Agrobiological and physiological evaluation of the accessions of the *Lathyrus* sp. collection from the Genebank in Sadovo

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Received: February 21, 2020 ▹ Accepted: April 13, 2020

Abstract. In view of the insetting climatic changes, *Lathyrus* sp. could become a wonder crop in the drought-prone areas, which resemble environmentally the conditions in Sadovo region. The present study will enhance the interest of researchers and farmers in this crop. Twelve genotypes have been examined of four different botanical species: *Lathyrus sativus*, *Lathyrus clymenum*, *Lathyrus nissola*, *Lathyrus tingitanus*. Accessions with the highest potential yield were traced down to *Lathyrus sativum* (BGR 2980, 2983, 2942; 2989). Genotypes with the shortest vegetation period belonged to *Lathyrus clymenum* (BGR 6264) and *Lathyrus nissola* (BGR 6265). The results have shown that drought-tolerant genotypes with the highest Chlorophyll Content Index were obtained from *Lathyrus tingitanus* (BGR 6291), *Lathyrus nissola* (BGR 6265) and *Lathyrus sativum* (B6E0396, BGR 2935, BGR 2966). These accessions could be included in the breeding programs with a view of drought tolerance, improvement of yields and earliness. This paper reports the results from a study of agrobiological characters and drought tolerance of four different *Lathyrus* sp. L. species from the Genebank in Sadovo.

Key words: agrobiological evalution, drought tolerance, *Lathyrus*

Introduction

Grass pea (*Lathyrus* sp.) is an ideal legume for cultivation by resource-poor farmers, because of its drought tolerance, high protein content, high-degree adaptability to extreme conditions, disease resistance, and low input requirement for its cultivation (Hillocks & Maruthi 2012). It is cultivated in the Indian Subcontinent, Ethiopia and to a lesser extent in North Africa, Australia, Asia, and Europe (Hanbury & al. 2000). Currently, similarly to other legumes such as chickpea, lentil and vetch, grass peas are beginning to be cultivated in the Old World (Mikić & al. 2011). Grass pea seeds have a high nutritional value (Ennenking 2011). Since that crop can survive under extreme conditions, *Lathyrus* sp. can serve as a survival food in difficult times. These appealing specificities make grass pea an interesting crop and encourage extensive characterization of its germplasm. Water deficit is one of the most important factors that not only affect plant growth and development but also limit productivity (Boyer 1982; Choudhary & Suri 2014). Under a level of extreme drought, grass pea is the only productive crop and, frequently, the only food for the poor in some rural or marginal areas (Vaz Patto & al. 2006).

Functional state of photosynthetic activity has been considered a very useful physiological indicator for sensitivity of plants to stress factors (Richardson & al. 2002; Stoeva & al. 2010). Synthesis of plastid pigments is of great importance for photosynthetic activity of plants. Plastid pigments content under normal and stressing environmental conditions has been widely studied and discussed (Mikiciuk & al. 2010; Wrobel & al. 2010; Aienl & al. 2011). The Chlorophyll Content Meter (CCM200+) employs calibrated light-emitting diodes and receptors for calculation of the

Chlorophyll Content Index (CCI), which is defined as a ratio of percentage transmission at 931 nm to 653 nm through a leaf sample. CCI units can be easily extrapolated to transmission measurements obtained with a spectroradiometer or remote-sensing measurements (Richardson & al. 2002).

The paper reports results from a study of agrobiological characters and drought tolerance of four different *Lathyrus* L. species from the Genebank in Sadovo.

Material and methods

Experimental work was carried out in the period 2018-2019, in the experimental field of the Institute of Plant Genetic Resources (IPGR) in Sadovo. The plants were grown by a standard technology for field production on cinnamon-forest soils, after a precursor of wheat.

The subject of this study were 12 accessions of local origin from the collection of *Lathyrus* sp., stored in the IPGR genebank. Genotypes of four botanical species were used: *Lathyrus sativus* L. – 9 accessions, *Lathyrus clymenum* L. – 1 accession, *Lathyrus nissola* L. – 1 accession, and *Lathyrus tingitanus* L. – 1 accession. The accessions of the *Lathyrus* genus were sown in five to 10 rows (depending on the sample grain size), on a 2 m wide plot, at depth of 4–6 cm and distance between the rows of 50 cm. Structural elements of the yield have been determined by biometric analysis of 10 plants from each accession. Evaluation of the accessions was based on the descriptors for *Lathyrus* spp. (IPGRI, 1985).

