EVALUATION OF COCK'S-FOOT (*DACTYLIS GLOMERATA* L.) GENETIC RESOURCES FOR BREEDING ACTIVITY

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Abstract

The study of cock's-foot (Dactylis glomerata l.) is integrated into a broader international context, in which forage plant breeding aims not only to maximize production, but also to ensure an efficient and sustainable use of natural resources. Therefore, Dactylis glomerata is emerging as a reference model in breeding programs for perennial grasses, with direct implications for the competitiveness and resilience of contemporary agricultural systems. In our institute, the breeding objectives are to create varieties for complex grassland mixtures, aiming, in addition to increasing forage production, to improve the nutritional value of the forage, resistance to foliar diseases (rusts, leaf spot), competitiveness in mixtures, winter resistance, and perennially. The plant material used in this experiment was represented by 9 accessions –8 local population and one variety. Following the measurements and determinations (plant height, number of vegetative and generative tillers, length and width of the standard leaf, spike length, rust resistance etc.),we can more easily select parental forms of future varieties, depending on the current breeding objectives, the most important of which are adaptability and resistance to stress factors (drought, heavy rainfall, diseases etc.).

Key words: cock's-foot, disease resistance, generative tillers, vegetative tillers,

INTRODUCTION

Dactylis glomerata is considered the most valuable species among perennial meadow grasses. It has a particularly wide ecological plasticity, being cultivated in almost all temperate climate zones of the globe. The cultivation area is from the plain area to the upper limit of the deciduous forest floor and the understory of beech forests. Due to its large ecological amplitude, it can be used in all seasonal conditions, offering multiple possibilities for use in different forms in animal feed. (Mocanu et al, 2021).

It is a species with high production and regeneration potential after use, in optimal vegetation conditions and can achieve 3-4 harvests per year, with productions of over 50 t / ha green mass, or over 12 t / ha D.M. It is recommended to use both in the composition of simple mixtures with alfalfa or red clover that are exploited in haymaking, and in complex mixtures with other species of perennial grasses and legumes, used for pasture or silage. (Varga et al, 1998)

The nutritional value of the feed is remarkable, with a protein content of 13-16.5% and a high degree of consumability and digestibility (60-62%), especially in the young stages, characteristics given by a relatively high proportion of leaves.

The cock's foot has excellent soil cover and can be used in soil erosion control on cleared forest lands or slopes and in the rehabilitation of sites affected by mining exploitation. The deep development of the

roots improves the structure and composition of the soil, in areas prone to summer drought. It has a very good durability, lasting 5-8 years in culture, depending on the exploitation conditions and the cultivation area (Varga et al, 1998).

As a result of the valuable characteristics of the species, the interest in breeding is very high and is determined by the high variability of this species which allows the selection and improvement of new genotypes that meet the breeding objectives. (Varga et al. 1998). This is exploited to obtain improved genotypes, capable of responding to the current challenges generated by climate change, through increased resistance to drought, extreme temperatures and pathogens. At the same time, recent research focuses on improving the digestibility and nutritional value of biomass, a priority objective in optimizing the sustainability of forage production.

Thus, the study of this species is integrated into a broader international context, in which forage plant breeding aims not only to maximize production, but also to ensure an efficient and sustainable use of natural resources. Therefore, *Dactylis glomerata* is emerging as a reference model in breeding programs for perennial grasses, with direct implications for the competitiveness and resilience of contemporary agricultural systems.

In our institute, the breeding objectives are to create varieties for complex grassland mixtures, aiming, in addition to increasing forage production, to improve the nutritional value of the forage, resistance to foliar diseases (rusts, leaf spot), competitiveness in mixtures, winter resistance, and perennially.

MATERIALS AND METHODS

The experiment was conducted in a field trial of the Research and Development Institute for Grasslands - Brașov, during the years 2023-2025.

