# EVALUATION OF MORPHOLOGICAL, BIOLOGICAL AND CHEMICAL PROPERTIES FOR BREEDING ON NEW FODDER-GRASS CULTIVARS

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## ABSTRACT
Our work is an attempt to emphasize the importance of grass morphological, biological and chemical properties in the process of development of new forage cultivars. Results of our investigations indicate that there are realistic possibilities of developing grass cultivars with improved nutritive properties. However, breeding works can only be effective if a wide range of different properties can be taken into consideration and if, simultaneously, mutual correlations occurring between them are also considered. High mutability of properties revealed by lower taxonomic units of the species observed in Poland indicates that they can constitute a valuable material for breeding work on forage cultivars.

## KEYWORDS
Breeding, cultivar, fodder grass, properties of grass

## INTRODUCTION
Cultivar is the most important element of the forage production process on grassland, particularly temporary grasslands. This is particularly true with regards to grasses which can be utilized as the exclusive feed in animal nutrition, mainly ruminants. Grasses supply forage of high nutritive value, cheap in production and naturally suited for this group of animals because of the physiology of digestion. These effects can be intensified by valuable cultivars and, therefore, improvement of forage grass varieties remains a constant priority (Laidlaw and Reed, 1993). In the process of a forage cultivar development, both during breeding work as well as during the process of evaluation preceding granting approval certificate, attention was focused on chemical composition. Other properties were of lesser importance (Elgersma, 1995). Our work is an attempt to emphasize the importance of grass morphological, biological and chemical properties in the process of development of new forage cultivars.

## MATERIALS AND METHODS
Experimental material were mainly all grass forms and ecotypes derived from their permanent, natural sites as well as native varieties. In our investigations methods used widely in studies on grass morphology, biology and phytochemistry were applied.

## RESULTS AND DISCUSSION
**Morphological properties.** Since these properties are essential for nutritive value and seed production of the future cultivar, they should be used as the starting point in the selection of appropriate material for breeding work. From this point of view, the specificity of lower taxonomic units within one species is often undervalued. The range of diversification of *Lolium perenne* plant material collected from natural meadow sites is well illustrated by research results presented in Table 1. Differences between separate taxonomical varieties are very considerable with reference to each of the examined characters. It may well be assumed that the cultivar derived from the material designated as *Lolium perenne var. orgyiale* will be more efficient in seed production. On the other hand, materials designated as *Lolium perenne var. tenue* will allow breeding of a cultivar characterized by low generative shoots and difficult seed production. In contrast to the remaining material, from this taxonomic variety it will be easier to breed a non-forage cultivar.

In breeding work, it is possible to take advantage of such morphological traits as the length of leaf blades and their assimilation area (Kozlowski and Golinski, 1993). These criteria were used to evaluate cultivars of *Lolium westerwoldicum* (Table 2). On the basis of these data, it is possible to talk about a real progress in breeding of this species in Poland. The size of leaf blades of *Lolium westerwoldicum* has a significant impact on their nutritive value expressed as sugar concentration. In case of these properties the positive correlation is conspicuous, and the correlation coefficient $r = 0{,}61^{**}$.

**Biological properties**. From among these properties, it is important to focus attention on the response of plants to thermal and moisture stresses (Jurek, 1994). In the temperate climate, this property becomes apparent during summer when water deficit and heat are very acute. On the other hand, susceptibility of plants to late spring frosts is often overlooked. The response of *Lolium perenne* ecotypes is presented below:

| Ecotype | Drop of chlorophyll content (%) | Green matter yield ($kg\ m^{2-1}$) |
|---|---|---|
| A | 49 | 1.4 |
| B | 46 | 1.6 |
| C | 45 | 1.4 |
| D | 40 | 1.6 |
| E | 31 | 1.7 |
| F | 1 | 2.7 |
| G | -15 | 2.5 |

Frosts which occurred 5 weeks after the initiation of vegetation, i.e. about 2 weeks before sward reached its stage of pasture maturity, reduced not only plant vitality as evidenced by the drop of chlorophyll, but also the yield size. Exceptional resistance of certain ecotypes indicated their usefulness in development of new cultivars.

