# EVALUATION OF THE YIELD AND SOME INDICATORS OF ADAPTIVITY OF BEANS VARIETIES (*Phaseolus vulgaris*)

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**Abstract**

The article presents the results of environmental testing of five varieties of beans, bred in Research Institute of Field Crops "Selectia" in different agro-climatic zones of Moldova (North, Central, and South) within the State Commission on Crop Varieties Testing trials network. The maximum grain yield of beans was produced in North zone - 2.79 t/ha, 0.38 and 1.65 t/ha higher than medium variety productivity in Central and Southern areas, respectively. The varieties of beans taken in study showed a high degree of potential productivity realization 72,1 - 81,6%. The highest grain yield an average by zones was obtained from varieties Garofitsa - 2.30 t/ha. The studied varieties of beans showed a high percentage of realization of potential productivity 72,1-81,6%. The varieties of beans with the regression coefficient on the environmental conditions above 1 refers to the highly plastic - Garofitsa with $b_i = 1,30$ and Aluna with $b_i = 1,06$.

**Key words:** adaptivity, beans varieties, productivity, weather conditions

Among leguminous crops one of a great food value is beans. Beans as a crop is spread in more than 70 countries with different soil and climatic conditions. Crop breeders from Republic of Moldova launched a number of bean varieties adapted to the soil and weather conditions of the country having a sufficiently high productivity potential. The purpose of this paper is to evaluate the grain productivity of different varieties of beans grown in different agro-climatic zones of the republic and the establishment of some indicators of adaptability on the statistical parameters calculated based on grain yield.

## MATERIAL AND METHOD

The studies were conducted in three varieties testing stations: Visoca situated in North part, Bacioi from Central part and in Grigorievka village from South part of Republic of Moldova.

The soil cover of Visoca variety testing station is presented by leached chernozems, highly humified, well-structured with waterproof structural units. The humus contents in the arable layer around 4.0%.

The soil in the central and southern agro-climatic zones was presented by calcareous chernozems, poorly humified. The humus content in the arable layer is 2.5-3%. The content of the following nutrients were next: N – 0.16-0.2%, $P_2O_5$ - 0,14-0.16%, and $K_2O$ - 1.4-1.6%. The reaction of the soil solution neutral to slightly alkaline, pH 7.0-7.2

Meteorological conditions in the zones of cultivation tend to increase the average daily temperature of air for the period of "seeding-maturation" from $19.0^0$ C in the North part to $20,9^0$ C in the South. The distribution of precipitation by interfacial periods of the growing season of beans and by cultivation areas are extremely uniform. It should be noted that most of the rainfall 197.7 mm in the North part fell in the period of "shoots - flowering," which ensured the formation of a significant amount of beans on plants and seeds in the pods. These figures contributed to obtaining the highest grain yield in this area. In Central and South part peak of rainfall was observed in the interphase period of "flowering - maturation" when most mature beans have dried up and the precipitation did not have its positive influence on the formation of grain yield of beans. The proces of testing varieties of beans was performed in a 4-fold repetition with systematically placement of plots. Accounting area of plots – 25 $m^2$. Yield of grain was the main indicator. There were studied 5 bean varieties bred in RIFC "Selectia" Chrysanthema (standard), Nikolina, Aluna, Floare and Garofitsa in the field experiment.

Statistical data processing was performed by the yield analysis of variance (Dospehov B.,1979); scope of yield (Zykin B., 2000). The regression coefficient on the environmental conditions by (Pakudin V., Lopatina L., 1984). The agroclimatic zone with the greatest manifestation of the trait, and with the highest level of the index of the medium is taken as *max*; with a minimum level of harvest and a negative value of the index of the medium it is adopted as *min.*

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Table 1

**Meteorological conditions for agro-climatic zones of the country, 2013**

| Phases | North zone | | | | | Central zone | | | | | South zone | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | days | °C | Rainfall | | | days | °C | Rainfall | | | days | °C | Rainfall | | |
| | | | 2013 | norm | ± to norm | | | 2013 | norm | ± to norm | | | 2013 | norm | ± to norm |
| Seeding - seedlings | 10 | 18.1 | 0.0 | 12.5 | -12.5 | 12 | 20.1 | 0.0 | 22.4 | -22.4 | 15 | 19.2 | 0.0 | 10.2 | -10.2 |
| seedlings-flowering | 47 | 20.5 | 197.1 | 98.4 | +98.7 | 48 | 19.8 | 93.9 | 67.8 | +25.9 | 39 | 20.2 | 57.3 | 80.3 | -23.0 |
| flowering-maturation | 48 | 20.8 | 62.8 | 84.3 | -21.5 | 32 | 21.0 | 100.8 | 78.8 | +22.0 | 44 | 23.4 | 167.6 | 82.2 | +85.4 |
| seeding-maturation | 105 | 19.8 | 259.9 | 195.2 | +64.7 | 102 | 20.3 | 194.7 | 169.0 | +25.7 | 98 | 20.9 | 224.9 | 172.7 | +52.2 |

