

## THE GRAIN QUALITY OF ACCESSIONS FROM THE RYE COLLECTION IN THE NATIONAL GENE BANK, SADOVO

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Plant genetic resources are in the base of creating new adaptive varieties. Grain quality of 53 Bulgarian rye accessions from the collection of the National Genbank has been evaluated. In two years the following traits were determined: 1000 kernel weight, test weight, crude protein, lysine+histidine, lysine+histidine in protein, crude fats, cellulose and ash content. The genetic distinctiveness was performed by a hierarchical cluster analysis considering the complex effect of the examined parameters. The 5 clusters in the dendrogram showed the considerable genetic distinction among the evaluated rye accessions. Some of them have high protein content (15 %), lysine + histidine (1.2%), large grain, so they are valuable genetic material to be included in the effective breeding programs for high quality.

**Key words:** rye accession; specific weight; protein; lysine

### КВАЛИТЕТОТ НА ЗРНОТО НА ПРИМЕРОЦИТЕ ОД КОЛЕКЦИЈАТА НА 'РЖТА ОД НАЦИОНАЛНАТА БАНКА НА ГЕНИ, САДОВО

Растителните генетски ресурси се основата за создавање нови адаптивни сорти. Вршена е оцена на квалитетот на зрното на 53 бугарски примероци 'рж од колекцијата на Националната банка на гени. Во текот на две години се определени следните особини: маса на 1000 зрна, сирови протеини, лизин+хистидин, лизин+хистидин во протеините, сирови масти, како и содржина на целулоза и пепел. Генетските карактеристики се определени со анализа на хиерархиски групи разгледувајќи го комплексниот ефект на испитуваните параметри. Од оценетите 'ржени примероци пет групи во дендограмот покажаа значајна генетска разлика. Некои од нив имаат висока содржина на протеини (15%), лизин+хистидин (1,2%), големо зрно, така што тие се драгоцен генетски материјал кој може да биде вклучен во ефикасните селекциони програми за висок квалитет.

**Клучни зборови:** примероци на 'рж; специфична маса; протеини; лизин

### INTRODUCTION

In the last decades researchers have been more interested in the local plant varieties and populations as new initial germ plasma (Izdebski, 1992). A large number of accessions drop from year to year, especially some cultures with intensive selection which were abandoned and are not grown any more (Bushuk, 2001).

Wherefore the preservation and conservation of biodiversity is the main national strategy of every country (Podyma, 1996). A wide range of researches were carried out in Poland, Germany, Russia, Belarus (Izdebski, 1992, Podyma, 1996).

Plant genetic resources in Bulgaria are permanently enriched and periodically studied. The development of the introduction work on the rye collection in the IPGR Sadovo gives a wide range of accessions that are diverse both in origin and in a complex of biological and economic traits. Almost 1300 rye accessions originated from more than 30 countries are in long term preservation in the National Genebank at the IPGR. One third of them are local populations, varieties and breeding lines. Evaluation of the status and the representatives of rye collection allow systematizing some of the parameters which are of great importance for breeding and agriculture.

The population variability and the quality of the rye variety Millennium were evaluated (Antonova, 2003, 2005; Mangova and Antonova, 2005). The drought tolerance and agro-technical field experiments of some rye varieties at different agro-ecological conditions have been studied (Antonova, 2006, 2009; Mangova et al., 2005, Zarkov and Mangova, 2007).

MATERIAL AND METHODS

The grain samples consisted of 53 old local Bulgarian rye populations and varieties were repatriated from VIR – St. Petersburg, Russia. Being part of the rye collection in the National Genebank Sadovo, they were tested and preserved (Antonova, 2009). The old varieties included in this study were as follows:

Reg. № BGR8839 – Sadovo № 019, Reg. № BGR8842-Sadovo № 362, Reg. № BGR8841 – Sadovo № 70 created in the Experimental Station, Sadovo.

Reg. № BGR8840 – Sofia № 59 created in the Institute of Genetics, Sofia.

