

EVALUATION OF THE MANIFESTATION OF AGROBIOLOGICAL CHARACTERS IN A COLLECTION OF BIRDSFOOT TREFOIL (*LOTUS CORNICULATUS* L.)

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Abstract. The plain grasslands in Western Romania are real germplasm reservoirs for Birdsfoot trefoil. The Birdsfoot trefoil occupies all the gaps in the natural meadows, where other legumes fail because it has a great capacity to adapt to harsh conditions. Wild Birdsfoot trefoil populations, from the grassland flora, are reservoirs of genes with tolerance to environmental factors, resistance to diseases and pests. In this context, the paper aims to evaluate the genetic potential of some populations of trefoil, obtained from seeds harvested from the spontaneous flora of the plain grasslands of Western Romania, in terms of important quantitative features, which will have a theoretical basis for obtaining new varieties. Birdsfoot trefoil populations analyzed in the paper come from seed harvested in natural grasslands in the plains of the Banat region, in Western Romania. The seeds were sown in vegetation pots and in the spring of 2019 the plants were transplanted in the field. In this study, all data on the main characteristics analyzed were obtained in the second year of culture (2020). Birdsfoot trefoil analyzed populations fluctuate the studied characters and can be successfully used in breeding programs for creating new varieties. The Lv8 population proved promising for its characters: the number of generative shoots per plant, the number of umbels per plant, the number of pods per plant, the number of seeds per plant, and the weight of seeds per plant. In the future, plant breeding will require an expansion of the genetic base to meet the challenges posed by climate change and the need to ensure food security, which requires the use of more local people in raising the productive level of Birdsfoot trefoil culture.

Keywords: birdsfoot trefoil, genetic resources, variation

INTRODUCTION

In Europe, the Birdsfoot trefoil is quite widespread, being found in almost all geographical areas of natural meadows (DRAGOMIR, 2005; DROBNÁ, 2010), where along with clover it provides the best quality fodder (VUCKOVIC et al., 2007; CHURKOVA, 2011). Legumes, of which *Lotus corniculatus* L. is a part, are characterized by a high protein content and a high degree of palatability and digestibility. Feed quality and protein content in Birdsfoot trefoil remain much longer than in other pasture species, even after the plants form seeds (SAREEN, 2004; DÖNMEZ and UZUN, 2016).

The Birdsfoot trefoil is very unpretentious to heat, withstands frost, early spring frosts, drought and floods well (STEINER and SANTOS, 2001). It is adapted to soils with low fertility, acidic and moist (STOFFELLA et al., 1998; AYRES et al., 2007), gives good results where alfalfa and clover fail (SAVATTI et al., 2004).

Several studies, as well as our research, indicate that this species is found in all altitude ranges (DÖNMEZ and UZUN, 2016). In Romania, it occupies a wide ecological range from the plain area (about 80 - 150 m altitude) to the mountain area (over 1800 m altitude).

In recent years, *Lotus corniculatus* L. has come to the attention of many researches due to the interest in sustainable, low-input feed systems (ESCARAY et al., 2012; UZUN and DÖNMEZ, 2016; COJOCARIU L., 2018), as well as the fact that it belongs to the group of medicinal feeds for parasite control. Birdsfoot trefoil populations vary in condensed tannin content (FERGUSON, 2017).

In Romania, the Birdsfoot trefoil is very widespread in the spontaneous flora (DRAGOMIR C. et al., 2011), being found in all pedoclimatic areas. Among the Birdsfoot trefoil species, the common Birdsfoot trefoil (*Lotus corniculatus*) predominates, occupying very large ecological areas, *Lotus tenuis* (salt Birdsfoot trefoil) adapted to areas with salty soils, and in the wetter depression areas, the species *Lotus uliginosus* is found in a smaller proportion. Although, in Romania, the Birdsfoot trefoil currently occupies smaller areas in pure culture than alfalfa and red clover, it is still increasingly noticeable the lack of sufficient quantities of seeds. These seeds are sometimes indispensable in complex mixtures in order to establish sown meadows as well as to improve semi-natural grasslands.

The selection value of the main production characters in the Birdsfoot trefoil is given by the degree of variability of the species (NEDELEA and MADOȘA, 2004). Wild Birdsfoot trefoil populations, from grassland flora, are reservoirs of genes that can be used in conventional breeding programs or by modern biotechnologies (KÖTELES and PEREȘ, 2013) in order to create crops with tolerance to environmental factors, resistance to diseases and pests. and finally with superior production potential.

