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ECOLOGICAL-GENETIC MODEL IN GRASS PEA (*Lathyrus sativus* L.) BREEDING

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ecological model for organizing the quantitative traits and the method of orthogonal regressions were applied to evaluate both, aboveground and root biomass of grass pea varieties different originating. The study was conducted for three years. The highest yields for fresh aboveground biomass were BGE015741 (840.40 kg/da), LAT4362 (779.3 kg da^{-1}) and BGE027129 (722.80 kg da^{-1}). Plants of LAT4362 and BGE025277 have a higher weight of fresh aboveground mass and fresh root mass and exhibit a good combination of adaptive and attraction genes. The highest average seed yield was recorded at BGE015741 (158.40 kg da^{-1}), BGE027129 (113.10 kg da^{-1}) and BGE025277 (108.30 kg da^{-1}). The BGE027129, BGE025277 and BGE015741 varieties are found of greatest interest with regard to seed weight per plant and they are suitable as initial materials for the purpose of combinatorial breeding for the obtaining of genotypes combining both, high seed weight and high root biomass weight per plant.
Key words: genotype,module, phenotype, resultant traits

INTRODUCTION

The need for a more efficient use of the plant's production potential implies the expansion of the legume species by including less widespread plant species with the simultaneous development of technologies for their cultivation (NOTOV, 2008; TYURIN and ZOLOTARYOV, 2013).

Legumes are valuable because of the high protein content, and along with cereals are essential in human food. Due to their high genetic potential for good development under different environmental conditions, recovery capacity and soil fertility improvement, they are an

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important component of sustainable agriculture (WANI *et al.*, 2012).

The main sources of plant proteins, which are the main products for complete nutrition are synthesized from the annual and perennial legumes (clovers, alfalfa, peas, soybean, lupine, and vetch). Legume crops under favourable climatic and soil conditions fixing nitrogen from the air (ZHUCENKO, 2001; DEBELYJ *et al.*, 2015).

Grass pea (*Lathyrus sativus* L.) is an annual legume crops with a wide distribution area. The main areas of its cultivation are countries with dry or semi-dry climatic conditions. *Lathyrus* species are well placed to meet the growing demand for global demand for food and animal feed at the time of climate change. Conservation and sustainable use of grass pea resources is essential to enable it to regain interest in it (BURLYAEVA and VISHNYAKOVA, 2010; SHEHADEH, 2011). Adaptation to environmental conditions by interacting with microorganisms is one of the fundamental properties of higher plants. Modern varieties are of an intensive type (not only for legumes) and because of their genetic features they are not always able to interact with the useful soil micro flora. To realize its biological abilities, it is necessary to seriously restructure the breeding process in these crops. This includes the creation of adaptive varieties with high productivity and good interaction with useful microorganisms in agro-biocenoses (SIDORIVA and SHUMNY, 2003; SOLOVOV, 2006) and environment x genotype interaction (MIHAILOVIC *et al.*, 2019; LAKIĆ *et al.,* 2019a; 2019b; 2022; POPOVIĆ *et al.,* 2020; SINGH *et al.,* 2021; MILUNOVIĆ *et al.,* 2022; ZEJAK *et al.*, 2022; BOJOVIC *et al.*, 2022; BOZOVIC *et al.*, 2022).

The purpose of the study was to assess the production capabilities of pea grass varieties by applying the ecological-genetic model for organizing the quantitative traits.

MATERIALS AND METHODS

The study was conducted in 2014-2016 in the experimental field of the Institute of Forage crops, Pleven, Bulgaria. Sowing was carried out manually in optimal time, according to the technology of cultivation of grass pea. Aboveground and root biomass plant material of 6 grass pea varieties, originating in Spain, vz BGE027129, BGE015741, BGE025277, and from Portugal, vz LAT4362, LA5108, LAT5038 was analyzed.

