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Evaluation of smooth-stalked meadow grass (*Poa pratensis* L.) genetic resources for breeding purposes

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Cluster analysis revealed three forage type-groups of smooth-stalked meadow grass accessions differing in the mean number of agro-morphological traits. In terms of high ranking traits such as luxuriance, plant height and bunch diameter, the best was a small group of accessions which included the forage type genotypes – cultivars, some promising breeder's lines and one wild ecotype. Our experimental evidence suggests that the wild ecotype (N0. 2315) is promising for improving seed productivity. The promising genotype 2315 was distinguished for significantly higher number of generative stems ($p < 0.05$) compared with the varieties 'Gaja' and 'Gausa'. As a result, the genotype produced a significantly higher ($p < 0.05$) seed yield per plant. The other seed productivity indicators – inflorescence length, seed width and 1000 seed weight – were similar to those of the registered varieties.

Key words: smooth-stalked meadow grass, forage-type, wild ecotypes, promising genotypes

INTRODUCTION

The facultative apomictic smooth-stalked meadow grass (*Poa pratensis* L.) is a forage and turf grass widely cultivated in temperate climate because of its high adaptive abilities [1]. Apomictic propagation of smooth-stalked meadow grass fixes heterosis, however, it is a certain constraint to breeders since the frequency of hybridization is too low in nearly all biotypes [2]. Most of the existing varieties of apomictic smooth-stalked meadow grass originated as individual plant selections collected from natural grass habitats or grasslands [3]. The benefits of the naturally occurring promising wild ecotypes of smooth-stalked meadow grass collected from natural habitats have been also reported [4–6].

Naturally occurring smooth-stalked meadow grass is characterised by a great diversity of forms with different morphological traits and biological characteristics [6–8]. These wild or semi-natural genotypes are a very valuable gene pool which may be used for improving important breeding characteristics.

Over the period 1994–2005, more than two hundred accessions of smooth-stalked meadow grass wild ecotypes were collected during expeditions in various natural habitats of Lithuania and Kaliningrad region (Russia). Part of the wild ecotypes collected in various natural habitats were characterised by a great variety of morphological and agronomical qualities within the genus [9].

Three cultivars of smooth-stalked meadow grass, derived from Lithuanian wild ecotypes 'Gaja' (forage type), 'Galve' and 'Klote' (turf type) have been registered.

The registered forage-type varieties 'Gausa' and 'Gaja' are leafy, high forage yielding, however insufficiently productive in terms of seed yield.

The present study was designed to estimate the diversity of Lithuanian germplasm of smooth-stalked meadow grass from the agro-morphological point of view for a potential use of forage with a high seed production.

MATERIALS AND METHODS

During the period 2003–2005, 28 genotypes (11 breeder's lines, 3 advanced cultivars and 14 wild ecotypes) of smooth-stalked meadow grass were tested as spaced plants in field trials at the Lithuanian Institute of Agriculture. In 2002, 14 seed accessions of smooth-stalked meadow grass wild ecotypes were collected in natural habitats of various geographical terrains of the southern region of Lithuania.

*Establishment of breeding nurseries and investigation of ecotypes***.** 32 plants of each genotype were transplanted in the field at a distance of 100 × 75 cm. Reference plants (standard) were arranged every 10th plot. The plots were not replicated. The plants were tested for 16 morphological and agronomically valuable characteristics: re-growth in spring, earliness, herbage yield of the 1st and 2nd cut, bush diameter and density, habitat, ear emergence, abundance of inflorescences, length of longest culm, leaf width, susceptibility to leaf diseases (spot, mildew, rusts) and other parameters. For assessments we used a 1–9 or 3–7 score system, 1–3 being a very small and small value of the characteristic, 5 – medium, 7–9 – very great and great value of the characteristic [10]. Besides the above-mentioned parameters, the plants were assessed for the level of apomixis and their prospects for breeding and gene fund.

Structural analyses and measurements of seed parameters of the genotype N0. 2315 and the Lithuania-registered varieties 'Gausa' and 'Gaja' were carried out for a detailed study of seed productivity and for comparison. Forage value was determined by chemical analyses. Structural analysis of herbage for determination of seed productivity was done by counting generative and vegetative culms and measuring inflorescences per 10 plants.

