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EVALUATION AND CHARACTERIZATION OF PERENNIAL RYEGRASS (*LOLIUM PERENNE* L.) GENOTYPES COLLECTED FROM NATURAL FLORA

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ABSTRACT

A total 568 perennial ryegrass collected from 66 different locations were characterized and evaluated regarding yield and quality. Seeds were firstly sown in plastic trays on October 2010 and then transplanted to field with 50 x 50 distances on March. In first year, there was no observation and plants were cut frequently to avoid seed formation. Observation began the second year and the traits: plant height, main stem diameter, node number, flag leaf length and leaf ratio, plant dry weight, protein, ADF, NDF ratios, and mineral matter (P, K, Ca, Mg,) content were investigated. The data was 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, 1.00-25.20 cm / 0.70-11.13 mm for flag leaf length/width, 5.41-91.03% for leaf ratio, 5.00-192.00 g for plant dry weight, 7.20-21.00% for protein ratio, 21.58-43.90% for ADF, 50.80-82.70% for NDF and 0.32-0.50%, 2.74-5.05%, 0.06-0.678%, 0.09-0.31% for P, K, Ca, Mg content, respectively. The study highlighted the existence of high variability between the populations. According to combined results, 14 genotypes for pasture purposes, 18 genotypes for forage and 11 genotypes for turf purposes were chosen.

Key words: *Lolium perenne* L., perennial ryegrass, ADF, NDF, protein.

INTRODUCTION

Inter species diversity is mostly seen in the gene centre for plants. Turkey, in the cross-point of Mediterranean and Close (Near) East gene centres, has five sub-gene centres (phyto-geographic region) for plants. Therefore, Turkey is a very important country regarding its rich genetic source and high diversity. Suitable forage species and cultivars should be improved for region to produce quality forages and to improve meadow-pastures. For this reason, forage species should be determined and protected in the flora. Grass and legumes in the flora should be collected, conserved and produced effectively; new cultivars should be realized by improving some characters of the species (Tan, 2010).

The aim of the plant breeder is to produce new cultivars, 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, the other name English ryegrass (*Lolium perene* L.), a cool-season grass is sown over a wide area in 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).

Forage quality is defined by different traits. One of the traits is crude protein ratio. Protein is an essential nutrient for animal health. Protein levels are connected to grass growth stage and are affected by soil nutrition. The neutral detergent fibre (NDF)

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and acid detergent fibre (ADF) are important traits of forage quality. ADF and NDF affect dry matter intake and digestibility (Hoekstra et al., 2013).

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. Selected genotypes are important genetic resources for the development of new varieties, which can make an important contribution to the improvement of turf and forage culture in the region.

MATERIAL AND METHODS

This study was conducted in Yozgat (Yerkoy) ecological conditions. Five hundred and sixty nine perennial ryegrass accessions were collected in 2010 in the Yozgat natural habitats. A total 568 populations were collected from 66 different locations.

The soil at the experimental site taken 30 cm depth is classified as clay-loam with pH: 8.67, organic matter content 0.72%, P_2O_5 content 3.04 kg da^{-1}, K_2O content 59.63 kg da^{-1}. Annual rainfall, average temperature and moisture are 330 mm, 11.8°C and 54.8%, respectively in the experimental site. Average altitude is 774 m.

Collected seeds were planted to plastic trays in October 2010. The seedling in plastic trays was planted with 50x50 cm distance to the experiment area in March 2011. Before planting, the planting land was fertilized with 150 kg N ha^{-1} and 150 kg P_2O_5 ha^{-1}. N was applied both in establishment years and second year. In the first year, the plants were cut at regular intervals before flowering to prevent seed formation. Second year plants were harvested in full flowering time. Observations and measurement were taken in second year. Investigated characters were plant height, main stem thickness, number of node, 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); Ayan et al. (2011) and Ozkose (2012). To determine dry weight, plant samples were dried at 60°C until constant weight. Dry weight was calculated through the values of fresh weight and dry-weight percentage. Then plant samples were ground to pass through 1 mm screen for quality analysis. 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 using SPSS 10.0 statistical software package program mean and coefficient of variation were calculated.