The following characteristics have been assess: i) in the beginning of flowering stage: leaf fresh weight per plant (g), stem fresh weight per plant (g), aboveground mass fresh weight per plant (g), nodule number per plant, weight of one nodule (g), supply of root mass of one plant in nodules, nodule weight per plant (g), root mass weight (g), aboveground fresh mass productivity (kg da^{-1}); ii) in the technical maturity of seeds stage: number of seeds per plant, weight of one seed (g), seed weight per plant (g), number of pods per plant, number of seeds in one pod, seed productivity (kg da^{-1}). Biometric measurements were made to 10 plants of each variety. During the vegetation, all observations were made to determine the sowing-beginning of flowering and sowing-technical seed maturity phonological periods.

The modular organization of the quantitative trait is presented in the model of DRAGAVTSEV (1995). According to this model, the genetic formula of the attribute consists of a multitude of discreetly displaying, functionally coherent components of a unified system. Due to the integrity of the elements of the genetic system within the whole organism, the phenotype can be presented as realization of two hierarchies - structural and temporary. The module as an elementary unit describes the organization of the quantitative trait, which consists of three interrelated attributes - one resultant and two components. The module reflects all stages of realization of genetic formulas depending on the level of ecological factors during ontogenesis. In the modular organization of the quantitative trait, the resultant can be considered as a component in another next module. For example: component attribute 1 x component attribute 2 = resultant attribute.

The orthogonal regression was described by Kramer (DRAGAVTSEV, 1995; 2002): If φ is the angle of orthogonal regression, then Xi is an individual (or mean) value the character xi, x is a mean value of all the individuals within the variety (or the mean of the average values of the varieties when calculating the genotypic regression).

$$tg2\varphi = \frac{2\mu_{11}}{\mu_{20} - \mu_{02}}$$

$$\mu_{20} = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

$$\mu_{02} = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})^2$$

$$\mu_{11} = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

The parameters of axes of the orthogonal regression are given by:

$$y - \bar{y} = \frac{2\mu_{11}}{(\mu_{20} - \mu_{02}) \pm \sqrt{(\mu_{20} - \mu_{02})^2 + \mu_{11}}}(x - \bar{x})$$

Where the sign "-" corresponds to the longer axis of the ellipse of dispersion.

$$a = \frac{c}{\frac{1}{2}(\frac{1}{\mu_{20}} + \frac{1}{\mu_{02}}) \pm \sqrt{\frac{1}{4}(-\frac{1}{\mu_{20}} - \frac{1}{\mu_{02}})^2} - \frac{1 - r^2}{\mu_{20}\mu_{02}}}$$

Where r- the coefficient of correlation, cthe constant (c=2 with P= 5%), a- the initial ordinate.

The essence of the phenomenon becomes clear when considering the divergence in a two-dimensional coordinate system with two attributes - breeding (BA) and background (BA). It should be noted that in the figures shown, so-called orthogonal regressions were used, from where the method bears the name of the orthogonal regression method. These regressions are different from those commonly used in the applied regression analysis, which are always two - A x B and B x A. Orthogonal regression is always only one - this is the major axis of the scatter ellipse or the geometric point of the points (straight line) the sum of squares of distances from which empirically the scattering point is minimal.

The co-ordination system BA-BA (Breeding - Background) allows to identify the genotype of the individual organism by phenotype. Unlike methods for genetic analysis of signs, it is proposed to study 7 gene-physiological systems, i.e. attractions (attr), micro distribution (mic), adaptability (ad), polygenic immunity, reaction to limiting soil nutrition factors, tolerance to seed density and genetic variation of the ontogenesis phase duration).

RESULTS AND DISCUSSION

Climate characteristic

The study period covers three consecutive years differing in climatic terms. Figure 1 the data on average monthly temperatures and the amount of precipitated rainfall by months during vegetation. The vegetation 2014 is the most favorable with average monthly air temperatures for April 12.3°C, May 16.7°C and June 20.6°C, and rainfall 139.8 mm, 83.0 mm and 54.3 mm, respectively. As a result of the balanced combination of air temperature and optimum rainfall it has been favorable for plant development. The second year (2015) has relatively higher temperatures in May of 18.8°C and uneven precipitation distribution, characterized by a certain drought in April (43.6 mm) and May (30.6 mm), and a larger quantity in June (95.7 mm). The third year (2016) occupies an intermediate position over the other two years with temperatures in the months of April and May, close to normal (15.3-16.4°C) and rainfall between 73.1 and 76.5 mm.