The plant material used in this experiment was represented by 9 accessions – 8 local population and a variety, with a total of 324 individual plants. The plants were obtained by sowing in March 2023, in the greenhouse, in rows in trays, followed by individual transplanting into small plastic pots. When the seedlings were sufficiently well developed, with vigorous shoots and a well-developed root system, they were transplanted into the field, as individual plants, at equal distances of 50 cm, 10 plants per row and 36 rows/per block. Regarding la vegetation period, 2025 was the second year.

The meteorological conditions in the years 2024-2025 (table 1) indicate a warmer period compared to the multiannual average. Considering the recorded temperatures, in both years the values exceeded the multiannual average, with 3,6 °C in 2024 and with 1,7°C in 2025. From the point of view of precipitation, the year 2024 recorded a total deficit of -22.6 mm and of -43,2 mm in the vegetation period compared to the multiannual average. In 2025 the temperature exceeded with 1.7°C compared to the multiannual average and during the vegetation period with 2°C. However the precipitation was more abundant with 120.7 mm in the vegetation period.

All these meteorological conditions led to optimal plant growth and development.

Table1.Meteorological conditions from Brașov stationary 2024-2025

Years	Annual average I - XII	Dev	Vegetation period IV - IX	Dev.
Temperature (°C)				
2024	11,4	+3,6	17,6	+3,4
2025	9,5	+1,7	16,0	+2,0
Average 59 years	7.8	0	14.2	0
Precipitation (mm)				
2024	730,6	-22,6	485.9	-43,2
2025	821,8	68,8	649,8	120,7
Average 59 years	753.2	0	529.1	0

During the vegetation period of 2025 year, the following observations and determinations have been made heading date (inflorescence emergence), growth habit (before inflorescences emergence) number of vegetative tillers, number of

generative tillers,, plant heigh, the distance in cm from the plant base to the of panicle after an thesis, resistance to rust (% of healthy plants).

The morphological and phenological characters were scored by visual inspection or measurements. The recorded data were statistically processed in the Statistica 7 software package.

RESULTS AND DISCUSSIONS

The present study aims is to characterize the main morphological, physiological and productive traits relevant for the objectives of the cock's foot breeding, to highlight recent advances in international research on the adaptability of the species and to outline the prospects for using the cock's foot as a fundamental genetic resource in modern forage plant breeding programs.

The results presented include studies on the correlations established between the forage production potential of germplasm (ecotypes, populations, varieties), used as sources for the creation of new synthetic varieties.

The results obtained from the observations and biometry (genotypes) from the selection fields were processed statistically, through several tests, to validate the respective results.

Morphphysiological measurements, plant height, number of vegetative and generative shoots, length and width of the standard leaf, spike length and rust resistance, were performed during the growing season, on 5 plants of each genotype, with the average results presented in Table 2.

Analysing the morphoproductive characters of the 8 local populations, and of the Intensiv variety, interpreted with the help of the Duncan test, it is observed that in terms of plant height, the studied genotypes are grouped into 5 classes of homogeneity. The local population Sp.9 Dealul Cetatii, Sp.1-Intensiv,Sp.7-Morozeni sat Breanova and Sp.6-Neculaeuca Orhei, are the highest.

The number of vegetative shoots are grouped into 3 classes of homogeneity, highlighting the local populations Sp.4 - Lac Dumbrăvița and Sp.8- Gradina Bot Nat 2022. In terms of the number of generative shoots, Sp.9 Dealul Cetatii and Sp.4- Lac Dumbrăvița stood out alongside the Intensiv variety.

Regarding rust resistance, the Intensiv variety was the most tolerant, followed by the local populations. The local populations in the same precocity class as the Intensiv variety are: Sp.5- Poiana Mică and Sp.8- Gradina Bot Nat 2022.

Following these measurements and determinations, we can more easily select parental forms of future varieties, depending on the current breeding objectives, the most important of which are adaptability and resistance to stress factors (drought, frost, heavy rainfall, etc.).

It is desirable that the composition of new synthetics include plants that are similar in terms of precocity, height and a large number of generative and vegetative shoots, to ensure the uniformity of the future variety.