Applying appropriate methods and criteria for evaluation is the basis for selection of valuable germ plasma as an initial form for high quality breeding. The assessment of the genetic diversity or similarity is not only important for the improvement of the crop but also for effective management and protection of germplasma resources. This information can be obtained by applying cluster analysis (Ward, 1963). Here the accessions included in the study are grouped according to the

behavior of the traits in relation to the average values. After the standardization of data a hierarchical cluster analysis for the average value was performed considering the complex effect of the analyzed traits. The computer software SPSS was used. The genetic distinctiveness was calculated by determining the Euclidian distance, defined by the studied traits and was illustrated by a dendrogram.

The principal component analysis (PCA) is one of the multivariate approaches of grouping based on similarity coefficients or variance-covariance of the component traits of the entries. The implementation of the PCA gives an opportunity to find out those traits that have contributed for most of the accessions grouping. Joint application of both analyses gives a clearer view of the importance of the quality traits used in the clustering of the accessions studied (Philippeau, 1990).

The grain quality for two crop years was assessed according to approved standard methods (Descriptors, 1985). The following characters were determined such as test weight, 1000 kernel weight, crude protein, lysine and histidine in the grain and in the protein, crude fats, cellulose and ash content.

RESULTS AND DISCUSSION

The dendrogram in Fig. 1 visualizes the hierarchical grouping of the evaluated accessions for two years. At a relatively low level of 2 distant units, they group five clusters.

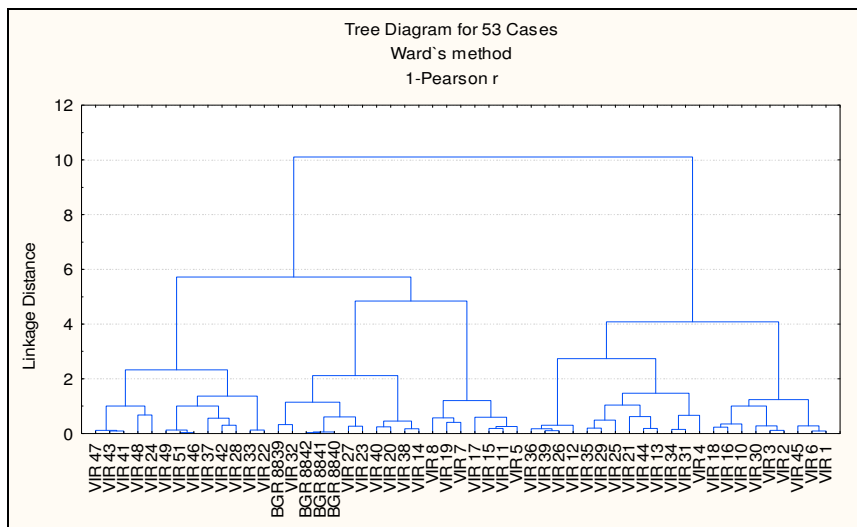


Fig. 1. Dendrogram of 53 rye accessions

The cluster 1 consisted of 13 accessions. They were described as having higher 1000 kernel weight of 28.6 g and crude fats of 1.9 % but with relatively lower content of crude protein than the accessions from the next clusters.

The second cluster consisted of 7 old local populations and of 4 old Bulgarian varieties. They were characterized as having heavy grain – very high 1000 kernel weight – 30.1 g, the highest protein content in grain – 15.1%, and test weight of 67.1 kg/hl. The dendrogram showed at a very low level close similarity between the old varieties of BGR 8842, BGR 8841 and BGR 8840 in this cluster.

The dendrogram showed close similarity between 7 old populations in the cluster III grouped according to 8 traits. They have high content of the essential amino-acids lysine and histidine in grain – 1.0 %, and in protein – 6.87 %. This group has the highest ash content of 1.9 % (Table 1).

Thirteen accessions were grouped in the IV<sup>th</sup> cluster. They have formed smaller grains of 1000 kernel weight averaging 27.5g. The content of crude protein is the highest – 15.4 %, compared with the accessions included in the other clusters of the dendrogram.

In the V<sup>th</sup> cluster 9 rye populations were characterized with very small grains – their 1000

kernel weight was 26 g and their test weight – 65.4 kg/hl, but this group had a very high content of protein, amino-acids and cellulose equal to the accessions in the second and in the fourth cluster.