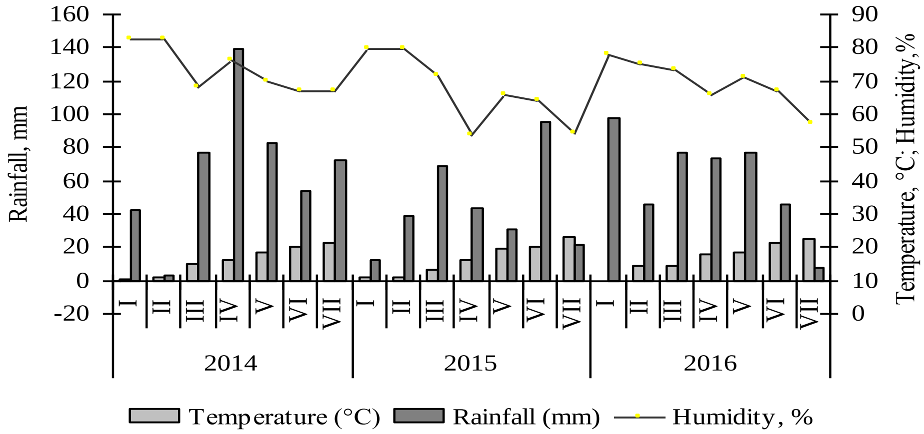


Fig. 1. Climatic characterization of the experimental period

Modular organization of the quantitative trait

Quantitative genetics has arisen and developed on the basis of Mendelism. Mater's polygene theory and dialectical analysis have been extensively applied in the selection and contributed to the development of both, quantitative genetics and selection. The set of applied methods is important for the development and the theoretical basis of modern technology of crops breeding. Table 1 presents the effect of the environment on five modules defining the productivity of the aboveground and root biomass of six pea grass varieties.

Table 1. Impact of environmental conditions on the modules seed productivity per plant and number of seeds per plant in grass pea varieties (at book value)

Variety	Year								
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Parameter	Component trait 1			Component trait 2			Resultant trait		
Module I. Seed productivity per plant									
Parameter	Seeds per plant			Weight of one seed (g)			Seed weight per plant (g)		
BGE027129	22	19.80	37	0.316	0.253	0.135	6.947	5.010	5.01
BGE025277	9	5.80	33	0.528	0.991	0.174	4.753	5.747	5.75
LAT4362	15	19.20	34	0.291	0.150	0.085	4.358	2.888	2.89
LA5108	29	35.00	21	0.191	0.079	0.131	5.541	2.752	2.75
LAT5038	14	22.40	28	0.307	0.121	0.097	4.300	2.720	2.72
BGE015741	16	34.40	35	0.384	0.256	0.252	6.142	8.809	8.81
Module II. Number of seeds per plant									
Parameter	Pods per plant			Seeds per pod			Seeds per plant		
BGE027129	11	17.6	19	1.90	1.13	1.95	22	19.80	37
BGE025277	7	6.4	17	1.29	0.91	2.01	9	5.80	33
LAT4362	7	12.6	17	2.11	1.52	2.00	15	19.20	34
LA5108	13	16.2	17	2.28	2.16	1.23	29	35.00	21
LAT5038	8	10.6	10	1.63	2.11	3.00	14	22.40	28
BGE015741	9	21.4	14	1.69	1.61	2.48	16	34.40	35
Module III. Productivity of fresh aboveground mass per plant									
Parameter	Fresh weight of leaves per plant (g)			Fresh weight of stems per plant (g)			Weight of fresh mass per plant (g)		
BGE027129	11.767	9.018	4.67	6.11	11.869	10.77	20.79	17.98	15.44
BGE025277	8.861	11.924	2.58	8.01	16.401	5.07	20.79	24.41	7.65
LAT4362	13.580	11.972	2.79	9.88	14.842	5.39	25.55	24.72	8.18
LA5108	5.574	4.344	2.50	5.65	6.224	3.54	9.92	11.87	6.04
LAT5038	10.833	6.717	1.99	8.80	8.820	3.25	17.55	17.62	5.24
BGE015741	20.021	11.539	2.79	8.92	10.657	9.10	31.56	19.58	11.89
Module IV. Nodule weight per plant									
Parameter	Number of nodules per plant			Weight of one nodule (g)			Weight of nodules per plant (g)		
BGE027129	62.00	27.60	33.8	0.0079	0.0074	0.011	0.491	0.205	0.36
BGE025277	19.63	23.40	41.8	0.0128	0.0082	0.006	0.252	0.192	0.25
LAT4362	38.17	43.80	21	0.0085	0.0064	0.009	0.324	0.281	0.19
LA5108	14.44	15.80	1	0.0097	0.0176	0.100	0.140	0.278	0.10
LAT5038	30.00	7.00	1	0.0073	0.0181	0.100	0.219	0.127	0.10
BGE015741	28.80	31.00	16	0.0455	0.0096	0.010	1.311	0.297	0.16
Module V. Weight of root mass per plant									
Parameter	Supply of root mass of one plant in nodules			Weight of nodules per plant (g)			Weight of root mass (g)		
BGE027129	2.006	4.351	2.181	0.491	0.205	0.36	0.985	0.892	0.7850
BGE025277	4.782	5.104	3.745	0.252	0.192	0.25	1.205	0.980	0.9362
LAT4362	3.565	3.007	2.488	0.324	0.281	0.19	1.155	0.845	0.4728
LA5108	5.000	1.640	2.636	0.140	0.278	0.10	0.700	0.456	0.2636
LAT5038	5.046	3.858	3.746	0.219	0.127	0.10	1.105	0.490	0.3746
BGE015741	0.858	2.734	5.769	1.311	0.297	0.16	1.125	0.812	0.9230