## RESULTS AND DISCUSIONS

The yield of varieties is the main objective indicator is taken into consideration when testing crops. In our studies yield of beans varieties in the Northern zone of the republic ranged from 2.48 t/ha of Floare variety to 3.19 t/ha of Garofitsa variety (*table 2*). The average yield of varieties for the first agro climatic zone was 2.79 t/ha, while that of the standard variety Chrysanthema - 2.50 t/ha. The studied varieties of beans Nikolina, Aluna and Garofitsa significantly exceeded the standard variety by 0.33 t/ha, 0.44 t/ha and 0.69 t/ha, or by 134.2%, 17.6% and 27.6%, respectively. At the level of the standard was the grain productivity of Floare variety -2.48 t/ha.

Table 2

**The yield of varieties of beans, t/ha, 2013**

| Varieties | Agro climatic zones | | | | | | The average of the zones | |
|---|---|---|---|---|---|---|---|---|
| | North | | Center | | South | | | |
| | t/ha | ± to st. | t/ha | ± to st. | t/ha | ± to st. | t/ha | ± to st. |
| Chrysanthema | 2.50 | - | 2.50 | - | 1.11 | - | 2.04 | - |
| Nikolina | 2.83 | +0.33 | 2.29 | -0.21 | 1.24 | +0.13 | 2.12 | +0.08 |
| Aluna | 2.94 | +0.44 | 2.46 | -0.04 | 1.20 | +0.09 | 2.20 | +0.16 |
| Floare | 2.48 | -0.02 | 2.13 | -0.37 | 1.10 | -0.01 | 1.90 | -0.14 |
| Garofitsa | 3.19 | +0.69 | 2.65 | +0.15 | 1.07 | -0.04 | 2.30 | +0.26 |
| The average - varieties | 2.79 | - | 2.41 | - | 1.14 | - | 2.11 | - |
| $LSD_{05}$, t/ha | - | 0.23 | - | 0.22 | - | 0.06 | - | - |
| The medium index $I_i$ | 0.68 | - | 0.30 | - | -0.97 | - | - | - |

In the Central zone of Moldova yield of tested varieties of beans ranged from 2.50 t/ha at the standard (*Chrysanthema* variety) to 2.65 at Garofitsa variety. Average-variety bean yield in this area amounted to 2.41 t/ha, which is 0.38 t / ha (13.6%) less than in the Northern zone. Statistical analysis of yield data showed that in the Central zone the productivity of bean variety was at the level of standard. An exception is variety Floare, which lost to the standard significantly by 0.37 t/ha. In the context of the South zone the grain productivity of these varieties of beans was even lower. Average - variety grain yield was 1.14t/ha, varying from 1.07 t/ha at variety Garofitsa to 1.24 t/ha at Nikolina. Nikolina variety of beans (1.2 t/ha) and Aluna (1.20 t/ha) significantly exceeded the standard by 0.13 t/ha and 0.09 t/ha. Productivity of Floare variety (1.10 t/ha) and Garofitsa (1.07 t/ha) was at the level of the standard variety Chrysanthemum – 1.11t/ha. On average agro-climatic zones yield of varieties of beans exceed two tones and was 2.11 t/ha, varying from 1.90 t/ha at the variety Floare to 2.30 t/ha at the variety Garofitsa. With regard to the standard variety of Chrysanthema (2,04 t/ha), most of the studied varieties exceeded its productivity by 0.08 - 0.26 t/ha. Productivity of Floare variety was below the standard by 0.14 t/ha and was 1.90 t/ha. Grain productivity of bean varieties in the experiment ranged from 1.07 to 3.19 t/ha. The most unfavorable weather conditions have developed in Southern agro-climatic zone, as evidenced by the ratio of medium index Ii = -0.97, where average – variety productivity was 1.14 t/h. The most favorable climatic conditions have developed in Northern

agro-climatic zone, where the medium index has a maximum value of 0.68. Average -variety productivity of varieties studied set is 2.79 t/ha. Comparison of productivity of beans varieties under study shows that in this set there are varieties with little difference between the (min-max) yield. According to (Goncharenko L., 2005),

the minimum difference between the highest and lowest yields, indicating a higher stress resistance of variety and its wider adaptive capabilities. According to this indicator is preferable to look at Chrysantema and Floare varieties, the scope of the yield of which is 1.39 - 1.38 t/ha or 55.6 and 55.6%, respectively (*table 3*).