For fodder, the production of vegetative mass is interested, respectively a higher proportion of vegetative shoots; but the generative shoots, the flowers and the seed are not to be neglected either, because they ensure the multiplication capacity, respectively the persistence of the species in the meadows.

The paper aims to evaluate the genetic potential of some Birdsfoot trefoil populations, obtained from seeds harvested from the spontaneous flora of the plain grasslands of Western Romania, in terms of important quantitative features, which will have a theoretical basis for obtaining new varieties.

MATERIALS AND METHODS

The populations of Birdsfoot trefoil analyzed in the paper come from seeds harvested from natural grasslands in the plain area of Banat region in Western Romania, in summer 2018. The grasslands chosen as a source of germplasm for the guides were selected by several field trips. Grasslands that have been used extensively without the application of chemical fertilizers and away from any source of pollution have been considered.

All 10 experimental sites (grasslands from which the Birdsfoot trefoil seed was harvested), but also the experimental field in which the samples were transplanted, are located in the same pedo-climatic conditions specific to the Banat Plain: average multiannual temperatures between 10 - 12°C, quantities of average multiannual precipitation between 550 - 650 mm, high level of groundwater and soils with average natural fertility.

In the experimental sites, later marked on maps, the guide was spread in parcels between 30 and 70 cm in diameter.

From the 10 experimental meadow sites, 150 g of seed were harvested from each Birdsfoot trefoil population, when the pods were mature. This resulted in 10 samples subsequently analyzed in the laboratory, according to the standards in force.

The seeds were sown in vegetation pots and in the spring of 2019 the plants were transplanted in the field of the Feed Laboratory of the Agricultural Research and Development Station Lovrin.

In the field, the plants from each guide population were planted in rows, in three repetitions, 25 plants in a row at a distance of 0.8 m between rows and between plants in a row.

For plants and biometric measurements, 10 plants from each repetition were used.

In this study, all data on the characteristics of: NL - No. Vegetative shoots / plant, NG -No. Generative shoots / plant, NU - No. of umbels/plant, NP - No. of pods / plant, NS – No. of seeds/plant, MMB - The weight of 1000 seeds, GSP - The weight of seed / plant, were obtained in the second year of culture (2020).

Statistical analysis. The PCA Analysis was performed using MVSP program.

The data sorted by Dual Clustering were square-root transformed in order to apply the Nearest neighbour, squared Euclidean method

RESULTS AND DISCUSSIONS

The location where the research was carried out in this work (Agricultural Research and Development Station Lovrin) is located in the plain area and as such we studied 10 populations of grasslands in extensive use also in the plain area, so that climatic conditions does not represent an impediment in the way of manifestation of hereditary characters.

In the first year, the environmental conditions favored the growth and development of the *Lotus corniculatus* L. plants in the field, developing a bush 30 - 40 cm in diameter. In the fall of 2019, the Birdsfoot trefoil plants underwent a strong defoliation by the hares. However, the plants recovered and sprouted strongly in spring. This aspect indicates that Birdsfoot trefoil has the ability to recover after low cuts (2-3 cm).

The climatic conditions in the spring of 2020 were favorable for the growth and development of the Birdsfoot trefoil plants, so that at the second harvest, the plants covered the space between the plants one by one. Regarding the characters investigated: NL - No. Vegetative shoots / plant, NG -No. Generative shoots / plant, NU - No. of umbels/plant, NP - No. of pods / plant, NS – No. of seeds/plant, MMB - The weight of 1000 seeds, GSP - The weight of seed / plant, there is great variability (Figure 1).

The average number of vegetative shoots in the analyzed Birdsfoot trefoil plants populations was between 10 - 71, and the average number of generative shoots showed values between 2 (at LV19) and 78 at Lv8. Populations that had a small number of vegetative shoots instead had a large number of generative shoots. This aspect can be used in breeding programs, populations that have a large number of vegetative shoots can be selected for grazing. Assuming that some of these specific variations have a genetic basis, it may suggest that in these populations there is a genetic potential that, if exploited, could allow populations to be productive and persistent.

On the other hand, a series of works in the field (PET ̳ et al., 2008; CHURKOVA, 2011; DÖNMEZ and UZUN, 2016) suggest that the Birdsfoot trefoil has the ability to develop new shoots in a vegetative cycle. The flowering of the Birdsfoot trefoil is staggered (STEPHENSON, 1984). In the Banat Plain in Romania the flowering of the Birdsfoot trefoil is between the end of May and the beginning of June (DRAGOMIR, 2005).