The formation of the module number of seeds per plant results from the mutual influence of the number of pods per plant and number of seeds in pod. The limits of the environment affect the expression of both component signs. The BGE027129 is more ecological stable and occupied the first or second position in the rank analysis (Table 2).

Table 2. Impact of environmental conditions on the modules productivity per plant and number of seeds per plant in grass pea varieties (by rank)

Parameter	Year											
	2014	2015	2016	av	2014	2015	2016	av	2014	2015	2016	av
	Component trait 1				Component trait 2				Resultant trait			
Module I. Seed productivity per plant												
Variety	Seeds per plant				Weight of one seed				Seed weight per plant			
BGE027129	2	4	1	2	3	3	3	3	1	3	3	2
BGE025277	6	6	4	5	1	1	2	1	4	2	2	3
LAT4362	4	5	3	4	5	4	6	5	5	4	4	4
LA5108	1	1	6	3	6	6	4	5	3	5	5	4
LAT5038	5	3	5	4	4	5	5	5	6	6	6	6
BGE015741	3	2	2	2	2	2	1	2	2	1	1	1
Module II. Number of seeds per plant												
Variety	Pods per plant				Seeds per pod				Seeds per plant			
BGE027129	2	2	1	2	3	5	5	4	2	4	1	2
BGE025277	5	6	2	4	6	6	3	5	6	6	4	5
LAT4362	5	4	2	4	2	4	4	3	4	5	3	4
LA5108	1	3	2	2	1	1	6	3	1	1	6	3
LAT5038	4	5	6	5	5	2	1	3	5	3	5	4
BGE015741	3	1	5	3	4	3	2	3	3	2	2	2
Module III. Productivity of fresh aboveground mass per plant												
Variety	Fresh weight of leaves per plant				Fresh weight of stems per plant				Weight of fresh mass per plant			
BGE027129	3	4	1	3	5	3	1	5	3	4	1	3
BGE025277	5	2	4	4	4	1	4	4	3	2	4	3
LAT4362	2	1	2	2	1	2	3	1	2	1	3	2
LA5108	6	6	5	6	6	6	5	6	6	6	5	6
LAT5038	4	5	6	5	3	5	6	3	5	5	6	5
BGE015741	1	3	2	2	2	4	2	2	1	3	2	2
Module IV. Nodule weight per plant												
Variety	Number of nodules per plant				Weight of one nodule				Weight of nodules per plant			
BGE027129	1	3	2	2	5	5	3	4	2	4	1	2
BGE025277	5	4	1	3	2	4	6	4	4	5	2	5
LAT4362	2	1	3	2	4	6	5	5	3	2	3	3
LA5108	6	5	5	5	3	2	1	2	6	3	5	3
LAT5038	3	6	5	5	6	1	1	3	5	6	5	4
BGE015741	4	2	4	3	1	3	4	3	1	1	4	2
Module V. Weight of root mass per plant												
Variety	Supply of root mass of one plant in nodules				Weight of nodules per plant				Weight of root mass			
BGE027129	5	2	6	4	2	4	1	2	5	2	3	3
BGE025277	3	1	3	2	4	5	2	4	1	1	1	1
LAT4362	4	4	5	4	3	2	3	3	2	3	4	3
LA5108	2	6	4	4	6	3	5	5	6	6	6	6
LAT5038	1	3	2	2	5	6	5	5	4	5	5	5
BGE015741	6	5	1	4	1	1	4	2	3	4	2	3