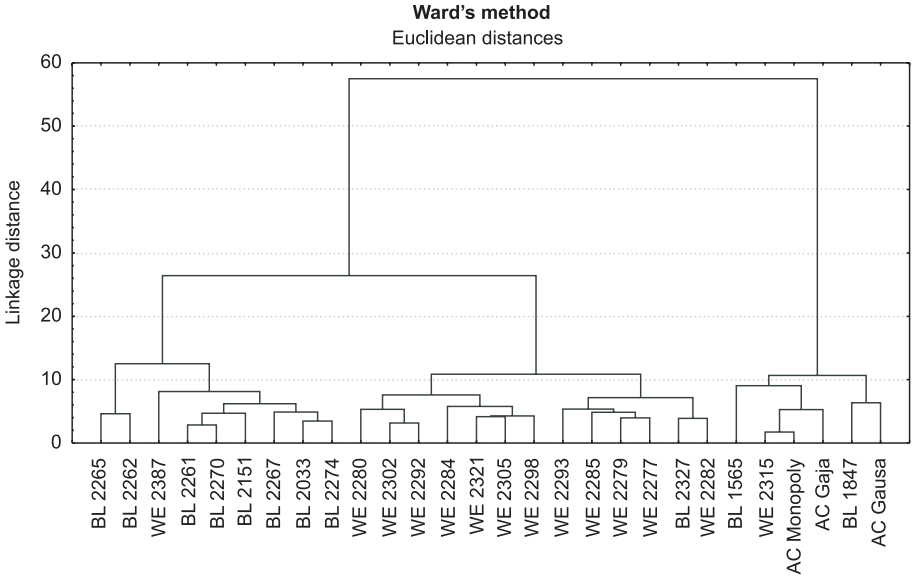

Figure. The dendrite of smoth-stalked meadow grass genetic resources.
BL – breeding line, WE – wild ecotype, AC – advanced cultivar

Crude protein and crude fibre contents in dry matter as well as dry matter digestibility were determined using the NIRS-6500 spectrometer [11].

The grasses were tested for two years. The data were processed by the statistical methods using 'Selekcija' software package [12].

RESULTS AND DISCUSSION

Cluster analysis revealed three forage type groups of smooth-stalked meadow grass differing in the mean number of traits (Figure). Most promising was found to be a small group of accessions, which included the forage-type genotypes – cultivars – registered varieties 'Gausa' and 'Gaja' (Lithuania), the foreign variety 'Monopoly' (Holland), some promising breeder's lines and one wild ecotype N0. 2315. The genotypes falling into this group were medium late and late (5–7–9 points), were characterised by a high herbage yield (7–8 points), good tillering (7–9 points), height (7 points), were either tolerant of or moderately susceptible to leaf diseases (3–5–7).

The largest group of accessions consisted of not promising wild ecotypes (Figure). The genotypes falling into this group were early (1–3 points), tall (7–9 points), but of a very poor tillering capacity. They formed a thin, small-diameter bunch (1–3 points), were susceptible to causal agents of foliar diseases (7–9 points). The genotypes of this group were not valuable from the viewpoint of breeding.

The third group of accessions was composed mostly of pasture-type genotypes. A large part of these genotypes were breeder's lines. The genotypes falling into this group were of various earliness (3–5–7), had a medium or big bunch diameter (5–7) and were rather short (3–5). Therefore they lagged behind the genotypes of smooth-stalked meadow grass of the first group in luxuriance and herbage yield (5 points), which made them not very promising for the breeding of forage-type varieties. In lawn breeding such genotypes are not very promising either, since they are not very short, in most cases their leaves are widish and the bunch is not very dense. This group included several genotypes (Nos. 2261, 2265) tolerant (3 points) of causal agents of leaf diseases. These genotypes will be placed in the genebank storage.

A preliminary assessment of agro-biological traits showed the wild ecotype No. 2315, included in the first group, to be the most promising one. This ecotype was collected on the riverside of the Nemunas, near the pinewood of Punia (Alytus district). It was late-maturing (7 points), produced a high herbage yield (8 points), was wide-leafed (7 points), with a big bunch diameter (7 points), tolerant of causal agents of leaf diseases (mildew – 5, rust – 3, leaf spot – 5 points), and the abundance of generative culms was preliminarily estimated by 8 points.