Table 1

The average values of traits for each of 5 identified clusters

Qualitative traits	Cluster				
	1	2	3	4	5
1000 kernel weight	28.6	30.1	28.4	27.5	26.0
Test weight	67.1	67.1	66.3	66.5	65.4
Crude protein	14.2	15.1	14.5	15.4	15.0
Lysine+histidine	0.94	0.9	1.0	0.88	1.05
Lysine+histidine in protein	6.52	5.97	6.87	6.14	7.04
Cellulose	1.73	1.55	1.1	1.9	2.07
Crude fats	1.9	1.55	1.37	1.45	1.66
Ash content	1.58	1.7	1.9	1.85	1.72

The principal component analysis (Fig. 2) was applied with the aim to specify the causes of the separation of the accessions. In our study the variation in the estimates of similarity was revealed by the first two components, indicating the suitability of qualitative traits used.

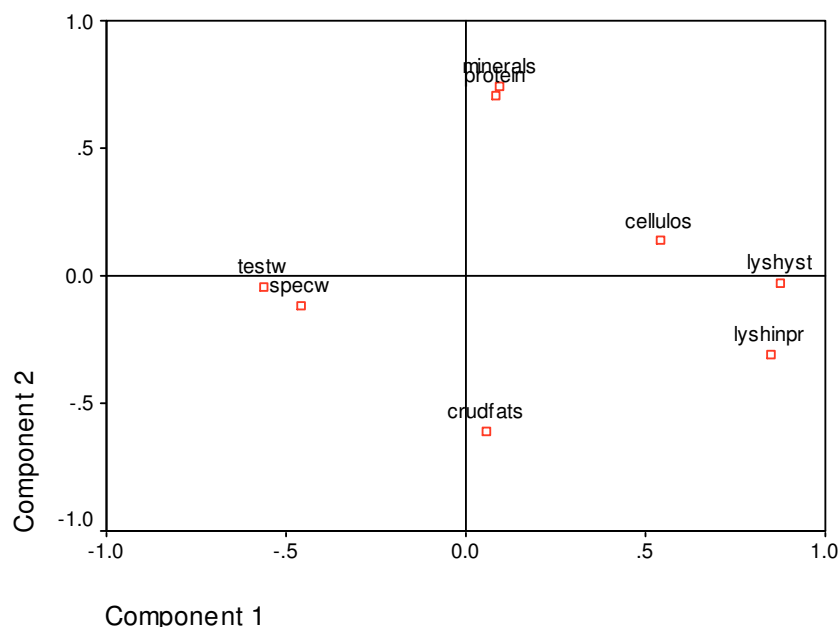


Fig. 2. Component plot in rotated space

Table 2 showed that the content of the two amino-acids (lysine and histidine) in grain and in protein had the greatest impact as far as clustering is concerned. The relatively variation of these two, correlated very strongly with the first principal component. The second principal component was most closely correlated with the relative variation of protein and ash content in grain.

Table 2

*Extraction method: principal component analysis rotation converged in 3 interactions*

Quality traits	Component 1	Component 2
1000 kernel weight	-0.46	-0.12
Test weight	-0.56	-0.05
Crude protein	0.09	0.71
lysine+histidine	0.87	-0.03
lysine+histidine in protein	0.85	-0.31
Crude fats	0.06	-0.61
C cellulose	0.54	0.14
Ash content	0.09	0.74

## CONCLUSIONS

The mutual application of the cluster and principal component analysis can advance research work on the evaluation of diversity in rye as well as in cereal collections and provide more opportunity for effective breeding programs.

The results obtained suggested that the old Bulgarian rye populations and varieties from the second (II) cluster have better physical characters of grain (BGR 8840, VIR 27) and those from the third cluster have higher biological value (VIR 15, VIR 17, VIR 11) than the rest of the evaluated accessions and can be eligible to be used as an initial material in breeding programs for good quality of rye.

**Acknowledgment:** The research is financed by the Ministry of Education and Science of Bulgaria.

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