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Adam RADKOWSKI[1], Iwona RADKOWSKA[2]
and Maria FISZER-SKRZYŃSKA[3]

DIVERSIFICATION OF YIELDING AND QUALITY TRAITS OF MEADOW GRASS ON AN EXAMPLE OF SELECTED CULTIVARS AND STRAINS

ZRÓŻNICOWANIE PLONOWANIA I CECH JAKOŚCIOWYCH WIECHLINY ŁĄKOWEJ NA PRZYKŁADZIE WYBRANYCH ODMIAN I RODÓW

Abstract: The paper presents an assessment of varieties and strains of meadow grass regarding dry mass yields, total protein and crude fibre content. Obtained results of strain value testing reveal that the collection resources contain forms which have a high breeding potential. The studied strains and varieties were characterized by big yields of dry matter with differences reaching even 39 %. Individual studied objects differed also with the content of total protein reaching from 11.60 to 19.10 %. On the other hand for crude fibre the values fluctuated from 22.50 to 29.20 %.

Keywords: variety of meadow grass, strain, total protein, crude fibre, yield

Meadow grass (*Poa pratensis* L.) is a species with high fodder value, revealing good digestibility and tastefulness, as well as advantageous mineral composition. The species is adapted to a wide spectrum of habitat conditions, but develops best on moist soils, tolerating pH from 4.5 to 8.5. It is resistant to big differences in temperatures ranging from 43 to –44 ^{o}C. Variability of environment in which meadow grass occurs led to its considerable morphological plasticity and formation of different genetic phenotypes [1, 2]. Scientific research confirmed a wide variability of functional features, which evidences a considerable genetic diversity of its varieties [3, 4, 5]. Moreover, a pheno-

[1] Department of Grassland Management, University of Agriculture in Krakow, al. A. Mickiewicza 21, 31–120 Kraków, Poland, phone: +48 12 662 43 61, fax: +48 12 633 62 45, email: rrradkow@cyf-kr.edu.pl

[2] National Research Institute of Animal Production Balice, ul. Krakowska 1, 32–083 Balice, Poland, phone: +48 666 081 149, email: iradkowska@izoo.krakow.pl

[3] Małopolska Plant Raising – HBP Ltd., Plant raising – productive Polanowice, Poland, phone: +48 12 388 16 82, email: mariafiszerskrzynska@interia.pl

menon of apomixis, which occurs in meadow grass can make cross-breeding difficult, but is helpful in maintaining pure breeding lines, which are both morphologically and genetically homogenous [6].

Fodder varieties of meadow grass characterized by a considerable proportion of leaves ensure high productivity with maintained advantageous fodder value. Due to its resistance to trampling, nibbling and cutting it is particularly recommended for pastures where it constitutes the main component of sward, it is also appropriate for park lawns and golf courses.

Breeding works aim in two directions: selecting high yielding varieties for fodder purposes and varieties for lawns in which preferred are narrow type of leaf and slow regrowth.

Success in breeding new varieties of meadow grass is to a considerable degree determined by the initial material and particularly a wide variety of biological and functional (morphological) features determining the value of the variety [4].

A review of literature shows the variety dependent diversification of the rate of biomass accumulation and differences in chemical composition. Research of Lemaire et al [7] reveals a strict dependence between plant morphological composition and the quality of obtained fodder.

Therefore the aim of the presented research was an assessment of diversification of strains and varieties of meadow grass regarding dry mass yields, total protein and crude fibre content.

Materials and methods

The research was conducted in 2005–2007 at Plant Breeding Station in Skrzeszowice near Krakow (220 m a.s.l.), on degraded chernozem developed from loess. Chemical properties of the soil were as follows: pH_{KCl} – 7.2, bioavailable P – 54, K – 127.2 and Mg – 48.1 g · kg^{-1}. Annual precipitation totals during the investigated period (years 2005–2007) fluctuated from 569.5 to 722.0 mm, whereas mean precipitation totals during the vegetation period (April–September) ranged from 325–465 mm. Average annual temperature in the years of the research ranged between 6.0 and 6.9 ^{o}C and during the April–September period from 12.3 to 13.9 ^{o}C. The experiment set up using randomized block method in three replications (plots 1 × 9.8 m^2) considered the standard Eska 46 variety, accompanying Skiz variety and three strains: SKW-15, SKW-17 and SKW-18. Component families of strains:

– SKW-15:
  1. Self-pollinated 46/2 with Eska 46,
  2. Self-pollinated 28/2 with Eska 46.
– SKW-17:
  1. Self-pollinated 10/2 with Eska 46,
  2. Self-pollinated 6/2 with Eska 46,
  3. Self-pollinated 12/3 with Eska 46.