LA5108 has also been ranked high (rank 2), although placed in unfavorable conditions (2015) it is ranked third position. This varietals lability is compensated by the higher number of seeds for the first two years of study with the rank 1. Such compensatory reactions have been found in other varieties, and this is the reason the BGE015741 variety generally has passed to the better second position by the resulting sign number of seeds per plant together with BGE027129.

The crop productivity module in all the varieties studied has been redefined for the genetic control of the attribute when changing the environment limit. The change of rank, both in the component and the resultant signs indicates that the varieties possess different spectrum of genes that determine the final state of the module. The highest ranking by weight of seeds per plant is BGE015741, followed by BGE027129 (rank 2). LAT5038 is characterized by productivity below the average for the group of varieties and occupies the last position (rank 6).

The unfavorable environmental factors have influenced the negative on plants of LA5108 variety in terms of the module fresh aboveground mass productivity per plant. Low mean values of leaf weight and stems weight determine its last place of rank 6. Despite the known fluctuations in the stability of these traits, the LAT4362 and BGE015741 varieties are high productive with leaf fresh weight of 2.79-20.021 g and stems fresh weight of 5.39-14.842 g, and stable positions (2) on the rank list.

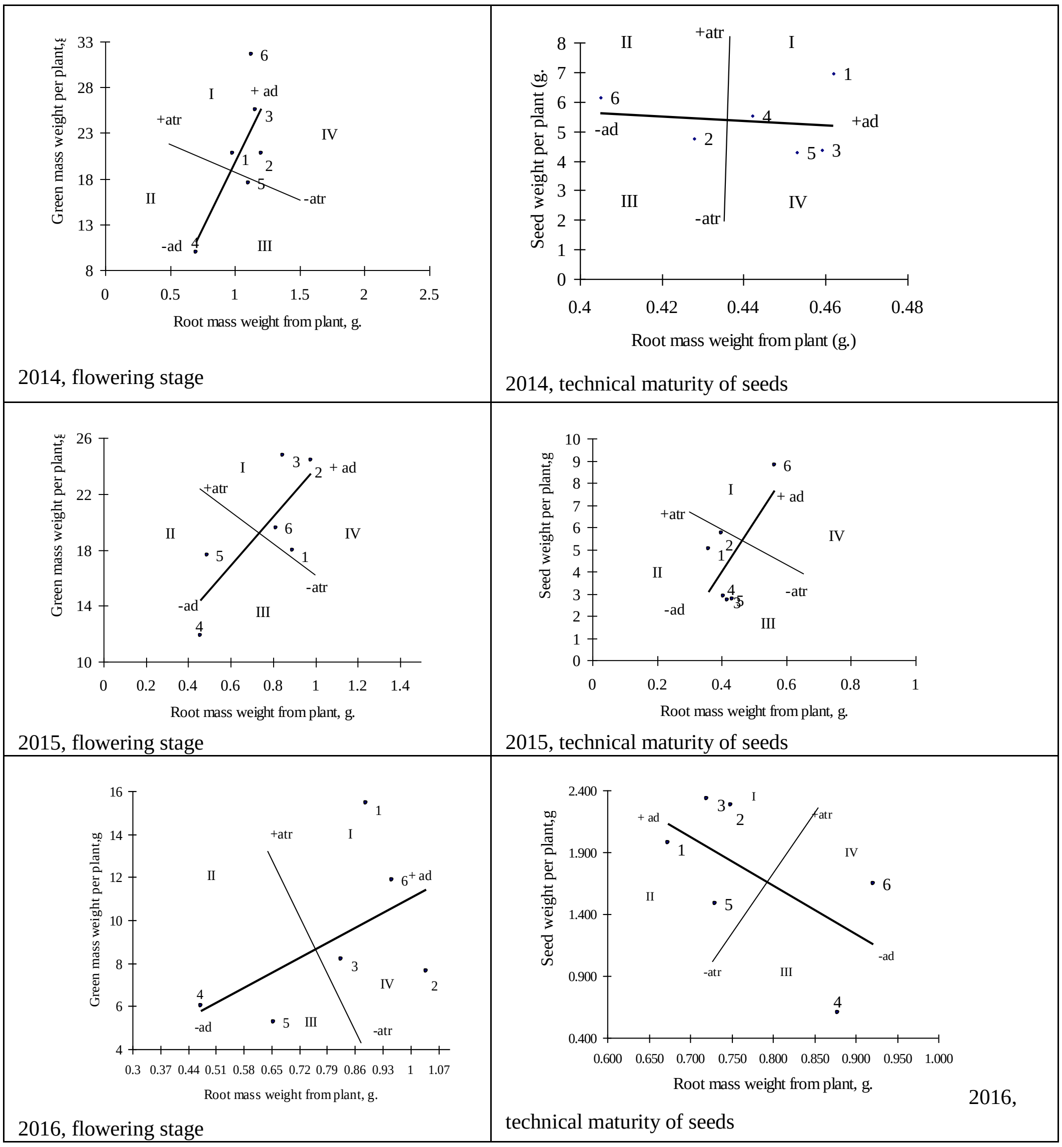
The module weight of the nodules per plant depends on the elements number of nodules per plant and the weight of the nodule. Each of the component features is characterized by different variability in individual varieties. With a higher average number of nodules per plant and with