# PARTIAL RESULTS ON THE INFLUENCE OF FERTILIZATION ON GRAIN PRODUCTION OF *Sorghum bicolor* L., IN THE CLIMATIC CONDITIONS OF CENTRAL MOLDAVIA

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**Abstract**

Sorghum is the species that has the same uses varied as the corn. Hundreds of millions of people in Africa, China and India consume sorghum bread. Also used as the feed for poultry and focused mainly raw material for spirits and beer. Climate evolution for heating and aridity of Romania, forcing a reconsideration of sorghum as: food grains, fodder plants and Technical plant. Improvement of technological sequences cultivation of sorghum, is a thing of great importance to our country the purpose of obtaining high yields, to ensure the necessary human food, animal feed raw material in the production of bioethanol - considered a fuel of the future. For this purpose, in the specific conditions of ARDS Secuieni (Center of Moldova) has placed a bifactorial experience in which followed the influence of the fertilization on grain production at Sorghum bicolor L. The biological material used were the hybrids F32, Armida, Alize, Quebec and KSH2G06. The results showed that the applied mineral fertilization has positively influenced sorghum crop production. Variation of the production obtained at sorghum hybrid varied depending on the dose of mineral fertilizers applied (N0P0, N40P40, N80P80, N120P120) and ranged from 2910 kg / ha (KSH 2G06 - unfertilized) of the 10279 kg / ha (Armida - N120P120 ). At the interaction genotype x fertilizer, the highest level of production was recorded in variants fertilized with N120P120 dose variation yields being from 7043 kg / ha (KSH 2G06) of the 10279 kg / ha (Armida).

**Key words**: grain sorghum, grain production, fertilization, hybrids, sowing density

The climatic evolution towards heating and aridization for the 2001-2050 period of time in the Balkan area, where Romania is also found, compels to a reconsideration of the sorghum as: alimentary cereal (beads used in the formula for composite flours destined for gluteic and agluteic panification, the sweet juice extracted from the body, used for making syrup, vinegar and other alimentary products), fodder plant (under the shape of green mass, hay, silo) and technical plant (stationary and textile celluloses, plastic material), the industry of construction materials and the handicraft industry (brushes of domestic and industrial use, brooms, nettings) (Volf M., 2009).

Specialists of U.S., European Union, Japan, Australia, China, etc., seeking solutions for industrial exploitation of biomass used in all forms and all adequate technologies. In this context appeared "stars biomass", of which emerges, first, to the temperate - continental, sorghum, known and used for many years in the U.S., China, Italy and France.

Currently, the concerns is to extending the sorghum crop in Romania, because of its success at quantitative and qualitative level depends to in a pregnant measure the future of agriculture, livestock, chemical and food industry. Once the integration of Romania into the European Union's economic system to ensure food requirements must be developed and apply new technologies for cultivation of sorghum, respecting the principles of ecology and environmental protection, which define the quality of life, in generally. Increasing the quantity and quality of production at the current requirements is not possible without the use of fertilizers (Bălteanu, 1998 Dumitraşcu et al., 2003; Mihaila et al., 1996; Săulescu 1967). In this paper we present preliminary data on nitrogen and phosphorus fertilization (four doses) to five genotypes of sorghum grain.

## MATERIAL AND METHOD

The researches was conducted in the agricultural year 2012 - 2013, at Agricultural

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Research and Development Station - Secuieni. In the experimental field of the unit was placed a bifactorial experience on a typical cambic chernozem soil type, pH 7.10 water, humus content 0.98, 23.6 ppm $NO_3$-N, $P_{AL}$ 100 ppm, mobile and $K_2O$ 150.2 ppm, after subdivided parcels method, in three repetitions.

The experimental factors were of the type A x B, where the factor A was represented by the genotype studied with five graduations: $a_1$ - Fundulea 32; $a_2$ - Armida; $a_3$ - Alize; $a_4$ - Quebec and $a_5$ - KSH 2G06 and the factor B was represented by fertilization culture with four graduations: $b_1$ - Unfertilized; $b_2$ - $N_{40}P_{40}$; $b_3$ - $N_{80}P_{80}$ and $b_4$ - $N_{120}P_{120}$.