A major factor limiting the wider use of the Birdsfoot trefoil is the fact that no commercial seed is found on the market as seed production is cumbersome. The quality of the seeds ensures a stronger growth of the plants, a higher level of density and a uniformity of the culture. (MCKERSIE et al., 1981; TOTH et al., 2015,).

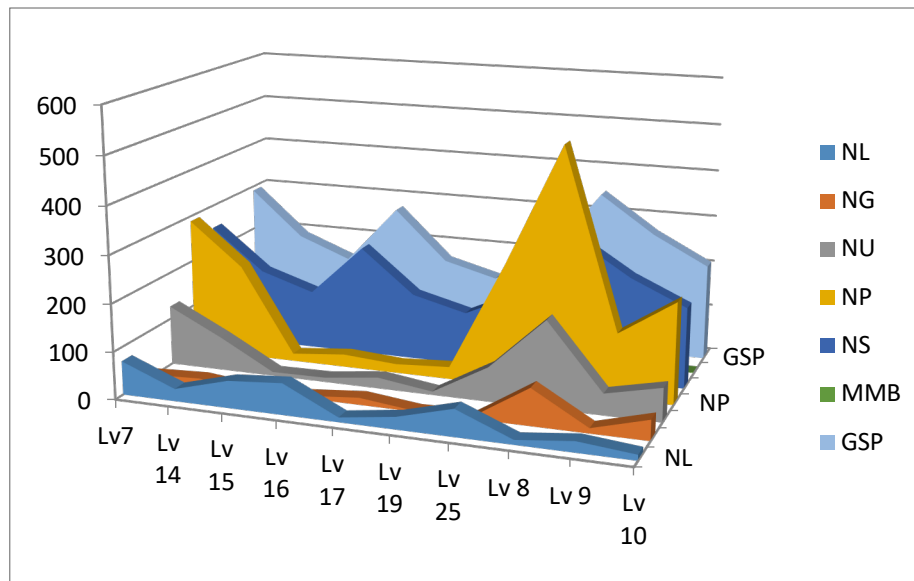


Figure 1. Area Fingerprint of investigated plant collections

[Legende: NL - No. Vegetative shoots / plant, NG -No. Generative shoots / plant, NU - No. of umbels/plant, NP - No. of pods / plant, NS – No. of seeds/plant, MMB - The weight of 1000 seeds, GSP - The weight of seed / plant]

Seed production is first given by the number of generative shoots and then by the number of umbels / plant, the number of pods / plant, the number of seeds / plant and the weight of seeds / plant. The average number of umbels per plant in the analyzed Birdsfoot trefoil populations shows a great variability being between 8 and 183.

The character of the number of seeds per plant in the analyzed birdsfoot trefoil populations also shows a great variability being between 113 and 296 seeds.

The weight of seeds per plant in the analyzed Birdsfoot trefoil populations ranged from 134 to 344 grams, and the weight of 1000 grains ranged from 1.15 to 1.19 g under the given conditions.

As can be seen from Figure 1, the highest values for the characters: the number of generative shoots per plant, the number of umbels per plant, the number of pods per plant, the number of seeds per plant and the weight of seeds per plant are found in the Birdsfoot trefoil population Lv 8.

A number of studies show that high phenotypic variability between populations in terms of analyzed phenological traits may be related to high phenotypic plasticity and / or genetic variation between individuals (GRABBER et.al., 2014, Savatti et.al., 2004). This determines the high ecological plasticity of the Birdsfoot trefoil.

Other studies show that soil, climatic conditions and hereditary dowry were a major factor in the manifestation of productive talent (CHURKOVA, 2011).

PCA analysis groups the plant collections into 2 groups (Figure 2):

Group I consisting of vectors of Birdsfoot trefoil populations (Lv15, Lv16, Lv19 and Lv17), characterized in particular by the number of seeds per plant and the weight of seeds per plant and

Group II consisting of vectors of Birdsfoot trefoil populations (Lv7, Lv25, Lv14, Lv10 and Lv8) characterized in particular by the number of pods per plant, as well as the population Lv9 characterized by the number of pods per plant as well as the number of seeds per plant and seed weight per plant.

