | 46.6              | 2.2 | 10.94 |
| DL (p 5%)   |                  | 9.1  |     |       | 7.7               |     |       |
| DL (p 1%)   |                  | 11.9 |     |       | 10.1              |     |       |
| DL (p 0.1%) |                  | 15.2 |     |       | 13.1              |     |       |

Table 4

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

| Va<br>r | Cultivar            | Percentage of leaves (%) |      |      | Number of flowers/inflorescence |               |       | Weight of 1000 seeds |      |      |
|---------|---------------------|--------------------------|------|------|---------------------------------|---------------|-------|----------------------|------|------|
|         |                     | $\bar{X}$                | Dif. | Sig. | $\bar{X}$                       | $s_{\bar{x}}$ | s%    | $\bar{X}$            | Dif. | Sig. |
| 1.      | Roxana (Mt.)        | 35                       | 0    | -    | 86.9                            | 4.8           | 9.71  | 1.8                  | -    | -    |
| 2.      | Arni                | 40                       | 5    | -    | 105.6                           | 10.7          | 24.95 | 1.7                  | -0.1 | -    |
| 3.      | Nessonas            | 38                       | 3    | -    | 109.5                           | 14.2          | 36.65 | 1.6                  | -0.2 | -    |
| 4.      | Bolognino           | 45                       | 10   | ***  | 165.3 ***                       | 55.0          | 47.14 | 1.9                  | 0.1  | -    |
| 5.      | Joseph              | 40                       | 5    | -    | 98.7                            | 6.0           | 10.75 | 2.0                  | 0.2  | -    |
| 6.      | Milo                | 42                       | 7    | **   | 135.2 *                         | 5.8           | 7.51  | 1.8                  | -    | -    |
| 7.      | Vignola             | 35                       | 0    | -    | 117.8                           | 14.8          | 32.30 | 1.7                  | -0.1 | -    |
| 8.      | Essex Broad Red     | 34                       | -1   | -    | 107.2                           | 6.1           | 9.94  | 1.5                  | -0.3 | -    |
| 9.      | Gumpensteiner       | 40                       | 5    | -    | 127.9 *                         | 11.1          | 19.88 | 1.9                  | 0.1  | -    |
| 10.     | Reichersberger Neu  | 36                       | 1    | -    | 79.8                            | 9.6           | 33.75 | 1.8                  | -    | -    |
| 11.     | Mercury             | 38                       | 3    | -    | 84.2                            | 9.1           | 25.96 | 1.6                  | -0.2 | -    |
| 12.     | Merviot             | 39                       | 4    | -    | 98.9                            | 5.0           | 8.88  | 1.6                  | -0.2 | -    |
| 13.     | Violetta            | 38                       | 3    | -    | 97.1                            | 10.1          | 18.06 | 2.0                  | 0.2  | -    |
| 14.     | Start               | 44                       | 9    | **   | 87.6                            | 10.7          | 21.11 | 1.9                  | 0.1  | -    |
| 15.     | Renova              | 45                       | 10   | ***  | 103.3                           | 9.5           | 22.52 | 2.0                  | 0.2  | -    |
| 16.     | Ruttinova           | 40                       | 5    | -    | 148.3 **                        | 15.2          | 25.01 | 2.1                  | 0.3  | -    |
| 17.     | Cardinal            | 35                       | 0    | -    | 147.5 **                        | 20.3          | 29.43 | 1.5                  | -0.3 | -    |
| 18.     | Triel               | 45                       | 10   | ***  | 213.6 ***                       | 22.4          | 26.16 | 1.6                  | -0.2 | -    |
| 19.     | Verdi               | 42                       | 7    | **   | 117.6                           | 11.9          | 25.66 | 1.7                  | -0.1 | -    |
| 20.     | Heges Hohenheimer   | 38                       | 3    | -    | 106.8                           | 4.2           | 8.87  | 1.8                  | -    | -    |
| 21.     | Lucrum              | 39                       | 4    | -    | 107.9                           | 2.8           | 5.95  | 1.8                  | -    | -    |
| 22.     | Nemaro              | 35                       | 0    | -    | 124.1 *                         | 6.7           | 11.94 | 1.9                  | 0.1  | -    |
| 23.     | Odenwalder Rotklee  | 30                       | -5   | -    | 113.5                           | 8.4           | 17.97 | 1.7                  | -0.1 | -    |
| 24.     | Pirat               | 30                       | -5   | -    | 83.9                            | 4.9           | 10.34 | 1.9                  | 0.1  | -    |
| 25.     | Fox                 | 28                       | -7   | 00   | 138.0 **                        | 8.1           | 10.17 | 1.4                  | -0.4 | 0    |
| 26.     | Jonas               | 28                       | -7   | 00   | 93.7                            | 5.0           | 9.36  | 1.5                  | -0.3 | -    |
| 27.     | Rode Maasklaver     | 30                       | -5   | -    | 71.3                            | 2.0           | 4.22  | 1.6                  | -0.2 | -    |
| 28.     | Bryza               | 30                       | -5   | -    | 73.3                            | 7.1           | 14.35 | 1.8                  | -    | -    |
| 29.     | Dajana              | 30                       | -5   | -    | 94.1                            | 5.5           | 13.76 | 1.8                  | -    | -    |
| 30.     | Parka               | 38                       | 3    | -    | 168.9 ***                       | 18.8          | 28.74 | 1.6                  | -0.2 | -    |
| 31.     | Raba                | 32                       | -3   | -    | 74.7                            | 15.7          | 36.78 | 1.4                  | -0.4 | 0    |
| 32.     | Viola               | 30                       | -5   | -    | 102.0                           | 8.6           | 16.68 | 1.5                  | -0.3 | -    |
| 33.     | Taplanszentkereszti | 35                       | 0    | -    | 102.9                           | 8.9           | 20.85 | 1.9                  | 0.1  | -    |
| 34.     | Select              | 35                       | 0    | -    | 113.8                           | 3.8           | 5.85  | 1.7                  | -0.1 | -    |
| 35.     | Krano Pajbjerg      | 40                       | 5    | -    | 92.5                            | 13.0          | 19.98 | 1.2                  | -0.6 | 0    |
| 36.     | Rajah               | 42                       | 7    | **   | 103.8                           | 6.6           | 11.01 | 1.4                  | -0.4 | 0    |
| 37.     | Jokoinen            | 40                       | 5    | -    | 79.1                            | 8.3           | 25.41 | 1.3                  | -0.5 | 0    |
| 38.     | Bjorn               | 39                       | 4    | -    | 136.8 **                        | 3.7           | 6.18  | 1.2                  | -0.6 | 0    |
| 39.     | Britta              | 40                       | 5    | -    | 99.9                            | 9.4           | 23.52 | 1.4                  | -0.4 | 0    |