Table 2. Morphophysiological measurements on the studied cock's-foot, genetic material (DUNCAN Test)

Plant heigh (cm)	No. vegetative tillers	No.generative tillers	Length leaf
Sp9 97.47 A	Sp4 31.33 A	Sp9 115.0 A	Sp1 41.90 A
Sp7 97.30 A	Sp8 30.00 A	Sp1 108.7 A	Sp4 32.87 AB
Sp1 96.77 A	Sp5 29.00 AB	Sp4 108.0 A	Sp7 31.13 B
Sp6 90.30 AB	Sp6 20.67 ABC	Sp6 98.00 AB	Sp9 30.43 B
Sp4 85.63 BC	Sp3 19.67 ABC	Sp5 93.67 AB	Sp5 29.93 B
Sp8 85.50 BC	Sp1 15.67 BC	Sp7 83.33 AB	Sp6 28.43 BC
Sp5 78.73 CD	Sp2 15.67 BC	Sp2 81.00 AB	Sp3 26.87 BC
Sp3 68.83 DE	Sp9 15.00 BC	Sp8 76.33 AB	Sp8 25.87 BC
Sp2 61.77 E	Sp7 14.00 C	Sp3 65.67 B	Sp2 19.70 C
DL5% = 10.29	**DL 5% = 14.31**	**DL 5% = 40.42**	**DL 5% = 10.07**

width leaf	**Disease resistance (%)**	**Heading date**
Sp7 9.670 A	Sp1 70.00 A	Sp1 76.67 A
Sp6 9.000 AB	Sp5 49.33 B	Sp5 76.33 AB
Sp9 8.330 ABC	Sp7 44.00 B	Sp8 73.67 ABC
Sp1 8.000 ABC	Sp4 43.33 B	Sp7 73.33 BCD
Sp8 7.670 ABC	Sp3 43.00 B	Sp4 72.67 CD
Sp2 7.330 BC	Sp9 40.67 B	Sp2 72.00 CD
Sp3 6.670 C	Sp8 40.00 B	Sp3 71.67 CD
Sp4 6.670 C	Sp2 36.67 B	Sp9 71.67 CD
Sp5 6.670 C	Sp6 36.00 B	Sp6 70.33 D
DL 5% = 2.165	**DL 5% = 16.37**	**DL 5% = 3.21**

Sp.1- Intensiv, Sp.2- Brădet 2020 Sp.3- Pietrele lui Solomon Sp.4- Lac Dumbrăvița, Sp.5- Poiana Mică, Sp.6- I Neculaeuca Orhei, Sp.7- Morozeni sat Breanova, Sp.8- Gradina Bot Nat 2022, Sp.9 Dealul Cetatii

The graphical representation of the correlation relationships ensured with a statistical significance by the Pearson correlation can be found in the following graph (Figure 1).

In the graphic representation is the expression of the correlation between the five studied characters.

On a general analysis of all the graphs, several genotypes stand out as the best, depending on the analysed character.