Thus, the characteristics of the two groups must first be taken into account for selection.

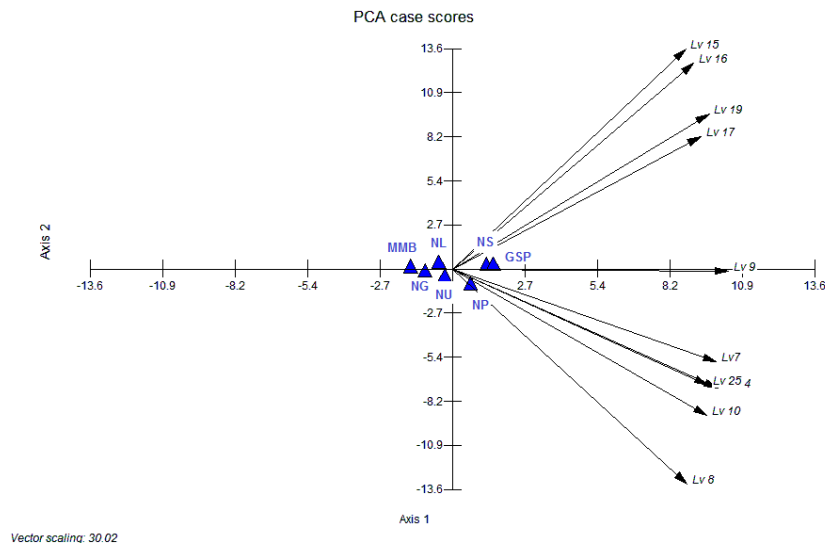


Figure 2. PCA biplot representation of data

A cluster analysis was performed to find out the degree of similarity between the Birdsfoot trefoil populations, depending on the characters analyzed. From figure 3 it can be seen that the population of Lv8 guides is in a group and the other 9 populations form another group, with two subgroups:

- Ist subgroup consisting of Birdsfoot trefoil populations: Lv9, Lv25, Lv10, Lv14 and detached Lv7 and
- IInd subgroup consisting of Birdsfoot trefoil populations: Lv17, Lv19, Lv15 and detached Lv16

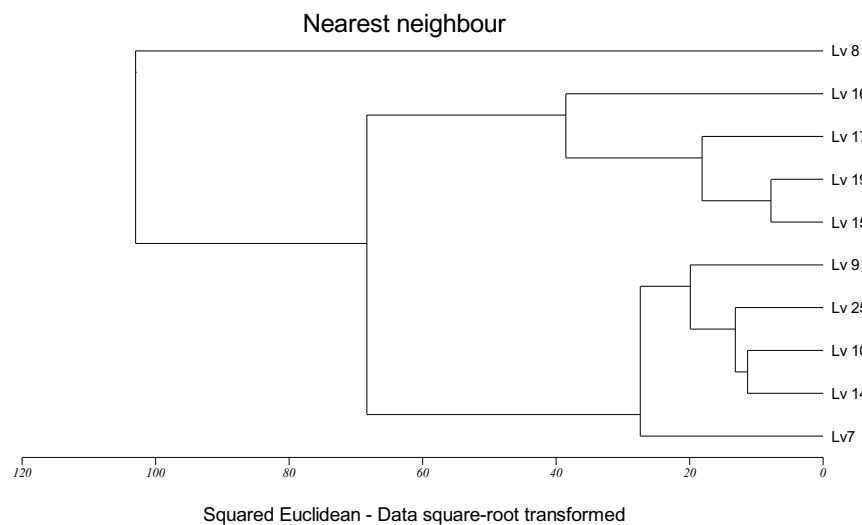


Figure 3. PCA biplot representation of data

Depending on the characteristics pursued in the selection, the groups of Birdsfoot trefoil populations with similar characteristics will be taken into account.

CONCLUSIONS

This study indicated that the plain grasslands in Western Romania are real germplasm reservoirs for Birdsfoot trefoil.

The analyzed Birdsfoot trefoil populations show a great variability of the studied characters, but they can be used successfully in the breeding programs for the creation of new varieties. The Lv8 population proved promising for its characters: the number of generative shoots per plant, the number of umbels per plant, the number of pods per plant, the number of seeds per plant, and the weight of seeds per plant.

In the future, plant breeding will require an expansion of the genetic base to meet the challenges posed by climate change and the need to ensure food security, which calls for greater use by local populations to raise the productive level of Birdsfoot trefoil culture.

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