|             |                  |     |    |    |          |      |       |     |      |    |
|-------------|------------------|-----|----|----|----------|------|-------|-----|------|----|
| 40.         | Elin             | 42  | 7  | ** | 85.3     | 7.6  | 15.59 | 1.4 | -0.4 | 0  |
| 41.         | Hermes II        | 42  | 7  | ** | 97.0     | 12.4 | 22.19 | 1.6 | -0.2 | -  |
| 42.         | Kora             | 40  | 5  | -  | 89.2     | 8.2  | 16.12 | 1.1 | -0.7 | 00 |
| 43.         | Pallas           | 40  | 5  | -  | 106.5    | 7.6  | 16.06 | 1.3 | -0.5 | 0  |
| 44.         | Redqwin          | 30  | -5 | -  | 94.9     | 7.8  | 14.34 | 1.3 | -0.5 | 0  |
| 45.         | Grasslands Hamua | 35  | 0  | -  | 145.7 ** | 14.7 | 24.87 | 2.0 | 0.2  | -  |
| DL (p 5%)   |                  | 5.3 |    |    | 36.7     |      |       | 0.4 |      |    |
| DL (p 1%)   |                  | 6.9 |    |    | 48.5     |      |       | 0.7 |      |    |
| DL (p 0.1%) |                  | 9.1 |    |    | 62.7     |      |       | 1.1 |      |    |