RESULTS AND DISCUSSION

Average plant height, main stem diameter and node number of the 568 ryegrass plants were measured as 46.23 cm, 2.26 mm and 3.85, respectively (Table 1). Plant height in 67.25% of genotypes was determined from 33.32 to 59.12 cm (Figure 1). Different authors reported that the plant height in perennial ryegrass genotypes ranged from 19.35 to 48.05 cm (Ozkose and Tamkoc, 2014), and ranged from 30.0 to 106.0 cm (Acar et al., 2010). The average main stem diameter and node number of 568 ryegrass genotypes was found 2.26 mm and 3.85 respectively (Table 1).

Table 1. Definitions of statistical values and results obtained from the perennial ryegrass genotypes

Features	N	Mean	Min.	Max.	CV (%)
Plant height (cm)	568	46.23	12.00	80.00	27.99
Main stem diameter (mm)	568	2.26	1.09	6.67	19.85
Node number	568	3.85	2.00	5.00	16.13
Flag leaf blade length (cm)	568	7.80	1.00	25.20	75.51
Flag leaf blade width (mm)	568	3.32	0.70	11.13	37.81
Dry weight per plant (g)	568	84.90	5.00	192.00	42.19

Table 1 continued

Leaf ratio (%)	568	43.95	5.41	91.03	31.16
Crude protein (%)	568	14.06	7.20	21.00	16.37
Acid detergent fiber (%)	568	32.74	21.58	43.90	11.41
Neutral detergent fiber (%)	568	65.03	50.80	82.70	7.95
Phosphorus (%)	568	0.41	0.32	0.50	8.16
Potassium (%)	568	4.10	2.74	5.05	8.37
Calcium (%)	568	0.24	0.06	0.78	39.11
Magnesium (%)	568	0.20	0.09	0.31	18.56