Sward is utilized not only by direct grazing but is often processed into hay, silage or dried material. The sustained interest in silage production from wilted grasses emphasized the importance of a very specific property, namely evaporation rate of water directly after cutting of plants (Elsäßer, 1984). As evidenced from the specification below, the variability of this trait shown by ecotypes and determined for several grass varieties 1 hour after leaf cutting is very high:

| Species | Rate of water evaporation (%) | Variation coefficient (%) |
|---|---|---|
| *Alopecurus pratensis* | 46.8 | 30.6 |
| *Arrhenatherum elatius* | 39.4 | 37.5 |
| *Bromus inermis* | 37.2 | 34.1 |
| *Phleum pratense* | 33.7 | 28.4 |
| *Poa pratensis* | 30.9 | 29.3 |
| *Festuca ovina* | 27.7 | 22.1 |
| *Festuca rubra* | 25.7 | 21.2 |

The rate of water evaporation by leaf blades is a sufficiently interesting trait to justify its inclusion in breeding works on cultivars intended for cutting.

**Chemical properties.** These properties are essential for the nutritive value of forage obtained from these grasses. There are significant differences in quantities of organic and mineral components occurring in different units isolated from one species. These properties must be taken into consideration during breeding work but should be accompanied by other properties - also morphological. This is well illustrated by results of experiments on *Alopecurus pratensis*:

| Component | Light-green form | Dark-green form |
|---|---|---|
| Crude protein | 12.70 | 12,36 |
| Sugars | 4.02 | 3.08 |
| Cellulose | 23.61 | 24.52 |
| Lignins | 2.50 | 3.28 |
| Potassium | 2.71 | 2.67 |
| Phosphorus | 0.282 | 0.189 |
| Calcium | 0.482 | 0.523 |
| Magnesium | 0.298 | 0.244 |

It appears that breeding material classified as light-green form can probably be used to develop a cultivar with high nutritive value, i.e. one which is characterized by higher digestibility and better palatability.

Results of our investigations indicate that there are realistic possibilities of developing grass cultivars with improved nutritive properties. However, breeding works can only be effective if a wide range of different properties can be taken into consideration and if, simultaneously, mutual correlations occurring between them are also considered. High mutability of properties revealed by lower taxonomic units of the species observed in Poland indicates that they can constitute a valuable material for breeding work on forage cultivars.

## REFERENCES

**Elgersma, A.** 1995. Breeding for seed yield - but how? Proc.of the 3th Intern.Herbage Seed Conf. "Yield and quality in herbage seed production", Halle (Salle), pp. 109-113.

**Elsäßer, M.** 1984. Auswirkungen der Heubelüftung mit solarerwämter Trocknungsluft auf Qualitätseigenschaften von Mähweidefutter. Diss.Univ.Hohenheim, pp. 130-135.

**Jurek, M.** 1994. The variability of the perennial ryegrass (*Lolium perenne* L.) in the response to water stress. Genet.Pol., **35A**: 127-134.

**Kozlowski, S. and P. Golinski.** 1993. Leaf assimilation surface as a characteristic feature of grasses and meadow communities. Rocz.AR Poznan, **251**: 61-74.

**Laidlaw, A.S. and K.F.M. Reed.** 1993. Plant improvement: evaluation and extension processes. Proc.of the XVII Intern.Grassld Congr., Hamilton, New Zealand, pp. 385-392.

**Table 1**
Evaluation of morphological properties of *Lolium perenne* L. biological varieties

| Feature | *Lolium perenne* L. var.*orgyiale* Döll | var.*cristatum* Döll | var.*tenue* (L.)Sm. |
|---|---|---|---|
| Height of generative shoots (cm) | 63.3 | 62.8 | 40.2 |
| Leaf blade length (cm) | | | |
| - first leaf | 17.6 | 13.8 | 5.1 |
| - third leaf | 15.9 | 14.9 | 7.2 |
| Inflorescence length (cm) | 21.6 | 20.3 | 10.0 |
| No.of spikelets per inflorescence | 19.7 | 20.1 | 19.0 |
| No.of flowers per spikelet | 10.8 | 7.6 | 3.6 |
| No.of leafs per vegetative shoot | 4.6 | 4.2 | 3.6 |

**Table 2**
Differentiation in the leaf blade length, LAI and sugars content of Polish *Lolium westerwoldicum* cultivars

| Cultivar | Registration year | Leaf blade length (cm) | LAI | Sugars content (% d.m.) |
|---|---|---|---|---|
| Motycki | 1962 | 18.50 | 2.405 | 7.46 |
| Gotra | 1972 | 31.2 | 3.305 | 10.16 |
| Kaja | 1985 | 33.56 | 4.522 | 8.29 |
| Telga | 1985 | 42.17 | 5.494 | 9.47 |
| Koga | 1987 | 45.51 | 6.329 | 12.26 |
| $lsd_{p=0.05}$ | - | 0.657 | 0.405 | 0.366 |