The sowing density was assured by 250.000 bg/ha an seeding depth was 3-4 cm, and the application of chemical fertilizers was done manually at the seedbed preparation. Soybean was the preceding plant.

In the experience we have complied all the technological links, plant precursory was soybean and the data were processed and interpreted statistically by variance analysis method (Ceapoiu, 1968).

**The climatic aspects of the agricultural year 2012 – 2013**

The climatic conditions of the A.R.D.S. Secuieni, in the agricultural year 2012-2013 was close to the annual average, but the distribution of rainfall and temperatures during the growing season of sorghum was uneven.

In terms of rainfall, throughout the growing season, the precipitations fell sorghum totaled 358, 4 mm, the deviation from the annual average (346.9 mm) being only 11,5 mm (≈3%).

The critical phases of humidity at sorghum to fall in July and August, the months when there was a deficit of -9.6 mm rainfall in July and - 22 mm in August. Also, the deficit on the rainfall in May (-13.4 mm) resulted in a delay and irregular emergence of culture (*figure 1*). This phenomenon had a negative influence in the formation of sorghum production.

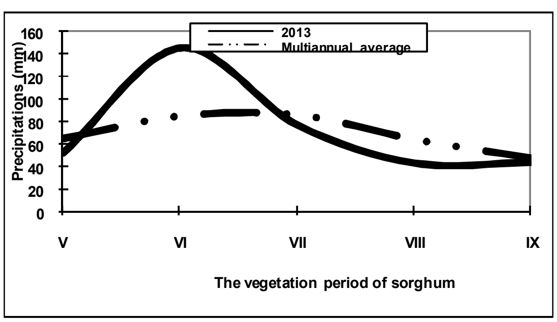


Figure 1 **The graph of the precipitations recorded in the agricultural year 2012 - 2013, at the meteorological station of A.R.D.S. Secuieni in the vegetation period of sorghum**

In terms of thermal conditions, during the growing season of sorghum was characterized as warm, deviations recorded compared to the annual average being beneficial culture, sorghum is a thermophilic species (*figure 2*).

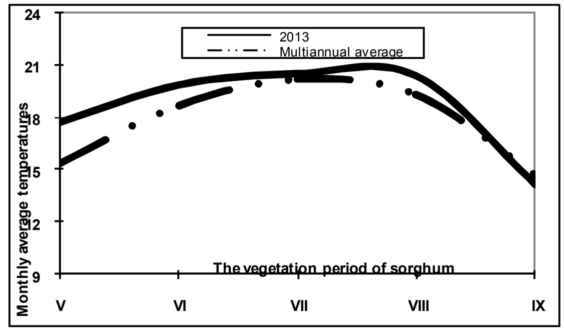


Figure 2 **The graph of the temperatures recorded in the agricultural year 2012 - 2013, at the meteorological station of A.R.D.S. Secuieni in the vegetation period of sorghum**

## RESULTS AND DISCUSSIONS

The experimental results show a significant difference in sorghum grain production depending on genotype cultivated, crop fertilization and the climatic conditions.

**a) The influence of the productions of hybrid seeds at *Sorghum bicolor* L.**

In the period of the experimentation, the studied genotypes have responded differently to the climatic conditions of the area.

In comparison with the production obtained at the control variant (Fundulea 32), only at the hybrid Armida were obtained increases production and interpreted to be statistically assured as being very significant. In the variants sown to the Alize and KSH2G06 hybrids, were accomplished differences of the production, interpreted to be negative very significant (*table 1*).

Thus, we can say that the hybrids with high adaptability to the Center of Moldova are Armida and Fundulea 32 (control) (*table 1*).

**b) The influence of the fertilization on grain production at *Sorghum bicolor* L.**

The fertilization determined very significant increases of the production and it was concluded that the conclusion that as an increase at the dose of the fertilizer with the dose N40P40, the production increases shall be brought about. 2 t/ha (*table 2*).

**c) The influence of the interaction between the hybrid x fertilization on grain production at Sorghum bicolor L.**

The fertilization with nitrogen and phosphorus influenced positively the number of harvested plants/ha, grain yield and its level was influenced by the hybrids and the climatic conditions of the agricultural year 2012-2013. Was observed that the fertilization had a positive influence of the number of harvested plants/ha, the number of the main plants and influenced negatively the degree of shoots (*table 3*).