– SKW-18:
  1. Self-pollinated 46/2 with Eska 46,
  2. Self-pollinated 46/2 with Eska 46.
– ESKA 46:
  43 component families.

All objects composing the strains originate from ESKA46 seeds treated with chemical mutagens: colchicine and phenylmercury acetate in 2000. Selected seedlings were planted on the field and following the observations, seeds of chosen self-pollinated plants made up constituents of strains.

The experiment was set out on 23rd May 2005. The standard sowing rate was 10 kg/ha. In autumn, phosphorus fertilizers were sown in the amount of 70 kg$P_2O_5 \cdot ha^{-1}$ as triple superphosphate and potassium fertilizers in the amount of 100 kg$K_2O \cdot ha^{-1}$ as potassium salt. Nitrogen fertilization was applied prior to sowing in the dose of 20 kgN $\cdot$ ha^{-1} of ammonium nitrate. The second dose of nitrogen fertilizer in the amount of 50 kgN $\cdot$ ha^{-1} was applied after the seeds sowing.

In the years of full utilisation the following fertilization was applied: 80 kg N $\cdot$ ha^{-1} under the first cut and 60 kgN $\cdot$ ha^{-1} of ammonium nitrate after the second and third cuts each, phosphorus – 120 kg$P_2O_5 \cdot ha^{-1}$ as triple superphosphate once, in the autumn preceding the harvest and potassium dosed 60 kg$K_2O \cdot ha^{-1}$ as 57 % potassium salt.

Total nitrogen was assessed by means of Kjeldahl's method in mean weighted average plant samples after their drying and grounding.

The obtained results were verified by the analysis of variance. Differences between means were assessed using Tukey multiple range test and then the least significant difference was calculated.

Results and discussion

Considering the analysed varieties and strains, Eska 46 standard variety yielded best over the total 2 years of utilisation, whereas the accompanying Skiz variety produced slightly poorer yields (Table 1). The lowest yields were registered for the plants of SKW-18 strain. The difference in dry mass yield between the standard variety and strains ranged from 20 to 27 %.

Table 2 shows a diversification of total protein contents between compared varieties and strains in the years of utilisation and in cuts. Regarding total protein content in the plant dry mass, the studied strains exceeded Eska 46 standard variety and Skiz variety as they proved to be definitely more abundant in protein. The situation may be explained by the fact that these varieties were characterised by poorer foliage which, as results from Buxton et al [8] and Julier et al [9] research on alfalfa, may have affected a decline in total protein content in dry mass. Diversified crude fibre content was presented in Table 3. In dry mass of the tested meadow grass strains crude fibre content was lower than in the varieties. According to some authors fibre content in plants to a considerable degree depends on the weather factors [10]. The lowest concentration of this factor was noted in the vegetation season in which the temperature and precipitations were favourable for the growth and development of plants. It was the

second regrowth in the second year of full utilisation. On the other hand, the higher level of fibre occurred in the season with high air temperatures and low precipitations, which accelerated the process of cell walls saturation with lignins.

Table 1

Yield of dry matter [Mg · ha^{-1}]

Object	Year of utilisation							Total for two years
	2006			2007				
	Cut			Cut				
	I	II	I + II	I	II	III	I + II + III	
SKW-15	3.68	2.64	6.32	3.80	5.02	3.40	12.22	18.54
SKW-17	3.69	2.36	6.05	3.52	4.76	3.01	11.29	17.34
SKW-18	3.69	2.46	6.15	3.47	4.32	2.99	10.78	16.93
SKIZ	6.27	3.93	10.20	5.78	4.00	3.02	12.80	23.00
ESKA 46	5.93	3.99	9.92	5.87	3.92	3.37	13.16	23.08
Mean	4.65	3.08	7.73	4.49	4.40	3.16	12.05	19.78
V(%)	2.85	2.65	2.76	2.74	1.08	0.66	0.83	1.54
$NIR_{(0.05)}$	0.77	0.57	1.32	0.81	0.39	0.14	1.01	2.25

Table 2

Crude protein content in the dry matter [g · kg^{-1} d.m.]