As regards the internodes/stem trait, there were a lot of cultivars with statistically assured differences as compared to the control (Roxana), such as Bolognino, Nessonas – South-European ecotypes; Cardinal, Nemaro, H. Hohenheimer, Raba – Central- European and K. Pajbjerg, Elin, Hermes, Hermes II, Palas – Northern-European ecotypes. The study of the number of ramifications/stem outlined the South-European cultivars (Bolognino, Vignola and Nessonas, the Central European (Lucrum and Renova) and Northern-European ones (Krano Pajbjerg and Rajah) as having significant differences in comparison with the control.

The height of the red clover plants at harvest time, in the two years of growth, is presented in Table 3.

In the first year, seven cultivars were identified with statistically assured positive differences as compared to the control (Roxana), one of them being South-European (Nessonas) and the other six, Central-European (Triel, O. Rotklee, Nemaro, Jonas, Essex Broad Red and Fox). In the second year the Central-European cultivars grew higher than the other ecotypes; out of these, the most remarkable ones, by their statistically assured differences in comparison with the control, were Reichersberger Neu, Viola and Triel.

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 Rajah (Denmark) and Elin and Hermes II (Sweden), with distinct significant differences as compared to the control.

The biggest number of flowers/inflorescence was noted in the case of the Southern (Bolognino) and Central European cultivars (Gumpensteiner, Nemaro, Ruttinova, Cardinal, Fox, Parka and Triel). Some of the plants belonging to the French Triel cultivar had multiple inflorescences, which should be taken into consideration by the breeding programmes.

The highest values of the weight of one thousand seeds came from the Central-European cultivars Temara and Maragto, which are very early. This aspect proves the fact that the size of the seed is influenced, up to a certain extent, by the earliness of the cultivar.

Table 5 presents the earliness of the diploid red clover cultivars. For the study of this trait were taken into consideration the date of the flowering (year 1) and the dates of the first and second cut (year 2). Out of the studied cultivars, the most early ones were those from Switzerland, Renova and Ruttinova, which flowered, in the first year, five days earlier than the control, and in the second year were harvested 15 days earlier at the first cut and 10 days earlier at the second cut.

The regrowth ability (height of the plants and percentage of plants with flowers one month after the cut) is presented in Table 6. The Italian cultivars Milo and Vignola (*subvar. praecox*) had the biggest height one month after the cut, with significant differences in comparison with the control. One month after the cut, in the first year, the Northern-European cultivars had not flowered yet and the other ecotypes had medium flowering percentages, which varied between 1.6% (the South-European cultivars) and 5.6% (the Central-European cultivars). Among the Central European cultivars, the Swiss ones - Renova

and Ruttinova - were remarked for their rich flowering, with very significant differences as compared to the control.

Table 7 presents the frequency of mildew powder and 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.

In the *praecox subvar.* the most resistant cultivars were Arni and Vignola; in the *intermedium subvar.* the Raba, Bryza and Cardina cultivars, and in the *serotinum var.* - the Bjorn cultivar. The Romanian cultivars showed good resistance to mildew-powder, with very low attack frequency (10%).

