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Evaluation and characterization of perennial ryegrass (*Lolium perenne* L.) genotypes collected from natural flora

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Abstract. This study was conducted to characterize perennial ryegrass genotypes collected from Yozgat's flora and evaluate regarding yield, quality and site adaptation. Plant materials were collected from 53 locations and, each location included several genotypes. Seeds firstly were sown in plastic trays on October 2010 and then transplanted to field with 50x50 distance on the following month of march. In the first year, there was no observation but plants were cut frequently to avoid seed formation. Observation began the second year and concerned: plant height, main stem diameter, node number, flag leaf length and leaf ratio, plant dry weight, protein, ADF, NDF ratios, and minerals (P, K, Ca, Mg) contents. In 462 genotypes collected from 53 locations, the data ranged between 46.2 - 71.2 cm for plant height, 1.09 - 6.67 mm for main stem diameter, 2.0 - 5.0 for node number, 5.50 - 35.00 cm / 1.00 - 5.00 mm for flag leaf length/width, 5.41 - 91.03% for leaf ratio, 4.21 - 285.86 g for plant dry weight, 8.64 - 17.95% for protein ratio, 21.34 - 41.14% for ADF, 45.13 - 70.41% for NDF, and 0.32 - 0.52%, 2.65 - 5.34%, 0.02 - 0.69%, 0.06 - 0.33% for P, K, Ca, Mg content respectively. The study highlighted the existence of variability between the populations. The investigated features in this study must be repeated one more year, and then in the light of the two year data, selection will be made to use turfgrass and forage cultivation.

Keywords. *Lolium perenne* L. – Perennial ryegrass – ADF – NDF – Protein.

Evaluation et caractérisation de génotypes de ray-grass anglais (*Lolium perenne *L.) collectés dans la flore naturelle

Résumé. *Cette étude a été conduite pour caractériser des génotypes de ray-grass anglais (*Lolium perenne*. L.) collectés dans la flore du Yozgat et évaluer leur production, leur qualité et leur adaptation au site. Le matériel végétal a été collecté en 53 lieux différents, chaque lieu comportant plusieurs génotypes. Les graines ont été d'abord semées dans des bacs plastiques en Octobre 2010, puis ils ont été transplantés au champ avec des intervalles de 50x50 cm en mars suivant. Durant la première année, il n'y a pas eu d'observations, mais les plantes ont été coupées régulièrement pour éviter la formation de graines. Les observations ont commencé la deuxième année et la hauteur des plantes, le diamètre de la tige, le nombre de nœuds, la longueur du limbe, la proportion de feuilles, le poids sec, les teneurs en protéines, ADF, NDF et en minéraux (P, K, Ca, Mg) on été mesurés. Parmi les 462 génotypes collectés en 53 lieux, les données ont varié entre 46,2-71,2 cm pour la hauteur, 1,09-6,67 pour le diamètre de la tige, 2,0-5,0 pour le nombre de nœuds, 5,50-35,00 cm / 1,00-5,00 mm pour la longueur/largeur du limbe, 5,41-91,03 % pour la proportion de feuilles, 4,21-285,86 g pour le poids sec, 8,64-17,95% pour la teneur en protéines, 21,34-41,14% pour l'ADF, 45,13-70,41% pour la NDF, et 0,32-0,52, 2,65-5,34, 0,02-0,69, 0,06-0,33% pour les teneurs en P, K, Ca et Mg respectivement. L'étude montre l'existence d'une variabilité entre populations. L'étude doit être répétée une deuxième année pour sélectionner des populations destinées à être cultivées.*

Mots-clés. Lolium perenne *L.* – ray-grass anglais – ADF – NDF – Protéine.

I – Introduction

The aim of the plant breeder is to produce new cultivar, improved in one or more important characteristics, in the most efficient manner possible. New phenotypes created by the plant breeder are a function of changes in genotype associated with selection and the environmental conditions under which the new cultivar will be utilized and which the breeder has replicated to the greatest extent possible (Conaghan and Casler, 2011).

Perennial ryegrass also named English ryegrass (*Lolium perenne* L.) is a cool-season grass sown over a wide area Europe. As a turf grass, it is especially adapted to the mild winter and cool moist summer conditions prevailing in western and north-western Europe. In these conditions, perennial ryegrass offers the most rapid turf establishment among cool-season turf grasses, and it provides the best wear tolerance and the best recovery after wear sequences (Sampaux *et al*., 2012).