Late maturity and wide leaves are desirable traits in smooth-stalked meadow grass breeding. This statement can be explained by the fact that smooth-stalked meadow grass is the earliest species in pasture mixtures for forage. An early heading variety of smooth-stalked meadow grass in pasture mixtures with other later maturing grasses or forages (fescue, timothy, red clover) would lose good feeding qualities more rapidly than late maturing at harvesting, although plants of this species lose good feeding qualities least rapidly during maturation, compared with other grasses [13]. Another very valuable trait is wide leaves. Wide leaves of smooth-stalked meadow grass are also a very desirable trait for the development of forage-type varieties since the plants of wide-leaved smooth-stalked meadow grass are characterised by a better digestibility [14].

In further tests we wanted to ascertain in more detail whether this promising genotype is higher seed yielding than the registered apomictic Lithuanian varieties 'Gaja' and 'Gausa', since the main drawback of these varieties is the insufficient seed productivity. We also wanted to compare varieties according to chemical composition since rather often a hight seed productivity negatively correlates with forage quality indicators.

The promising genotype 2315 was most distinguished by the fact that it formed a significantly ($p < P.05$) higher number of generative culms than the varieties 'Gaja' and 'Gausa' (Table). Due to this, the genotype produced a significantly ($p < 0.05$) higher seed yield per plant. The other seed productivity indicators – inflorescence length, seed length, seed width and 1000 seed weight – were markedly lower than or identical with those of the registered varieties.

By herbage quality – crude protein content in dry matter and digestibility – this genotype lagged behind the registered

Table. **Herbage structure, quality indicators and seed production data of Lithuanian smooth-stalked meadow grass varieties and promising wild ecotype 2315**

Characteristics	P05	Promissing ecotype	Lithuanian varieties	
		N0 2315	'Gaja'	'Gausa'
Abundance of generative culm, points	87.5	313	159	222
Abundance of vegetative culm, points	1.1	353	381	402
Lenght of inflorescence, cm	1.45	8.4	10.1	9.3
Seed yield per plant, g	1.45	13.8	9.6	11.8
Seed length, mm	0.14	4.02	4.21	4.31
Seed width, mm	0.08	1.27	1.27	1.16
1000 seed mass, %	0.05	0.3	0.3	0.3
Leafiness, %	3.7	76.8	79.2	78.8
Crude protein, %	–	14.0	15.5	14.1
Digestibility, %	–	52.5	56.1	53.5

varieties 'Gaja' and 'Gausa', since it was less leafy. Thus, a higher number of generative culms almost always determines a lower number of vegetative stems, a lower percentage of leafiness and poorer chemical parameters. Nevertheless, the genotype remains promising since seed production is a very important trait.

CONCLUSIONS

1. Wild or semi-natural ecotypes of smooth-stalked meadow grass are characterised by a great diversity of forms within the genus with different morphological traits and biological characteristics.

2. The wild ecotype No. 2315 can be used for improving seed productivity, which is an important breeding characteristic.

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PIEVINĖS MIGLĖS (*POA PRATENSIS* L.) GENETINIŲ IŠTEKLIŲ TYRIMAI SELEKCIJOS TIKSLAMS

Santrauka

Genetinių išteklių matematinės duomenų analizės (*Cluster analysis*) pagrindu 28 tiriami pievinių miglių pašarinio tipo genotipai buvo padalyti į tris grupes, kurios skyrėsi vidutinėmis agromorfologinių požymių reikšmėmis. Pagal tokius svarbius požymius, kaip vešlumas, augalo aukštis bei kero diametras, išsiskyrė nedidelė genotipų grupė, kurią sudarė trys registruotos veislės, dvi selekcinės linijos ir vienas laukinis ekotipas (No 2315). Sėklingumo tyrimai rodo, kad šis laukinis ekotipas galėtų būti perspektyvus pievinių miglių selekcijoje, nes formavo patikimai daugiau ($p < 0,05$) generatyvinių stiebų ir davė patikimai didesnį ($p < 0,05$) vieno augalo sėklų derlių, lyginant su registruotomis veislėmis 'Gaja' ir 'Gausa'. Kiti augalų sėklingumo rodikliai – žiedyno ilgis, sėklų plotis bei 1000 sėklų masė – buvo panašūs į registruotų veislių.