Table 5

The earliness of the diploid red clover cultivars

| Var. | Cultivar            | Date of the flowering |             | Date of first cut<br>(50% plants with flowers) |             | Date of second cut<br>(50% plants with flowers) |             |
|------|---------------------|-----------------------|-------------|--|-------------|---|-------------|
|      |                     | $\bar{X}$             | Dif. (days) | $\bar{X}$                                      | Dif. (days) | $\bar{X}$                                       | Dif. (days) |
| 1.   | Roxana (Mt)         | 30.07                 | -           | 6.06   | -           | 11.07   | -           |
| 2.   | Arni                | 24.07                 | -6          | 6.06   | -           | 11.07   | -           |
| 3.   | Nessonas            | 10.07                 | -20         | 30.05  | -7          | 5.07  | -6          |
| 4.   | Bolognino           | 20.08                 | 21          | 10.06  | 4           | 15.07   | 4           |
| 5.   | Joseph              | 31.07                 | 1           | 4.06   | -2          | 9.07  | -2          |
| 6.   | Milo                | 23.07                 | -7          | 28.05  | -9          | 5.07  | -6          |
| 7.   | Vignola             | 18.07                 | -12         | 2.06   | -4          | 7.07  | -4          |
| 8.   | Essex Broad Red     | 14.07                 | -16         | 6.06   | -           | 11.07   | -           |
| 9.   | Gumpensteiner       | 17.07                 | -13         | 1.06   | -5          | 7.07  | -4          |
| 10.  | Reichersberger Neu  | 10.08                 | 11          | 29.05  | -8          | 12.07   | 1           |
| 11.  | Mercury             | 8.08                  | 9           | 2.06   | -4          | 15.07   | 4           |
| 12.  | Merviot             | 9.08                  | 10          | 6.06   | -           | 11.07   | -           |
| 13.  | Violetta            | 26.07                 | -4          | 2.06   | -4          | 17.07   | 6           |
| 14.  | Start               | 23.07                 | -7          | 2.06   | -4          | 7.07  | -4          |
| 15.  | Renova              | 25.07                 | -5          | 22.05  | -15         | 1.07  | -10         |
| 16.  | Ruttinova           | 26.07                 | -4          | 22.05  | -15         | 1.07  | -10         |
| 17.  | Cardinal            | 3.08                  | 4           | 4.06   | -2          | 9.07  | -2          |
| 18.  | Triel               | 9.07                  | -21         | 24.05  | -13         | 3.07  | -8          |
| 19.  | Verdi               | 26.07                 | -4          | 24.05  | -13         | 3.07  | -8          |
| 20.  | Heges Hohenheimer   | 16.07                 | -14         | 30.05  | -7          | 12.07   | 1           |
| 21.  | Lucrum              | 15.07                 | -15         | 4.06   | -2          | 17.07   | 6           |
| 22.  | Nemaro              | 19.07                 | -11         | 2.06   | -4          | 15.07   | 4           |
| 23.  | Odenwalder Rotklee  | 21.07                 | -9          | 30.05  | -7          | 5.07  | -6          |
| 24.  | Pirat               | 13.08                 | 14          | 2.06   | -4          | 7.07  | -4          |
| 25.  | Fox                 | 11.07                 | -19         | 30.05  | -7          | 5.07  | -6          |
| 26.  | Jonas               | 20.07                 | -10         | 6.06   | -           | 11.07   | -           |
| 27.  | Rode Maasklaver     | 13.07                 | -17         | 2.06   | -4          | 15.07   | 4           |
| 28.  | Bryza               | 5.08                  | 6           | 30.05  | -7          | 12.07   | 1           |
| 29.  | Dajana              | 30.07                 | -           | 4.06   | -2          | 9.07  | -2          |
| 30.  | Parka               | 7.08                  | 8           | 2.06   | -4          | 7.07  | -4          |
| 31.  | Raba                | 20.08                 | 21          | 6.06   | -           | 22.07   | 11          |
| 32.  | Viola               | 9.08                  | 10          | 6.06   | -           | 11.07   | -           |
| 33.  | Taplanszentkereszti | 8.08                  | 9           | 4.06   | -2          | 9.07  | -2          |
| 34.  | Select              | 5.08                  | 6           | 4.06   | -2          | 9.07  | -2          |
| 35.  | Krano Pajbjerg      | 13.08                 | 14          | 10.06  | 4           | 27.07   | 16          |
| 36.  | Rajah               | 15.08                 | 16          | 10.06  | 4           | 22.07   | 11          |
| 37.  | Jokoinen            | 25.08                 | 26          | 20.06  | 14          | 14.08   | 34          |