the best grade rating (2), BGE027129 and LAT4362 are distinguished. The varieties LA5108 and LAT5038 fail to form a larger number of nodules and therefore occupy the last position of rank 5. The same varieties are distinguished by better indices of the second component - weight of a nodule. A good ratio of these signs is characterized by variety BGE015741 with final rank 2, followed by BGE027129 of the same rank, LAT4362 and LA5108 with rank 3.

The weight of nodules per plant and the supply of root mass in nodules are included as structural elements of the module root mass weight per plant. In the group of varieties tested BGE025277 and LAT5038 had the highest average value of weight of root mass (4.54-4.22 g) and ranked the stable second rank. In the final ranking by resulting sign weight of root mass the first position is occupied by BGE025277 and second is occupied by BGE027129, LAT4362 and BGE015741. The lowest root mass weight per plant showed LA5108 variety.

Table 3. Impact of environmental conditions on the modules seeds yield and fresh aboveground mass yield in grass pea varieties (at book value and rank)

Parameter	Limit (years)			Yield (kg/da)	Ranks			
	2014	2015	2016	2012-2014	2014	2015	2016	Average
Variety	Module seeds yield							
BGE027129	138.9	100.2	100.2	113.1^{b}	1	3	3	2
BGE025277	95.1	114.9	115.0	108.3^{ab}	4	2	2	3
LAT4362	87.2	57.8	57.8	67.6^{a}	5	4	4	4
LA5108	110.8	55.0	55.0	73.6^{ab}	3	5	5	4
LAT5038	86.0	54.4	54.4	64.9^{a}	6	6	6	6
BGE015741	122.8	176.2	176.2	158.4^{c}	2	1	1	1
Variety	Module fresh aboveground mass yield							
BGE027129	831.6	719.2	617.6	722.8^{b}	1	4	1	2
BGE025277	831.6	976.4	306.0	704.7^{b}	2	2	4	3
LAT4362	1022.0	988.8	327.2	779.3^{b}	3	1	3	2
LA5108	396.8	474.8	241.6	371.1^{a}	4	6	5	5
LAT5038	702.0	704.8	209.6	538.8^{ab}	5	5	6	5
BGE015741	1262.4	783.2	475.6	840.4^{b}	6	3	2	4

