Assessment of genetic diversity of white lupin (*Lupinus albus* L.) accessions based on agro-morphological traits

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Introduction

Lupinus is a relatively large genus and one of the most geographically widespread with a rich diversity of species. Lupin is an annual or perennial legume belonging to legume family, Fabaceae, one of the oldest crops. In our country lupin is not a traditional crop, but it has been used for a long time as a green manure source. The conservation and preservation of the white lupin genetic resources are of crucial importance for the breeding programs aiming the cultivar improvement. **The aim of this study was to assess the genetic diversity of ten white lupin accessions regarding components of productivity and biological traits.**

Material and Methods

Ten white lupin genotypes were used for this study. At maturity was measured following morphological traits: plant height, height to the first pod, number of productive branches, number of pods per plant, number of grains per plant, number of grains per pod, mass of grains per plant and mass of 100 grains. The phenological traits were assessment by coefficient of earliness. For ultra early varieties the value of this coefficient was from 1.00 to 1.17, for the early varieties from 1.17 to 1.33, for middle-early ones from 1.34 to 1.66 and for the late varieties was greater than 1.66. The studied agro-morphological traits were processed mathematically by analysis of variance. To investigate the genetic diversity between the studied lupin accessions was used Cluster analysis.

Results and discusion

The clustering of the lupin accessions based on their morphological traits is presenting **on Fig. 1.** The traits data are given **on Table 1**. The accessions were divided into two main groups (clusters). Only the accession BGR3080 was included in the first cluster. This genotype had large grains, big mass of grains per plant and big number of grains per pod.

The second claster was divided into two sub-clusters. The first sub-cluster included three genotypes, with tall plants, big number of productive branches and big mass of grains per plant. The BGR 3086 genotype differed significantly by plant height. This accession also had a high number of grains per plant and the shortest vegetation period. The accession BGR6341 had significant differences by plant height, number of productive branches, number of grains per plant and mass of grains per plant. This accession characterized also by high values of number of pods per plant and number of grains per pod. The BGR 3085 accession had significant differences by mass of grains per plant. The second sub-cluster included six accessions possessing medium-high to short stem and medium-large to large grains. The data showed that within this sub-cluster significant genetic distance was observed between the genotypes.

The clustering of the agro-morphological traits of the lupin accessions is presented **on Fig. 2**. From the clustering of the traits we could concluded that they were combined into two main clusters. Only vegitation period was included in the first cluster. The second cluster was divided into two sub-clusters: the first sub-cluster included the following traits: plant height, number of grains per plant, germination-beginning of flowering, mass of 100 grains and height to the first pod united by the close value of the Euclidean distance. The remaining four were combined into the second sub-cluster.