|     |                 |       |     |       |    |       |    |
|-----|-----------------|-------|-----|-------|----|-------|----|
| 38. | Bjorn           | 22.08 | 23  | 15.06 | 9  | 10.08 | 30 |
| 39. | Britta          | 18.08 | 19  | 15.06 | 9  | 5.08  | 25 |
| 40. | Elin            | 22.08 | 23  | 15.06 | 9  | 1.08  | 21 |
| 41. | Hermes II       | 23.08 | 24  | 15.06 | 9  | 1.08  | 21 |
| 42. | Kora            | 18.08 | 19  | 15.06 | 9  | 5.08  | 25 |
| 43. | Pallas          | 18.08 | 19  | 15.06 | 9  | 5.08  | 25 |
| 44. | Redqwin         | 16.07 | -14 | 4.06  | -2 | 17.07 | 6  |
| 45. | Graslands Hamua | 18.07 | -12 | 28.05 | -9 | 12.07 | 1  |

Table 6

## The regrowth ability

| Var. | Cultivar            | Height of plants (cm)<br>(one month after harvest) |               |       | Plants with flowers (%)<br>(one month after harvest) |            |              |
|------|---------------------|--|---------------|-------|--|------------|--------------|
|      |                     | $\bar{X}$  | $s_{\bar{x}}$ | s%    | $\bar{X}$  | Difference | Significance |
| 1.   | Roxana (Mt.)        | 9.6  | 0.9           | 8.49  | 1.3  | 0.0        | -            |
| 2.   | Arni                | 9.0  | 0.5           | 7.04  | 1.6  | 0.3        | -            |
| 3.   | Nessonas            | 8.3  | 0.4           | 5.98  | 1.6  | 0.3        | -            |
| 4.   | Bolognino           | 9.0  | 1.2           | 12.08 | 0.0  | -1.3       | -            |
| 5.   | Joseph              | 10.0   | 0.8           | 8.92  | 1.6  | 0.3        | -            |
| 6.   | Milo                | 15.0**   | 1.3           | 9.26  | 4.0  | 2.7        | -            |
| 7.   | Vignola             | 13.3*  | 1.1           | 8.34  | 1.0  | -0.3       | -            |
| 8.   | Essex Broad Red     | 10.6   | 0.7           | 9.78  | 0.0  | -1.3       | -            |
| 9.   | Gumpensteiner       | 10.0   | 1.1           | 11.26 | 4.0  | 2.7        | -            |
| 10.  | Reichersberger Neu  | 9.6  | 1.0           | 9.30  | 3.3  | 2.0        | -            |
| 11.  | Mercury             | 8.0  | 0.5           | 5.50  | 0.6  | -0.7       | -            |
| 12.  | Merviot             | 10.0   | 0.8           | 6.47  | 0.6  | -0.7       | -            |
| 13.  | Violetta            | 10.3   | 0.7           | 5.89  | 3.3  | 2.0        | -            |
| 14.  | Start               | 10.0   | 0.5           | 5.48  | 9.3  | 8.0        | *            |
| 15.  | Renova              | 11.0   | 0.9           | 8.40  | 33.3   | 32.0       | ***          |
| 16.  | Ruttinova           | 11.6   | 1.0           | 8.83  | 36.6   | 35.3       | ***          |
| 17.  | Cardinal            | 8.6  | 0.2           | 4.69  | 8.3  | 7.0        | -            |
| 18.  | Triel               | 9.0  | 0.2           | 4.08  | 12.3   | 11.0       | **           |
| 19.  | Verdi               | 9.6  | 0.2           | 4.88  | 0.0  | -1.3       | -            |
| 20.  | Heges Hohenheimer   | 10.3   | 1.1           | 12.84 | 1.0  | -0.3       | -            |
| 21.  | Lucrum              | 10.0   | 1.0           | 11.81 | 0.0  | -1.3       | -            |
| 22.  | Nemaro              | 11.0   | 0.8           | 9.78  | 8.6  | 7.3        | -            |
| 23.  | Odenwalder Rotklee  | 11.6   | 0.7           | 9.40  | 0.0  | -1.3       | -            |
| 24.  | Pirat               | 10.0   | 0.8           | 11.46 | 4.0  | 2.7        | -            |
| 25.  | Fox                 | 12.0   | 0.1           | 3.56  | 1.6  | 0.3        | -            |
| 26.  | Jonas               | 11.3   | 0.6           | 6.91  | 5.0  | 3.7        | -            |
| 27.  | Rode Maasklaver     | 13.0   | 1.5           | 9.70  | 0.0  | -1.3       | -            |
| 28.  | Bryza               | 11.3   | 0.7           | 7.07  | 6.6  | 5.3        | -            |
| 29.  | Dajana              | 10.6   | 2.1           | 15.83 | 1.0  | -0.3       | -            |
| 30.  | Parka               | 10.0   | 1.0           | 10.07 | 5.6  | 4.3        | -            |
| 31.  | Raba                | 9.3  | 1.1           | 12.10 | 0.0  | -1.3       | -            |
| 32.  | Viola               | 10.0   | 1.4           | 11.02 | 1.0  | -0.3       | -            |
| 33.  | Taplanszentkereszti | 11.0   | 0.8           | 10.81 | 1.6  | 0.3        | -            |
| 34.  | Select              | 9.0  | 0.9           | 10.41 | 0.0  | -1.3       | -            |
| 35.  | Krano Pajbjerg      | 7.6  | 1.0           | 12.20 | 0.0  | -1.3       | -            |
| 36.  | Rajah               | 7.0  | 0.8           | 11.37 | 0.0  | -1.3       | -            |
| 37.  | Jokoinen            | 6.3  | 1.0           | 12.72 | 0.0  | -1.3       | -            |