The quantitative characters were recorded, namely plant height (cm), number of main branches, number of pods per plant, number of grains per pod, mass of grains per plant (g), and mass of 100 grains (g). The beginning of flowering was plotted from the 10% plant flowering stage. The period needed by a genotype from germination to that stage of development was recorded as the number of days until 10% flowering. The qualitative characters such as growth habit, shape of leaflets and grains, and color of flowers have been also plotted. The colour of grains was recorded from 100 randomly selected grains, immediately after threshing.

Physiological assessment of the accessions was carried out *in vivo* in the field after a period of drought. Measurements were taken at two dates for a leaf sample. After the plants reached the stages of mowing maturity, the relative chlorophyll content in leaves has been determined as the Chlorophyll Content Index by CCM 200+. For each plant, 15 leaf readings were taken from the central part of the leaf at two dates.

The analysis of variance (mean, error of mean, minimum, maximum, range, standard deviation and Coefficient of Variation) (Lidansci 1988) and Duncan's method were applied with the SPSS 19.0 statistical program for Windows.

Results and discussion

Results of the variance analysis are given in Table 1.

There was a strong variation for all studied characters of the *Lathyrus* sp. accessions, except in the days to maturity with Coefficient of Variation 7.83% and the number of main branches with Coefficient of Variation 8.06%. The earliest accessions with the shortest vegetation period were from the species *Lathyrus clymenum* (BGR 6264), with 98 days, and *Lathyrus nissola* (BGR 6265), with 106 days. The former needed 48 days to the beginning of flowing and the latter 50 days. All grass pea accessions needed between 47 and 69 days to the beginning of flowing. One of the most important characters of grain legumes was their earliness in reaching the flowering and maturity cycle. Thus, they avoided the high temperatures and low air humidity during the flowering and podding stages (Stoilova & Berova 2009). The number of main branches was very important for the grain yield per

Table 1. Qualitative characters observed in 12 accessions from four different species of the genus *Lathyrus* sp.

Characteristics	Mean/error of mean	Min	Max	Range	Sandart division	Coefficient of Variation, CV (%)
Days to maturity	112±2.5	98.00	129.00	31.00	8.77	7.83
Days to flowing	54.92±2.3	47.00	69.00	22.00	7.95	14.48
Plant height (cm)	74.51±1.1	41.80	193.10	151.30	38.38	51.51
Height until first pod (cm)	21.08±1.7	16.90	38.50	21.60	5.89	27.94
No. of main branches	3.35±0.1	2.90	3.70	0.80	0.27	8.06
No. of pods/plant	22.39±2.5	9.80	36.70	26.90	8.62	38.50
No. of grains /plant	49.90±5.9	2.40	78.70	76.30	20.51	41.10
No. of grains/pod	3.43±0.5	2.50	8.90	6.40	1.77	51.60
Mass of grains/plant (g)	9.08±1.5	0.10	14.10	14.00	5.16	56.83
Mass of 100 grains (g)	18.04±2.1	1.00	25.20	24.20	7.26	40.24

plant and that was why one of the breeding directions was to select plants with a higher number of branches per plant and, along with this, with a higher number of pods per plant. Of all studied accessions, the highest mean number of main branches was recorded in the accessions of BGR 2983, 2989 and 2935. These accessions belonged to the *Lathyrus sativum* species, with a spreading growth habitus, lanceolate leaflets and greyish-white color of grains.

There was a great difference among the accessions in the mass of grains per plant, number of grians per pod and plant height. These characters were especially important for the Coefficient of Variation, and thus the most variable. Accessions with the highest mass of grains per plant belonged to BGR 2980, 2983, 2942, and 2989. They were obtained from the *Lathyrus sativum* species and had a spreading growth habitus, lanceolate leaflets and greyish-white color of grains. Accessions with the highest mean number of grians per pod were obtained from the *Lathyrus nissola* species (BGR6265), with plants with erect growth habitus and black color of grains; and from the *Lathyrus clymenum* species (BGR6264), with plants with prostrate growth habitus and brown color of grains. The plants of both species had ovate-lanceolate leaflets, pink flower wings and spherical grains. The species *Lathyrus tingitanus* had the greatest mean plant height (193.10 cm) and plants with semi-erect growth habitus, ovate-lanceolate leaflets, red flag and wings color of the flowers, and oblate/flattened grains brown in color.