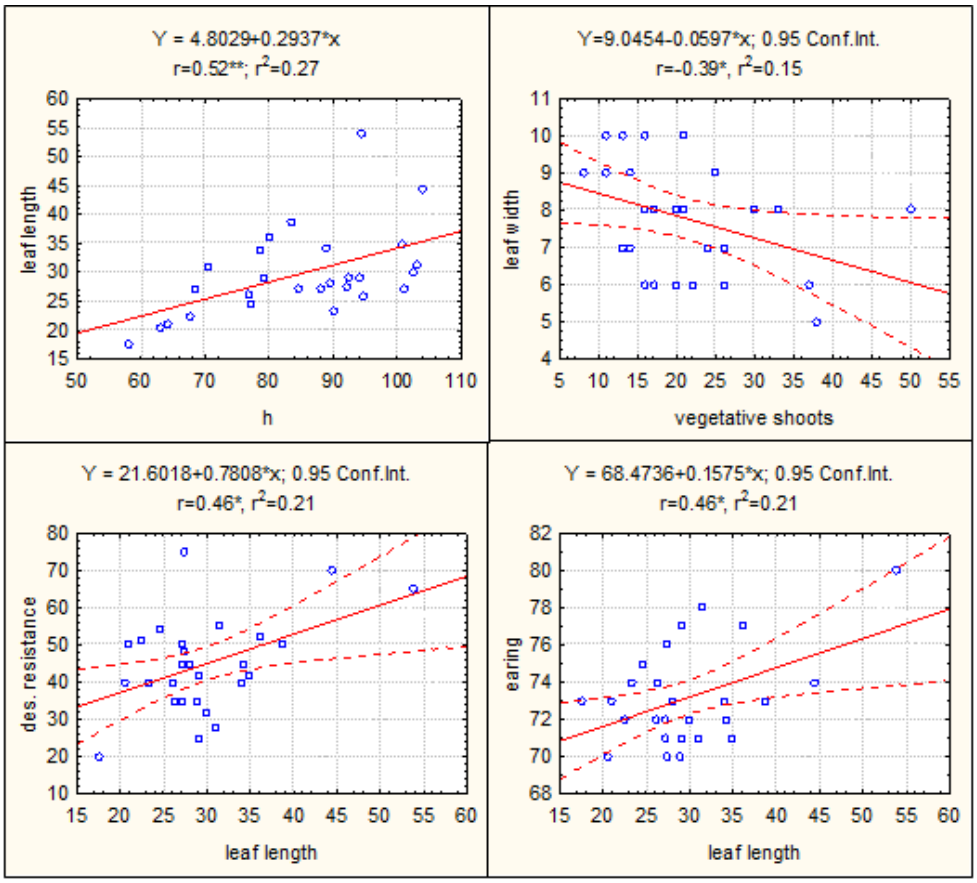


Figure 1. Graphic representation of correlation relations

The correlation coefficient highlights the following statistically ensured interdependencies in the expression of morphoproductive characters in genotypes selected from the selection fields: the height of the plant shows a distinctly significant positive correlation (0.52) with length leaf. The number of vegetative tillers and width leaf are significantly negative correlated (-0.39).

Length leaf was correlate significantly with the disease resistance (0.46) and heading date(0.46).

The morphoproductive characters investigated in the selection and breeding process of Dactylis glomerata were analysed through the correlation matrix to estimate the correlation of the analyzed genotypes. (table 3).

Table 3. Corelation matrix

	plant h. (cm)	No. vegetative tillers	No. generative tillers	Length leaf	width leaf (cm)	Disease resist (%)	heading date
plant heigh (cm)	1.00	-0.19	0.34	0.52**	0.35	0.27	0.14
No. v.tillers		1.00	-0.13	-0.07	-0.39*	-0.15	0.09
No.g.tillers			1.00	0.27	-0.08	0.32	0.18
Length leaf				1.00	0.22	0.46*	0.46*
width leaf					1.00	0.09	-0.24
Disease resistance (%)						1.00	0.55
Heading date							1.00

Following the calculations performed by principal component analysis (PCA), it resulted that the studied morphoproductive characters are grouped into 7 components, so that the first 2 components bring a variance of 74.25%, having a majority weight, implicitly and a special influence, which we will discuss further.

Principal component 1 (PC1), which represented 46.07% of the total variation, includes the variables with the highest negative correlation coefficients: plant height (r=-0.79), generative shoots (r=-0.69), banner leaf length (r=-0.95) and rust resistance (r=-0.82).

Principal component 2 (PC2), which accounted for 28.18% of the total variation, includes the variable with positive correlation coefficients: the number of vegetative shoots (r=0.18) and negative, and leaf width (r=-0.32), and spiking (r=-0.61) (table 3).