a, b, c, d - statistically proven differences in P=0.05



1- BGE027129; 2- BGE025277; 3- LAT4362; 4- LA5108; 5- LAT5038, 6- BGE015741

Figure 2. Distribution of mean values of grass pea varieties

When grading the grass pea varieties by seed productivity for the period of study (Table 3) with stable positions is usually distinguished by BGE015741 and BGE027129 (ranks 2-1-1 and 1-3-3, respectively). Variety BGE025277 occupies the third position with ranks 4-2-2. These varieties are highly yielded, with no statistically significant differences between those with second and third ranks. The lowest average seed yields were found in the LAT4362 (67.6 kg da^{-1}) and LAT5038 (64.9 kg da^{-1}) varieties, respectively ranked 4 and 6.

The data presented in Table 3 for the average fresh biomass yield show that only LA5108 variety (371 kg da^{-1}) has statistically proven differences from all other varieties. The highest yield (840.40 kg da^{-1}) is characterized by variety BGE015741, but it also exhibits great variability (ranging from 6 in 2014 to 2 in 2016) and is rated with a median rank of 4. For the breeding of this crop, BGE027129 is of interest, which, in addition to high seeds yield, has the biological potential to develop larger aboveground biomass. BGE027129, together with the LAT4362 ranked best position in this sign and ranked second, followed by the BGE025277 (rank 3).

Orthogonal regression method. Identification of genotype by phenotype

The orthogonal regression method applied in the study suggests identifying the genotype (variety, hybrid, line) by moving the individual (or the variety depicted as a point of the coordinate system) along the lines of attraction (attr) and adaptability (ad). As a criterion for the selection value of the variety (carrier of suitable polygenic genetic-physiological systems), its value on the lines of attraction and adaptability was used when changing the limiting factors of the environment (PETROVA, 2005; VELIJEVIC *et al.*, 2018).

Models (1), (3) and (5) provide specific quantitative values of variables in a given environment. When changing limit factors, the value of the variable is moved to the coordinate system. The prediction of why and in what direction is the displacement occurs through the phenomenon of variance of the changes of the quantitative sign of the individual under the influence of genetic causes and the environment in a two-dimensional coordinate system with two attributes - breeding and background.

On the coordinate system in Figure 2 of the abscissa, the weight of the root mass of each of the grass pea varieties, and on the ordinate - the relative values of fresh biomass weight or weight of seeds per plant (in the technical maturity phase) were presented. The adaptive line (the regression line), intersecting with the orthogonal regression line, divides the coordinate system into four quadrants.

With a particular breeding value are the genotypes that fall into the first quadrant with positive adaptability and attraction. Such characteristics showed the BGE027129 and LAT4362 during the favorable 2014 with respect to the weight of fresh biomass. When the growth of plants occurs in restrictive conditions (2015), BGE027129 is moved to a fourth quadrant with positive adaptability but with "weak" genes for attraction. LAT4362 retains its place in a first quadrant, grown and in unfavorable conditions, suggesting that it possesses gene complexes that provide it with good development in various micro-ecological niches.

From the point of view of hybrid variability, BGE025277 is also of interest, moving from the second to the first quadrant in the worsening of the environment (2015), occupying the best adaptive position. When crossing it with first quadrant varieties, new genotypes can be expected with better combination of desired favorable genes and characterized by a positive moving in genetic and physiological systems of attraction and adaptability.

In the negative part of the regression line are the varieties LA5108 and LAT5038. Their position in the second and third quadrants defines them as genotypes with poor adaptive capability. LAT5038, in contrast to LA5108, placed in limiting conditions, passes into a second quadrant, indicating that it has a better combination of genes for attraction.