|             |                  |      |     |       |      |      |   |
|-------------|------------------|------|-----|-------|------|------|---|
| 38.         | Bjorn            | 10.0 | 1.3 | 12.65 | 0.0  | -1.3 | - |
| 39.         | Britta           | 12.0 | 1.0 | 10.56 | 0.0  | -1.3 | - |
| 40.         | Elin             | 9.6  | 2.1 | 13.97 | 3.3  | 2.0  | - |
| 41.         | Hermes II        | 8.6  | 1.0 | 9.64  | 0.0  | -1.3 | - |
| 42.         | Kora             | 9.0  | 1.0 | 9.30  | 0.0  | -1.3 | - |
| 43.         | Pallas           | 9.0  | 1.1 | 11.51 | 0.0  | -1.3 | - |
| 44.         | Redqwin          | 10.3 | 0.5 | 6.77  | 2.3  | 1.0  | - |
| 45.         | Grasslands Hamua | 10.3 | 1.0 | 8.68  | 0.0  | -1.3 | - |
| DL (p 5%)   |                  | 8.2  |     |       | 7.7  |      |   |
| DL (p 1%)   |                  | 10.9 |     |       | 10.2 |      |   |
| DL (p 0.1%) |                  | 14.0 |     |       | 13.2 |      |   |

Table 7  
Frequency of mildew powder (%) and cold resistance (% of surviving plants at the end of winter)