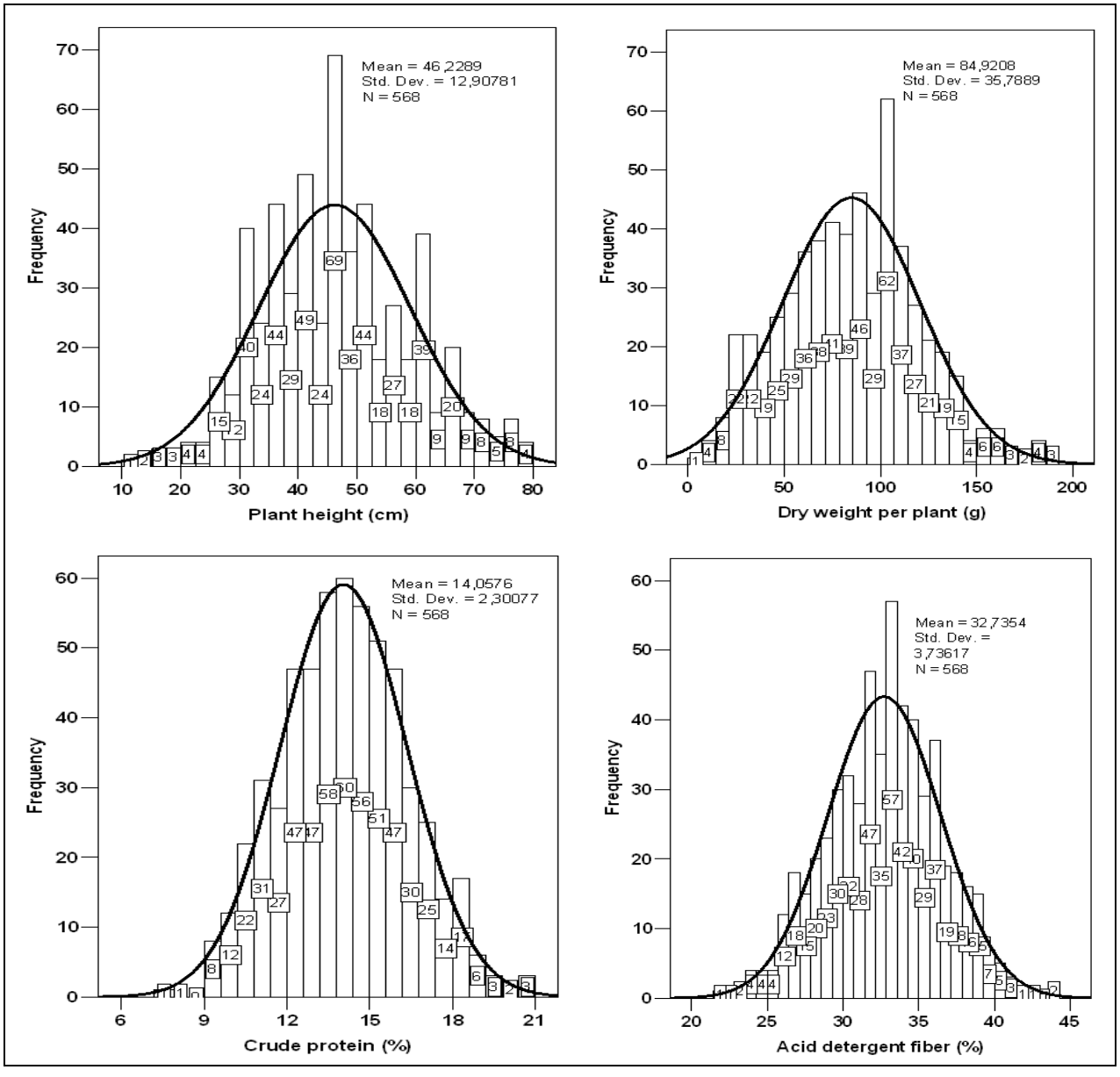

Figure 1. General distribution of plant height, dry weight per plant, crude protein and acid detergent fiber of perennial ryegrass genotypes.

It is also noteworthy to mention that the average of the flag leaf blade length and width of the samples were 7.80 cm and 3.32 mm. The high CV values for flag leaf blade and length (75.51 and 37.81%, respectively) which is very important traits for yield and quality may give an alternative for breeders to select better genotypes for different purposes.

Average dry weight per plant was determined as 84.90 g. The CV for this

character, which is an important character for hay yield, was 42.19% (Table 1). Dry weight per plant in 72.00 % of genotypes was ranged from 49.13 to 120.71 g. (Figure 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 was very high in this study, offering significant scope for genetic improvement. Ayan et al. (2011) reported that dry weight per plant in ryegrass populations was ranged from 49.60 to 170.28 g and CV for these characters was found 21.78%.

The average leaf ratio, crude protein, ADF, NDF, P, K, Ca and Mg was 43.95%, 14.06%, 32.74%, 65.03%, 0.41%, 4.10%, 0.24% and 0.20%, respectively (Table 1). Crude protein ratio in 60.92% of genotypes was determined from 11.76 to 16.36%. Acid detergent fiber ratio in 59.86% of genotypes was determined from 29.00 to 36.48% (Figure 1). Neutral detergent fibre ratio in genotypes was determined from 50.80 to 82.70%. 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 was 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 similar variation among the examined characters on perennial ryegrass (Elgersma, 1990; Tamkoc et al., 2009; Acar et al., 2010; Hammond et al., 2011; Sampaux et al, 2012; Sun et al., 2012).

CONCLUSIONS

Extensive progresses have been achieved in breeding perennial ryegrass. Genetic variations are available which offer potential for breeding. This study highlighted the existence of variability between the populations. The combined results of the present study revealed that there are numerous promising ryegrass genotypes, which may be used in breeding for pasture purposes (14), for forage purposes (18) and for turf purposes (11).

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