In the technical maturity stage, BGE027129 has the highest seed yield and takes the right upper corner of the first quadrant. From its location on the coordinate system, it is clear that it possesses a reliable set of genes defining its genetic variability (attraction genes) and adaptation but displaying only in optimal growing conditions. The LA5108 is placed in the same quadrant, which is very close to the line of adaptability, therefore it is the carrier of weaker genes for attraction.

Only variety BGE015741 falls from second to first quadrant, moving from the negative to positive part of the regression line, thus showing the best adaptive capability in unfavourable environment in 2015. The LAT4362, LA5108 and LAT5038 varieties are moved to the extreme left in a third quadrant under the same conditions, indicating that the genetic control of their adaptability is adversely affected.

By seed productivity and weight of root mass in the technical maturity stage cannot be determined the variety that combines both, strong genes for adaptation and attraction in deterioration of growing conditions.

Variable environmental conditions for the cultivation of different varieties contribute to improving the efficiency of the breeding process. The contrast of the environment plays the role of a differentiating factor that enables the identification of biological and economic valuable features or properties of the plant organism, which cannot be revealed on an unfavorable background.

According to ISMOILOV (2005) at present, the term "genetics of quantitative signs of plants" is used, both in a wide and in a narrow sense. In general, it includes the principles of differentiation of mean (ecological) and genotypic variability, additionally, dominance, epistapic dispersion, field experiment schemes and algorithms for analysis of these distinctions, calculations and predictions for identification of genotypes by phenotype, principles of selection of parent couples, etc. In this sense, the term is equivalent to the term "plant breeding theory" and is used in this context. In a narrow sense, the authors apply the concept of genetics of quantitative signs in relation to localization and estimation of the number of genes (or chromosomes), determination of quantitative differences, as well as assessment of additive, dominant and epistatic dispersion and covariance in the population.

Further studies by DRAGAVTSEV (2000) and KOMAROV and DRUZHNINA(2008) show that the instability of the genetic parameters (as inheritance coefficient) that are actually measured in the populations, as well as the labile transmission, transformation and implementation of genetic information ontogenesis, have led to the creation of the ecological-genetic model of the quantitative trait.

DRAGAVTSEV (2010) recommends for a more precise assessment of plant genetic resources and for greater reliability of the method of orthogonal regressions to create only one limiting factor and on others to grow the plants in optimal conditions in order to better understand their behavior in the particular environmental factor.

CONCLUSIONS

Evident is that the level of manifestation of the quantitative signs from the limits of environment and the changing of the ranks of the varieties on their productive capacities is obvious. This leads to some inconsistency with the slender logic of Mendelism in the genetics of the quantitative trait and creates a problem in analyzing the genotype - environment interaction.

The ecological-genetic model allows predicting the change of the genetic parameters in the polygene model, due to changes in the environment in which the individual development of the particular organism takes place. Within this model, the possibility of their prognosis is of great theoretical interest and is of significant practical significance.

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EKOLOŠKO-GENETSKI MODEL U OPLEMENJIVANJU SASTRICE (*Lathyrus sativus* L.)

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Izvod

Ekološki model za organizaciju kvantitativnih svojstava i metoda ortogonalnih regresija primenjeni su za procenu nadzemne i korenske biomase sorti sastrice različitog porekla. Istraživanje je sprovedeno u trajanju od tri godine. Najveći prinosi za svežu nadzemnu biomasu bili su BGE015741 (840,40 kg/ha), LAT4362 (779,3 kg/ha) i BGE027129 (722,80 kg/ha). Biljke LAT4362 i BGE025277 imaju veću težinu sveže nadzemne mase i sveže korenske mase i pokazuju dobru kombinaciju adaptivnih i privlačnih gena. Najveći prosečni prinos semena zabeležen je kod BGE015741 (158,40 kg/da), BGE027129 (113,10 kg/da) i BGE025277 (108,30 kg/ha). Sorte BGE027129, BGE025277 i BGE015741 su od najvećeg interesa s obzirom na masu semena po biljci i pogodne su kao početni materijal u svrhu kombinovanog oplemenjivanja za dobivanje genotipova koji kombinuju i veliku masu semena i veliku masu biomase korena po biljci.

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