Object	Year of utilisation					Mean
	2006		2007			
	Cut		Cut			
	I	II	I	II	III	
SKW-15	181.0	145.0	183.0	144.0	159.0	162.4
SKW-17	171.0	143.0	182.0	147.0	174.0	163.4
SKW-18	169.0	140.0	191.0	142.0	170.0	162.4
SKIZ	153.0	149.0	160.0	116.0	152.0	146.0
ESKA 46	161.0	146.0	158.0	132.0	144.0	148.2
Mean	167.0	144.6	174.8	136.2	159.8	156.5
V(%)	6.34	2.32	8.50	9.26	7.77	5.50
$NIR_{(0.05)}$	11.1	3.6	13.3	15.9	12.5	8.3

From the perspective of fodder value, the content of analysed components was adequate. The studied varieties proved slightly less abundant in total protein but no decline in the yield of this element was registered in result. For two years of utilisation the harvest for Eska 46 standard variety was 3.47 Mg · ha^{-1} and 3.39 Mg · ha^{-1} for Skiz. On the other hand, total protein yield for strains was on average lower by 1.74 Mg · ha^{-1}

in comparison with the standard (total yield of total protein for two years of full utilisation).

Table 3

Crude fiber content in the dry matter [g · kg^{-1} d.m.]

Object	Year of utilisation					Mean
	2006		2007			
	Cut		Cut			
	I	II	I	II	III	
SKW-15	250.0	248.0	240.0	225.0	260.0	244.6
SKW-17	249.0	251.0	239.0	231.0	255.0	245.0
SKW-18	260.0	252.0	236.0	239.0	261.0	249.6
SKIZ	292.0	247.0	249.0	247.0	253.0	257.6
ESKA 46	287.0	246.0	272.0	259.0	264.0	265.6
Mean	267.6	248.8	247.2	240.2	258.6	252.5
V(%)	7.67	1.04	5.94	5.57	1.74	3.57
$NIR_{(0.05)}$	14.7	2.2	8.8	12.0	4.4	6.2

Table 4

Yield of crude protein [Mg · ha^{-1}]

Object	Year of utilisation		Total for two years
	2006	2007	
SKW-15	1.05	1.96	3.01
SKW-17	0.97	1.86	2.83
SKW-18	0.97	1.78	2.75
SKIZ	1.54	1.85	3.39
ESKA 46	1.54	1.93	3.47
Mean	1.21	1.88	3.09
V(%)	2.48	0.37	1.05
$NIR_{(0.05)}$	0.19	0.07	0.27

The analysed populations of varieties and strains of meadow grass are diversified regarding many traits. Accumulated genotypes widen the diversity within the genus of meadow grass which may be used in breeding and research works.

Conclusions

1. Both varieties and strains differed slightly from one another regarding dry mass yields and the content of total protein and crude fibre.

2. The feature which significantly differed varieties and strains were meteorological conditions.

3. On the basis of many-year observations it was determined that further thorough observations should be conducted in order to identify valuable strains.

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[1] Zakład Łąkarstwa Uniwersytet Rolniczy im. Hugona Kołłątaja w Krakowie
[2] Instytut Zootechniki – Państwowy Instytut Badawczy w Balicach koło Krakowa
[3] Małopolska Hodowla Roślin – HBP Sp. z o.o., Zakład hodowlano-Produkcyjny Polanowice

Abstrakt: Praca prezentuje ocenę zróżnicowania odmian i rodów wiechliny łąkowej pod względem plonów suchej masy, zawartości białka ogólnego oraz włókna surowego. Uzyskane wyniki badania wartości rodów wskazują, że w zasobach kolekcyjnych są formy, które mają dużą wartość hodowlaną. Badane rośliny charakteryzowały się dużymi plonami suchej masy, gdzie różnice sięgały nawet 39 %. Poszczególne rośliny różniły się także zawartością białka ogólnego, które wynosiły od 11,60 do 19,10 %. Natomiast dla włókna surowego wartości te kształtowały się od 22,50 do 29,20 %.

Słowa kluczowe: odmiana wiechliny łąkowej, ród, białko ogólne, włókno surowe, plon