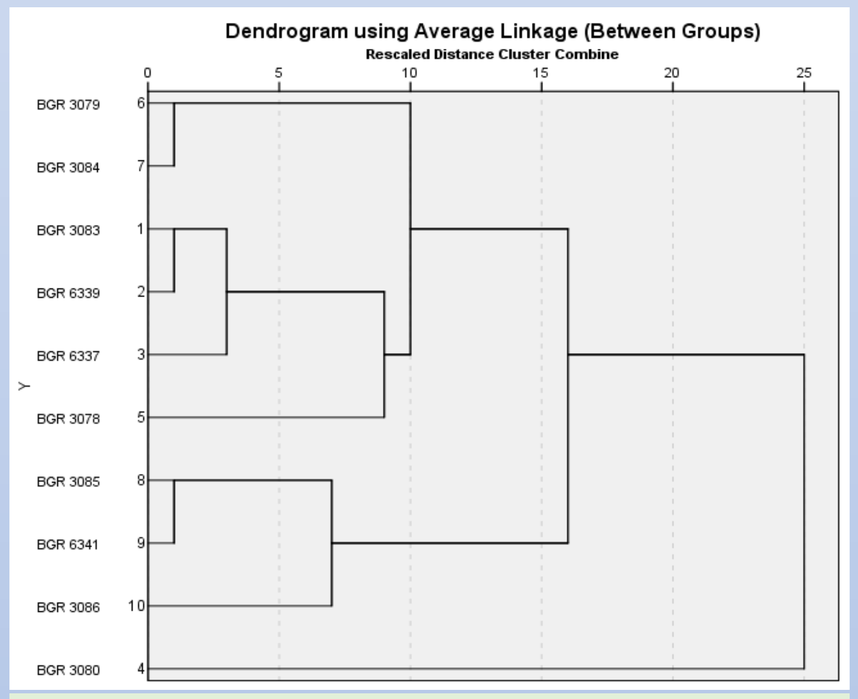

Fig. 1. Dendogram of genotype grouping using cluster analysis

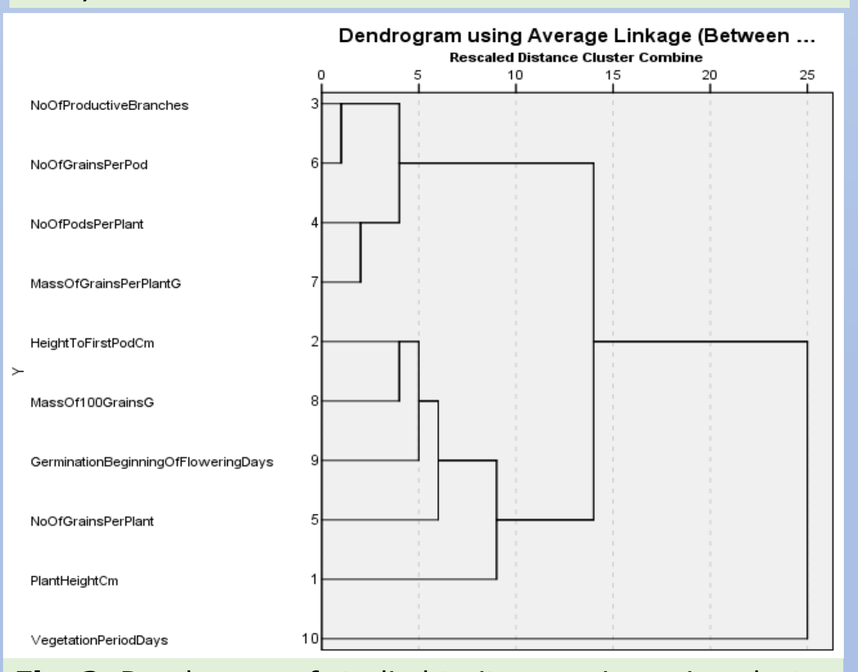

Fig. 2. Dendogram of studied traits grouping using cluster analysis

Table 1. Experimental data and grouping of the studied genotypes using cluster analysis

Accession	Plant height, cm	Height to the first pod, cm	Number of productiv branches	Number of pods per plant	Number of grains per plant	Number of grains per pod	Mass of grains per plant, g	100 grains mass, g
BGR 3083	53.29	28.00	2.14*	8.71	35.00	4.49	13.23	37.80
BGR 6339	51.57*	23.43*	3.14	10.14	40.29	4.77	14.84	37.05
BGR 6337	55.43	22.57**	3.57	11.57	45.43	4.80	14.43	32.45
BGR 3080	63.86	28.14	3.14	12.14	47.43	4.90	18.91	40.80
BGR 3078	66.43	38.00***	3.43	11.14	36.87	4.60	14.74	34.40
BGR 3079	56.57	30.86	2.14*	6.86	24.00*	3.91*	9.73	40.30
BGR 3084	54.71	32.57	2.71	6.14*	22.00*	3.84**	7.99*	35.30
BGR 3085	61.86	26.57	4.00	14.43	60.14	4.63	22.14*	37.75
BGR 6341	67.43*	28.14	4.43*	15.14	64.43*	5.03	22.20*	36.75
BGR 3086	68.43*	33.71	3.71	12.14	52.86	4.97	17.20	33.10
average St	59.96	29.20	3.24	10.84	42.84	4.59	15.54	36.57
min	**51.57**	**22.57**	**2.14**	**6.14**	**22.00**	**3.84**	**7.99**	**32.45**
max	**68.43**	**38.00**	**4.43**	**15.14**	**64.43**	**5.03**	**22.20**	**40.80**
LSD 0.05% *	**7.56**	**5.38**	**1.18**	**4.79**	**19.36**	**0.56**	**6.85**	**1.28**
LSD 0.01% **	**10.03**	**7.13**	**1.56**	**6.35**	**25.69**	**0.75**	**9.09**	**1.75**
LSD 0.001% ***	**12.99**	**9.24**	**2.02**	**8.23**	**33.28**	**0.97**	**11.77**	**2.35**

The phenological observations were performed in order to evaluate the earliness of the white lupin accessions **(Table 2)**. The earliest blossom was observed in BGR 3086 accession, classified as ultra-early variety with a coefficient of earliness 1.00. Two accessions, were included in the group of early varieties with a coefficient of earliness 1.60. All other accessions possessed coefficient of earliness greater than 1.66. The established phenological differences were preserved during the whole vegetation period.

Table 2. Phenological development of white lupin accessions

Accessions	BGR 3080	BGR 3085	BGR 3083	BGR 3079	BGR 3086	BGR 3078	BGR 6337	BGR 6339	BGR 3084	BGR 6341
Sowing-beginning of flowering, days	54	54	53	54	49	54	54	54	52	52
Sowing-maturity, days	97	98	99	93	90	97	97	99	95	95
Earliness coefficient	**2.00**	**2.00**	**1.80**	**2.00**	**1.00**	**2.00**	**2.00**	**2.00**	**1.60**	**1.60**

Conclusions

Ten *Lupinus albus* accessions were characterized by their agro-morphological traits. The variability of the studied traits proved the genetic diversity within the accessions.

The accessions were clustered in two groups by the economical important quantitative traits. On the other hand, the traits were combined into two main clusters that would facilitate the crop breeding programs.

According to the coefficient of earliness, the white lupin accessions are grouped in three groups: ultra-early, early and late. BGR 3086, BGR 3084 and BGR 6341 were selected as early accessions and will be used as gene sources for improvement of vegetation period.

The carried out assessment gave valuable data about important economical traits in tested accessions. This will increase opportunities for their use in different fields: indirectly in breeding programs, reproduction, recovery in the gene bank, international exchange, technology assessment and direct implementation open pollinated varieties.

Acknowledgements

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