| Var. | Cultivar            | Frequency of mildew powder | Difference | Signif. | Surviving plants (%) | Difference | Signif. |
|------|---------------------|----------------------------|------------|---------|----------------------|------------|---------|
| 1.   | Roxana (Mt.)        | 10.0                       | 0.0        | -       | 41.6                 | 0.0        | -       |
| 2.   | Arni                | 8.3                        | -1.7       | -       | 33.3                 | -8.3       | -       |
| 3.   | Nessonas            | 18.3                       | 8.3        | *       | 38.3                 | -3.3       | -       |
| 4.   | Bolognino           | 38.3                       | 28.3       | ***     | 30.0                 | -11.6      | -       |
| 5.   | Joseph              | 9.3                        | -0.7       | -       | 48.3                 | 6.7        | -       |
| 6.   | Milo                | 16.6                       | 6.6        | -       | 50.0                 | 8.4        | -       |
| 7.   | Vignola             | 1.0                        | -9.0       | 0       | 46.6                 | 5.0        | -       |
| 8.   | Essex Broad Red     | 18.3                       | 8.3        | *       | 58.3                 | 16.7       | -       |
| 9.   | Gumpensteiner       | 7.6                        | -2.4       | -       | 68.3                 | 26.7       | *       |
| 10.  | Reichersberger Neu  | 55.0                       | 45.0       | ***     | 55.0                 | 13.4       | -       |
| 11.  | Mercury             | 28.3                       | 18.3       | ***     | 56.6                 | 15.0       | -       |
| 12.  | Merviot             | 26.6                       | 16.6       | ***     | 60.0                 | 18.4       | -       |
| 13.  | Violetta            | 31.6                       | 21.6       | ***     | 36.6                 | -5.0       | -       |
| 14.  | Start               | 13.3                       | 3.3        | -       | 51.6                 | 10.0       | -       |
| 15.  | Renova              | 93.3                       | 83.3       | ***     | 36.6                 | -5.0       | -       |
| 16.  | Ruttinova           | 86.6                       | 76.6       | ***     | 38.3                 | -3.3       | -       |
| 17.  | Cardinal            | 5.0                        | -5.0       | -       | 16.6                 | -25.0      | 0       |
| 18.  | Triel               | 15.0                       | 5.0        | -       | 51.6                 | 10.0       | -       |
| 19.  | Verdi               | 75.0                       | 65.0       | ***     | 23.3                 | -18.3      | -       |
| 20.  | Heges Hohenheimer   | 48.3                       | 38.3       | ***     | 35.0                 | -6.6       | -       |
| 21.  | Lucrum              | 11.6                       | 1.6        | -       | 60.0                 | 18.4       | -       |
| 22.  | Nemaro              | 38.3                       | 28.3       | ***     | 65.0                 | 23.4       | *       |
| 23.  | Odenwalder Rotklee  | 71.6                       | 61.6       | ***     | 50.0                 | 8.4        | -       |
| 24.  | Pirat               | 14.3                       | 4.3        | -       | 46.6                 | 5.0        | -       |
| 25.  | Fox                 | 16.6                       | 6.6        | -       | 76.6                 | 35.0       | **      |
| 26.  | Jonas               | 13.3                       | 3.3        | -       | 63.3                 | 21.7       | -       |
| 27.  | Rode Maasklaver     | 8.3                        | -1.7       | -       | 13.3                 | -28.3      | 0       |
| 28.  | Bryza               | 3.3                        | -6.7       | -       | 31.6                 | -10.0      | -       |
| 29.  | Dajana              | 5.0                        | -5.0       | -       | 40.0                 | -1.6       | -       |
| 30.  | Parka               | 20.0                       | 10.0       | **      | 36.6                 | -5.0       | -       |
| 31.  | Raba                | 1.6                        | -8.4       | 0       | 40.0                 | -1.6       | -       |
| 32.  | Viola               | 8.3                        | -1.7       | -       | 30.0                 | -11.6      | -       |
| 33.  | Taplanszentkereszti | 18.3                       | 8.3        | *       | 30.0                 | -11.6      | -       |
| 34.  | Select              | 11.6                       | 1.6        | -       | 41.6                 | 0.0        | -       |
| 35.  | Krano Pajbjerg      | 18.3                       | 8.3        | *       | 68.3                 | 26.7       | *       |
| 36.  | Rajah               | 23.3                       | 13.3       | ***     | 56.6                 | 15.0       | -       |
| 37.  | Jokoinen            | 13.3                       | 3.3        | -       | 28.3                 | -13.3      | -       |