Table 2 shows the Chlorophil Content Index (CCI) measured for the accessions of BGR 6291, 2935 and 2966 at the first reporting date. The highest value was produced by the former, with a statistically significant difference in comparison to the rest. *Lathyrus tingitanus* (BGR 6291) set into a different group from all others with similar results. The plants of the *Lathyrus tingitanus* species had the gretaest average height and greatest height until the first pod.

During the second measurement date, there was reduction in the chlorophyll content in all accessions, except for the genotype of BGR 6265 (*Lathyrus nissola*), in which the pigment degradation process was the lowest. Only that accession belonged to the **b** group and stood out with a great number of main branches and number of grains per pod. Based on the processed statistical results by Duncan's method, the accessions were divided into three groups and most of them belonged to **a** group.

The mean values of CCI in the studied genotypes were close, with a significantly distinguished accession of BGR 6291 of the *Lathyrus tingitanus* species, which according to Duncan's method, was in a separate group. Despite the strong reduction of its chlorophyll content during the second date, *Lathyrus tingitanus* retained the greatest functionality of its photosynthetic apparatus as compared to the other studied accessions. Two genotypes from the other group of species *Lathyrus nissola* (BGR 6265) and *Lathyrus sativus* (B6E0396) showed a high mean value of the Chlorophyll Content Index. All five genotypes (BGR 6291, 2935, 6265, 2966; and B6E0396) with high CCI values possessed drought tolerance and could be used in the breeding programs.

The results showed that accessions with the highest potential yield belonged to the *Lathyrus sativum* species (BGR 2980, 2983, 2942; 2989). They showed the highest values of the grains mass per plant, number of pods per plant and number of grains per plant. Genotypes with the shortest vegetation period came from the species *Lathyrus clymenum* (BGR 6264) and *Lathyrus nissola* (BGR 6265). These two species stood out with the highest average number of grains per pod.

Table 2. Chlorophyll Content Index (CCI) of 12 accessions of four different species of *Lathyrus* sp.

Accessions	Species	Chlorophyll Content Index (first date)	Chlorophyll Content Index (second date)	Chlorophyll Content Index (mean)
BGR 2935	*Lathyrus sativus*	6.04 [a]	1.45 [a]	3.75 [a]
BGR 2942	*Lathyrus sativus*	3.89 [a]	2.11 [a]	3.00 [a]
BGR 2966	*Lathyrus sativus*	5.23 [a]	2.01 [a]	3.62 [a]
BGR 2979	*Lathyrus sativus*	3.18 [a]	1.47 [a]	2.33 [a]
BGR 2980	*Lathyrus sativus*	4.37 [a]	1.73 [a]	3.05 [a]
BGR 2981	*Lathyrus sativus*	3.09 [a]	1.69 [a]	2.39 [a]
BGR 2983	*Lathyrus sativus*	3.57 [a]	1.64 [a]	2.60 [a]
BGR 2989	*Lathyrus sativus*	4.80 [a]	1.87 [a]	3.34 [a]
BGR 6264	*Lathyrus climenum*	4.13 [a]	1.56 [a]	2.85 [a]
BGR 6265	*Lathyrus nissola*	4.14 [a]	4.98 [b]	4.56 [a]
BGR 6291	*Lathyrus tingitanus*	33.87 [*b]	1.69 [a]	17.78 [b]
B6E0396	*Lathyrus sativus*	4.19 [a]	3.34 [ab]	3.77 [a]

Note: a,b,ab – different groups according to Duncan's method; * – significant at 0.05 level.

The drought tolerance genotypes with the highest Chlorophyll Content Index came from the species *Lathyrus tingitanus* (BGR 6291), *Lathyrus nissola* (BGR 6265) and *Lathyrus sativum* (B6E0396, BGR 2935, BGR 2966). All these accessions could be included in the breeding programs for improvement of yields, earliness and drought tolerance.

In view of the insetting climatic changes, *Lathyrus* sp. could be used as a wonder crop in drought-prone areas, close in environmental conditions to the Sadovo region. The present study is expected to increase the interest of researchers and farmers in this crop.

Acknowledgements. The authors' deep gratitude in acknowledgement of research funding go to the Agricultural Academy and the project "Healthy foods for a strong bioeconomy and quality of life" work package 1.3.

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