The quality of the grass intake affects both animal production and nitrogen (N) utilization (Rearte, 2005). The neutral detergent fibre (NDF) and acid detergent fibre (ADF) are important parameters of herbage quality as they affect dry matter intake and digestibility. Protein is an essential nutrient, but the N mass fraction of temperate pasture grazed at an immature stage is usually exceeding the animal requirements (Hoekstra *et al.*, 2007).

The objectives of this study were to characterize perennial ryegrass (*Lolium perenne* L.) genotypes collected from Yozgat's flora and to evaluate them regarding yield, quality and site adaptation. The usage potentialities of these materials will be set up for improvement of turfgrass and forage agriculture in the region.

II – Material and methods

In this study, perennial ryegrass populations collected from 53 different locations in Yozgat/Türkiye were used as material. The experiment was established in Yozgat-Turkey ecological conditions. The soil at the experimental site taken 30 cm depth is classified as clay-loam with pH: 7.34, low organic matter (1.82%), medium P_2O_5 (24.28 ppm) and high K_2O (807.08 ppm) contents. Annual rainfall, average temperature and moisture are 330 mm, 11.8 °C and 54.8 %, respectively in the experimental site. *Lolium perenne* seeds were collected from 53 different locations, and in total 462 genotypes were studied. Seeds collected from each genotype were sown in viol in October 2010. The seedlings in viol were planted at 50X50 cm in observation plots in March 2011. Before planting, the land was fertilizer with 10 kg N da^{-1} and 10 kg P_2O_5 da^{-1}. N fertilizer was applied both at the establishment year and the second year. The first year, plants were harvested not being allowed to produce seeds. Observations and measurement were taken in second year. Investigated characters were plant height, main stem thickness, number of nodes, flag leaf length and width, leaf ratio, dry weight per plant, crude protein ratio, ADF, NDF, P, K, Ca and Mg. These measurements were applied on the basis of Tosun (1992), Sagsoz *et al.* (1996), Mut (2003), and Tamkoc *et al.* (2009). To determine dry weight per plant, plant samples were dried at 60°C until constant weight. Dry weight was calculated through the values of green forage production and dry-weight percentage. After cooling and weighing, the samples were ground to pass through 1 mm screen for quality analyses. Crude protein (CP), Acid detergent fiber (ADF), Neutral detergent fiber (NDF), Ca, P, Mg and K contents were determined by using Near Reflectance Spectroscopy (NIRS, 'Foss XDS') with software package program 'IC-0904FE'. The measurements taken on each genotype were analyzed using SPSS 10.0 statistical software package program; mean and coefficient of variation were calculated.

III – Results and discussion

Average plant height, main stem diameter and nodes number of the 462 ryegrass plants were measured as 59.20 cm, 2.26 mm and 3.85, respectively. It is also noteworthy to mention that the average of the flag leaf blade length and width of the samples were 14.33 cm and 2.66 mm. Regarding this characters, which is very important for yield and quality, high variation (25.62 and 28.74%, respectively) may give an alternative to select better samples for breeding.

Average dry weight per plant was determined as 72.85 g. The CV for this character, which is an important character for hay yield, was 57.16% (Table 1). The aim of plant breeding is to successfully select for the best genotypes leading to the development of improved cultivars. Genetic variation within population is very high in this study, thus offering significant scope for genetic improvement.

Table 1. Definitions of statistical values and results obtained from the experiment

Features	N	Mean	Minimum	Maximum	CV (%)
Plant height (cm)	462	59.20	46.19	71.17	16.59
Main stem diameter (mm)	462	2.26	1.09	6.67	19.85
Node number	462	3.85	2.00	5.00	16.13
Flag leaf blade length (cm)	462	14.33	5.50	35.00	25.62
Flag leaf blade width (mm)	462	2.66	1.00	5.00	28.74
Dry weight per plant (g)	462	72.85	4.21	285.86	57.16
Leaf ratio (%)	462	43.95	5.41	91.03	31.16
Crude protein (%)	462	15.19	8.64	17.95	13.11
Acid detergent fibre (%)	462	31.16	21.34	41.14	12.03
Nötr detergent fibre (%)	462	60.76	45.13	70.41	8.55
Phosphorus (%)	462	0.42	0.32	0.52	6.71
Potassium (%)	462	4.18	2.65	5.34	8.99
Calcium (%)	462	0.29	0.02	0.69	35.27
Magnesium (%)	462	0.16	0.06	0.33	25.77

The average leaf ratio, crude protein, ADF, NDF, P, K, Ca and Mg figured out 43.95%, 15.19%, 31.16% and 60.76%, 0.42%, 4.18%, 0.29% and 0.16%, respectively (Table 1). These characters are very important for hay quality. Digestibility is the most important selection criterion for improving the nutritional value of grasses (Conaghan and Casler, 2011). The variation for these characters in our study is very high. It is the notion among the breeders that the high level of genetic diversity in a gene pool contributes to variation, demonstrating the significance of selection (Acar *et al.*, 2010).