Table 3

Indicators of adaptivity of beans varieties, 2013

| Varieties | Average yield of grain, t/ha | Scope of yield | | Realization of potential productivity, % | $\dfrac{Ymin + Ymin}{2}$ | Regression coefficient, $b_i$ |
|---|---|---|---|---|---|---|
| | | $Y_{min} - Y_{Max}$, t/ha | % | | | |
| Chrysantema(st) | 2.04 | $\dfrac{1.11 - 2.50}{-1,39}$ | 55.6 | 81,6 | $\dfrac{1.11 + 2.50}{1.81}$ | 0.90 |
| Nikolina | 2.12 | $\dfrac{1.24 - 2.83}{-1,59}$ | 56.2 | 74.9 | $\dfrac{1.24 + 2.83}{2.04}$ | 0.92 |
| Aluna | 2.20 | $\dfrac{1.20 - 2.94}{-1,74}$ | 59.2 | 74.8 | $\dfrac{1.20 + 2.94}{2.07}$ | 1.06 |
| Floare | 1.90 | $\dfrac{1.10 - 2.48}{-1,38}$ | 55.6 | 76.6 | $\dfrac{1.10 + 2.48}{1,79}$ | 0.85 |
| Grarofitsa | 2.30 | $\dfrac{1.07 - 3.19}{-2,12}$ | 76.0 | 72.1 | $\dfrac{1.07 + 3.19}{2.13}$ | 1.30 |
| Average by varieties | 2.11 | | | | | |

Garofitsa variety showed the greatest scope of yield in different agro-climatic zones 2.12 t/ha or 76.0%. It should be noted that the studied varieties of beans in various agro-climatic zones ensure a high percentage of realization of the potential productivity of 81.6-72.1%. An indication of the extent to which beans genotypes fit to environmental conditions is their average yield in contrasting conditions (Ymin+Ymax/2). For this indicator, the most preferred varieties are: Garofitsa (2,13 t/ha), Aluna (2.07 t/ha) and Nikolina (2.04 t/ha). Other varieties of studied beans under the circumstances in 2013 showed a low compensatory ability.

The calculations of the regression coefficient ($b_i$) showed that the greatest responsiveness to changing growing conditions showed variety

Garofitsa - 1.30, followed by 1.06 variety Aluna. Other varieties of beans studied the value of the regression coefficient on the environmental conditions were close to one. The existing classification of genotypes by size of regression coefficient allows you to select three groups: $b_i < 0$ - the highest response to changing environmental conditions; $b_i = 1$ - ecologically plastic genotype and $b_i > 1$ intensive or high ductile (Sclearov I., Ladighina E., 1979). Thus, under the tested under different environmental conditions, varieties of beans, two of them having the regression coefficient for the environmental conditions and

the one above are superplastic - is Garofitsa and Aluna. The rest of the varieties in this group are eco-plastic, the regression coefficient for the environmental conditions is 0,85-0,92.

**CONCLUSIONS**

Based on the results of testing varieties of beans in various agro-climatic zones of Moldova we can draw the following conclusions: The highest grain yield (average-variety) beans produced in Northern agro-climatic zone - 2.79 t/ha, higher than in the Central zone to 0, 38 t/ha or 13.6%, and South zones by 1.65 t/ha or 59.1%.The maximum grain productivity in different ecological conditions showed variety Garofitsa - 2.30 t/ha, which is 0,26 t/ha or 11.3% higher than the standard variety. The highest scope of yield in the experiment obtained from varieties Garofitsa 76.0%, much higher than from other varieties of beans.The studied varieties of beans showed a high percentage of realization of potential productivity 72,1-81,6%. The regression coefficient on the environmental conditions allowed the identification of varieties of beans on ecological plasticity and high plasticity.

**REFERENCES**

**Анохина, Т. А., Чирко, Е., Кадыров, Р., Гвоздова, Л., 2013,** *Сравнительная оценказерновой продуктивности и параметровад аптивности сортообразцов гумизы.* Вести

национальной академии наук Белорусси Серия аграрных наук. 2013. №2. р.69-76.

**Анохина, Т., А., Dубовик, Е., Кадыров, Р.М., Чирко, Е., 2011,** *Характеристика адаптивности и зерновой продуктивности тетраплоидных сортов и образцов гречихи, различающихся по морфотипу растения.* Вести национальной академии наук Белоруссии. Серия аграрных наук. 2011. №4. р.52-58.

**Пакудин, В.З., Лопатина, Л., 1984,** *Оценка эколо-гической пластичности и стабильности сортов сельскохозяйственных культур.* Сельскохозяйственная биология. 1984. вин. 4. с. 109-113.

**Склярова, И.П., Ладыгина, Е., 1984,** *Метод оценки пластичности и стабильности сортов и гибридов картофеля по содержанию сухого вещества.* Селекция и семеноводство. №4. р. 12-14.

**Доспехов, Б.А., 1979** - *Методика полевого опыта.* Москва, Колос. 416 с.

**Гончаренко, А.А., 2005,** *Об адаптивности и экологической устойчивости сортов зерновых культур.* Вестник Рос.академии сельскохозяйственных наук. №6. с.49-53.

**Зыкин, В.А.,** и др., **2000,** *Селекция яровой пшеницы на адаптивность: результаты и перспективы.* Докл. РАСХН. 2000. №2. с.5-7