Table 3. Factor-variable correlations, based on correlations

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
plant heigh (cm)	-0.7975	-0.4350	-0.2911	-0.2631	-0.0466	0.1332	0.0291
No. vegetative tillers	0.1802	0.6641	-0.6314	-0.3489	-0.0330	-0.0701	0.0139
No. Generative tillers	-0.6928	-0.1296	-0.5192	0.4362	0.2049	-0.0355	0.0030
Length leaf	-0.9528	0.1217	-0.0378	0.0227	-0.2657	-0.0297	-0.0628
width leaf	-0.3213	-0.8696	0.1094	-0.3211	0.1044	-0.1211	-0.0030
Disease resistance (%)	-0.8257	0.4003	0.3679	0.0766	-0.0937	-0.0588	0.0680
Heading date	-0.6196	0.6284	0.2829	-0.2210	0.3005	0.0346	-0.0293

In the breeding process, genotypes with a frequency of over 80% disease-resistant plants and phenotypically similar plants will be chosen. It is found that, accepting the expression of the initial causality in the space of the studied variables, namely through a single principal component, only 46.07% of the initial variance is explained. Extending the number of principal components to the tree, the explanation of 88.27% of the total variance is ensured (figure 2).

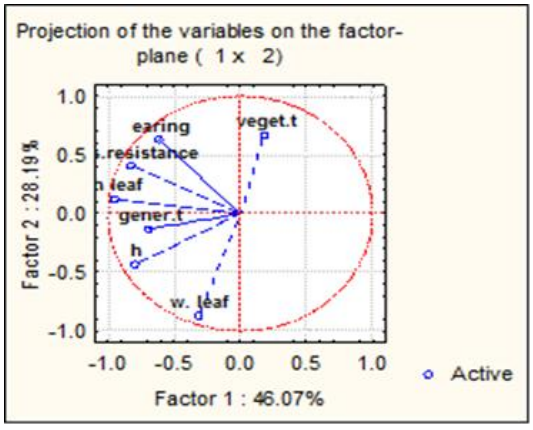
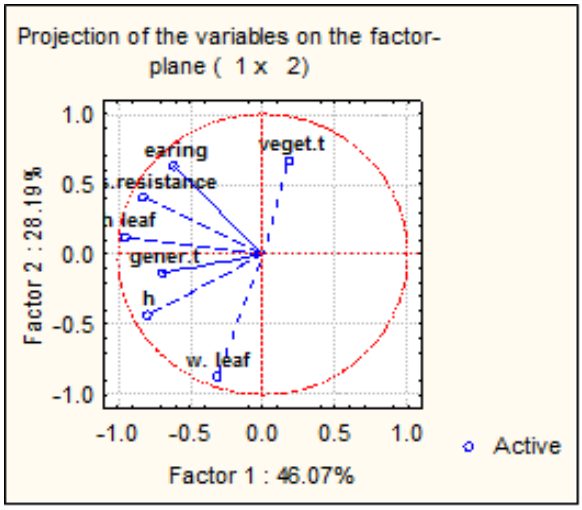


Figure 2. Projection of the variables in the plane of the factor axes of the two principal component



Sp.1- Intensiv, Sp.2- Brădet 2020 Sp.3- Pietrele lui Solomon Sp.4- Lac Dumbrăvița, Sp.5- Poiana Mică, Sp.6- I Neculaeuca Orhei, Sp.7- Morozeni sat Breanova, Sp.8- Gradina Bot Nat 2022, Sp.9 Dealul Cetatii

Figure 3.Projection of genotypes in the plane of the factorial axes of the two principal components [Factor 1/CP1 and Factor 2/CP2]

The Intensiv variety and the local populations Brădet 2020 Pietrele lui Solomon and Gradina Bot Nat 2022, represented in the figure with points 2, 3 and 8, have an important contribution to PC 1, namely generative shoots, leaf length, rust resistance and plant height. The abundance of generative shoots, confers a high biological potential to break the negative correlations between seed and forage production. The local populations Lac Dumbrăvița, Poiana Mică, (no. 4, 5) have a positive contribution to PC 2, represented here by the number of vegetative tillers, leaf width and heading date, and Neculaeuca Orhei and Dealul Cetatii (6 and 9)) have a negative contribution. The Intensiv variety (no. 1) has a significant contribution within the main component PC 1.