Previous studies showed the similar variation among the examined characters on perennial ryegrass samples (Elgersma, 1990; Tamkoc *et al.*, 2009; Acar *et al.*, 2010; Hammond *et al.*, 2011; Sampaux *et al.*, 2012; Sun *et al.*, 2012).

IV – Conclusions

The study highlighted the existence of variability between the populations. The investigated features in this study must be repeated one more year, and then in the light of the two year data, selection will be made for turf grass and forage cultivation.

References

Acar Z., Ayan I., Tongel O., Mut H. and Basaran U., 2010. Morphological traits of perennial rygrass accesions in Black Sea Region of Turkey. In: The contributions of grasslands to conservation of mediterranean biodiversity. *Options Méditerranéennes*, Series A, 92, p. 117-120.

Conaghan P. and Casler M.D., 2011. A theoretical and practical analysis of the optimum breeding system for perennial ryegrass. *Irish Journal of Agricultural and Food Research*, 50: 47-63.

Elgersma A., 1990. Spaced-plant trait related to seed yield in plots of perennial rygrass (*Lolium perene* L.). *Euphytica*, 51, p. 151-161.

Hammond K.J., Hoskina S.O., Burkeb J.L., Waghornc G.C., Koolaarda J.P. and Muetzela S., 2011. Effects of feeding fresh white clover (*Trifolium repens*) or perennial ryegrass (*Lolium perenne*) on enteric methane emissions from sheep. *Animal Feed Science and Technology*, vol. 166-167, p. 398-404.

Hoekstra N.J., Struik P.C., Lantinga E.A. and Schulte R.P.O., 2013. Chemical composition of lamina and sheath of *Lolium perenne* as affected by herbage management**.** *NJAS*, 55 (1): 55-73.

Mut H., 2003. Determination of some phenologic, morphologic, agricultural and cytologic characters of natural orchardgrass (*Dactylis glomerata* ssp. *glomerata* L.) collected from different places of Ondokuz Mayıs University Campus area. Ondokuz Mayis University, Graduate School of Natural and Applied Science, MSC Thesis, Samsun-Turkey.

Rearte D.H., 2005. New insights into the nutritional value of grass. In: J.J. Murphy (Ed.), *Utilisation of Grazed Grass in Temperate Animal Systems*. Proceedings of a Satellite Workshop of the 20th International Grassland Congress, 26 June – 1 July 2005, Dublin. Wageningen Academic Publishers, Wageningen, p. 49-59.

Sagsoz S., Tosun M. and Akgun I., 1996. Determination of some phonological, morphological and biological characters or orchard grass plants (*Dactylis glomerata* L.) collected from different locations. Turkey III. Pasture and Forage Congress p. 527-535, Erzurum-Turkey.

Sampoux J. P., Baudouin P., Bayle B., Beguier V., Bourdon P., Chosson J. F., de Bruijn K., Deneufbourg F., Galbrun C., Ghesquie`re M., Noël D., Thare B. and Viguié A., 2012. Breeding perennial ryegrass (*Lolium perenne* L.) for turf usage: an assessment of genetic improvements in cultivars released in Europe, 1974-2004. Blackwell Publishing Ltd. *Grass and Forage Science*, vol. 68 (1), p. 33-48.

Sun X.Z., Waghorn G.C., Hoskin S.O., Harrison S.J., Muetzel S. and Pacheco D., 2012. Methane emissions from sheep fed fresh brassicas (*Brassica* spp.) compared to perennial ryegrass (*Lolium perenne* L.). *Animal Feed Science and Technology*, 176 (2012), p. 107-116.

Tamkoç A., Özköse A. and Avci M.A., 2009. Seedling characteristic perennial ryegrass (*Lolium perenne* L.) genotypes collected from natural flora. Türkiye VIII. Field Crops Congress, p. 594-598, Erzurum-Turkey.

Tosun M., 1992. Investigation of some morphological, phenological and cytological properties of orchard grass (*Dactylis glomerata* L.) plants naturally grown in Erzurum region. Atatürk University, Graduate School of Natural and Applied Science, MSC Thesis, Erzurum-Turkey.