|             |                  |      |       |     |      |      |    |
|-------------|------------------|------|-------|-----|------|------|----|
| 38.         | Bjorn            | 0.0  | -10.0 | 00  | 41.6 | 0.0  | -  |
| 39.         | Britta           | 16.6 | 6.6   | -   | 56.6 | 15.0 | -  |
| 40.         | Elin             | 25.0 | 15.0  | *** | 50.0 | 8.4  | -  |
| 41.         | Hermes II        | 5.0  | -5.0  | -   | 45.0 | 3.4  | -  |
| 42.         | Kora             | 21.6 | 11.6  | **  | 76.6 | 35.0 | ** |
| 43.         | Pallas           | 5.0  | -5.0  | -   | 50.0 | 8.4  | -  |
| 44.         | Redqwin          | 11.6 | 1.6   | -   | 46.6 | 5.0  | -  |
| 45.         | Grasslands Hamua | 8.3  | -1.7  | -   | 45.0 | 3.4  | -  |
| DL (p 5%)   |                  | 11.5 |       |     | 22.0 |      |    |
| DL (p 1%)   |                  | 13.4 |       |     | 29.0 |      |    |
| DL (p 0.1%) |                  | 15.7 |       |     | 37.6 |      |    |

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), was 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.

#### CONCLUSIONS

It has noticed a wide range of the variability of the main traits of the studied diploid red clover cultivars, which allows identifying valuable genitors for the breeding programmes. Making a comparison between the average growth rhythms of the red clover plants in the two years of vegetation, could note the fact 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 the plant height was much smaller in the second year, with a tendency to reduce the differences. In the first year, the highest values in what the plant height was concerned came from the South-European cultivars (*subvar. praecox*), and in the second year from the Central-European ones (*subvar. intermedium*). The highest values of the average number of ramifications per stem were obtained in the case of the South-European (*subvar. praecox*) and North-European (*var. serotinum*) cultivars, which proves the fact that this trait is not influenced by the ecologic conditions in which the cultivar 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 diploid germplasm of red clover that was 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 the breeding of the tetraploid cultivars. For the red clover germplasm, 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 and South-European groups), as well as to var. *expansum* (the North-American group). These could be therefore used as genitors for increasing the seed yield.

Within the red clover germplasm, the earliest cultivars, both in the first and in the second year, were those from Switzerland, which flowered two weeks before the Romanian cultivars used as control. 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 diploid red clover cultivars has average variability in the first year and high variability in the second year. 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. Generally speaking, the cultivars with very good resistance to mildew powder are those from southern Europe (subvar. *praecox*); this characteristic is one of the most important goals of the breeding programmes in the origin area, given the specific climatic conditions (increased soil and air drought). The Romanian diploid cultivars Roxana and Select showed good resistance to *Erysiphe trifolii*.

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#### REZUMAT

#### VARIABILITATEA UNOR CARACTERISTICI IMPORTANTE PENTRU AMELIORAREA TRIFOIULUI ROȘU, LA DIFERITE SOIURI DIPLOIDE STUDIATE ÎN CONDIȚIILE ECOLOGICE DE LA CLUJ-NAPOCA

Însușirile valoroase ale trifoiului roșu (productivitatea, rezistența la factorii biotici și abiotici, precum și calitatea) sunt dependente de o multitudine de însușiri morfologice și fiziologice, care sunt

sub influența unor factori genetici și de mediu. În condițiile de la Cluj-Napoca s-a urmărit variabilitatea însușirilor morfologice și fiziologice la 45 cultivaruri diploide de trifoi roșu și implicațiile acestora asupra capacității de producție și a calității furajului. Pe baza rezultatelor obținute, se recomandă ca genitori pentru ameliorarea trifoiului roșu pentru producția de masă verde soiurile din Centrul și Vestul Europei (*subvar. intermedium*). Din cadrul acestei subvarietăți s-au remarcat printr-o precocitate sporită și o bună capacitate de regenerare după coasă îndeosebi soiurile Renova și Ruttinova, din Elveția. Soiurile tardive nord-europene (*var. serotinum*) pot fi utilizate ca genitori pentru ridicarea procentului de frunze și pentru sporirea rezistenței la iernare. S-a constatat că, în condițiile de la Cluj-Napoca, rezistența la iernare constituie o caracteristică generală a acestei varietăți. În general, o rezistență foarte bună la fâinare au prezentat soiurile sud europene (*subvar. praecox*), fapt explicabil întrucât rezistența la fâinare a constituit unul dintre principalele obiective de ameliorare, date fiind condițiile climatice ale zonei de origine (secetă atmosferică și pedologică pronunțată).