To identify the most valuable genotypes, which could form the basis for the creation of new qualitatively and quantitatively superior synthetic combinations and the highlighting and selection of parental forms of future synthetic varieties of *Dactylis glomeata*.

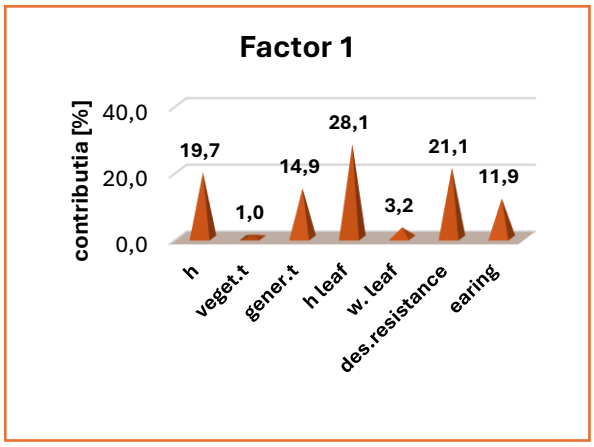
In Figure 4, the contributions of each of the characters studied in the selection field within the main components are presented.

This facilitates the choice of the most valuable parental forms, well correlated with each other, in function of the current breeding objectives

The reduced phenotypic correlation between seed production and fruiting at the individual plant level in relation to seed lots, makes selection at the individual plant level to have a low efficiency (Elgersma, A., 1990).

The existence of a negative correlation between the number of vegetative shoots that ensure fodder production and the number of generative shoots that ensure seed production complicates the breeding process, the objective being to find genotypes that meet both characteristics.

a)



b)

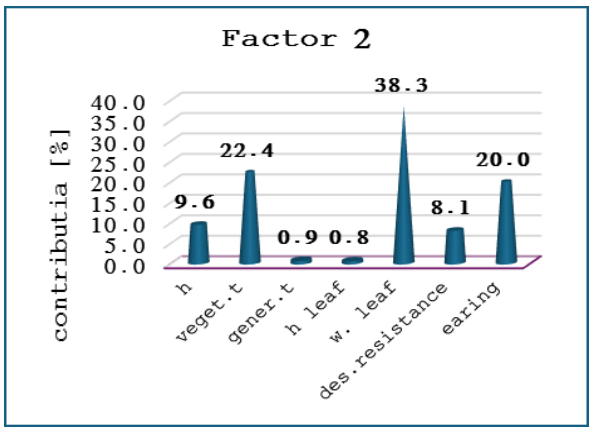


Figure 4 Principal Component Analysis (PCA 1-a) și (PCA 2-b)

CONCLUSIONS

The study confirms the special value of the Dactylis glomerata species in fodder crops, due to its ecological plasticity, high

productivity and important role in soil conservation and improvement of degraded lands.

Biometric and statistical analyses revealed significant genetic variability between the Intensiv variety and local populations, which provides a solid basis for the selection and improvement of new genotypes.

The identified correlations between morphoproductive characters show both positive relationships (plant height with leaf length, leaf length with disease resistance) and negative ones (number of vegetative shoots with leaf width), which complicates the improvement process, but also indicates the directions of selection.

The Intensiv variety and the Brădet 2020, Pietrele lui Solomon and Grădina Botanică Nat 2022 populations were distinguished by favorable combinations of characters (high number of generative shoots, good disease resistance and high height), representing valuable genetic sources for obtaining new synthetic combinations.

Principal component analysis demonstrated that the first two components explain most of the variation (74.25%), highlighting the importance of key characters such as rust resistance, leaf length and shoot production potential in parental selection.

nOverall, the results support that breeding programs must aim at the balance between forage productivity and seed production potential, as well as increasing resistance to climatic stress and diseases, in order to obtain competitive and sustainable genotypes in the context of modern agriculture.

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