The fluctuations of productions were large, productions are varied within very wide limits, from 2910 kg / ha to 10279 kg / ha (*table 4*).

The lowest level of production has been at the unfertilized variants. In these variants, yields ranged from 2910 kg / ha and 4165 kg / ha and were influenced by hybrids and favorable climatic conditions (*table 4*). The highest level of production was recorded at the fertilized variants with $N_{120}P_{120}$ dose, variation in yields is between 7043 kg/ha (KSH 2G06) at 10279 kg/ha (Armida) (*table 4*). From the statistical point of view, under the influence of NP fertilizers and genotype interaction occurred very significant production increases, the biggest difference of production (6582 kg / ha) was obtained in hybrid variant sown Armida which applied dose $N_{120}P_{120}$ fertilizer, which suggests that this genotype responds very well to high doses of fertilizers (*table 4*).

To provide the compelling proof statistics were calculated correlation coefficients (r) between the doses of fertilizer and grain yields obtained.

We observed that between doses of nitrogen and phosphorus fertilizer applied and yields of grain sorghum genotypes obtained were recorded very strong direct correlation, the correlation coefficients were statistically very significant (figure 3).

Table 1

**The influence of the productions of hybrid seeds at *Sorghum bicolor* L. species**

| Hibrids | Yield (kg/ha) | % to control | Diff. (kg/ha) | Sign. |
|---|---|---|---|---|
| Fundulea 32 | 6747 | 100 | Control | - |
| Armida | 7180 | 106 | 433 | *** |
| Alize | 5647 | 84 | -1100 | ooo |
| Quebec | 6612 | 98 | -135 | |
| KSH2G06 | 5191 | 77 | -1556 | ooo |
| LSD (kg/ha) | | 5% =<br>1% =<br>0,1% = | 147<br>214<br>321 | |

Table 2

**The influence of the fertilization on grain production at *Sorghum bicolor* L. species**

| Dose (kg a.s/ha) | Yields (kg/ha) | % to control | Diff. (kg/ha) | Sign. |
|---|---|---|---|---|
| $N_0P_0$ | 4334 | 100 | Control | - |
| $N_{40}P_{40}$ | 5709 | 132 | 1375 | *** |
| $N_{80}P_{80}$ | 7377 | 170 | 3045 | *** |
| $N_{120}P_{120}$ | 8448 | 195 | 4114 | *** |
| LSD (kg/ha) | | 5% =<br>1% =<br>0,1% = | 84<br>114<br>151 | |

Table 3

**Influence of fertilization on the number of harvested plants/ha and the number of main plants**

| Factor A (Hibryd) | Factor B (Fertilization) | Total plants harvested (thousand/ha) | In wich: | |
|---|---|---|---|---|
| | | | Main plants (thousand/ha) | Offshoots (thousand/ha) |
| $a_1$ (Fundulea 32) | $b_1$ - $N_0P_0$ | 214 | 81 | 133 |
| | $b_2$ - $N_{40}P_{40}$ | 263 | 136 | 127 |
| | $b_3$ - $N_{80}P_{80}$ | 285 | 177 | 108 |
| | $b_4$ -$N_{120}P_{120}$ | 342 | 245 | 87 |
| $a_2$ (Armida) | $b_1$ - $N_0P_0$ | 199 | 85 | 114 |
| | $b_2$ - $N_{40}P_{40}$ | 264 | 141 | 123 |
| | $b_3$ - $N_{80}P_{80}$ | 325 | 204 | 121 |
| | $b_4$ -$N_{120}P_{120}$ | 348 | 247 | 101 |
| $a_3$ (Alize) | $b_1$ - $N_0P_0$ | 193 | 71 | 122 |
| | $b_2$ - $N_{40}P_{40}$ | 239 | 120 | 119 |
| | $b_3$ - $N_{80}P_{80}$ | 283 | 174 | 109 |
| | $b_4$ -$N_{120}P_{120}$ | 338 | 247 | 91 |
| $a_4$ (Quebec) | $b_1$ - $N_0P_0$ | 193 | 79 | 114 |
| | $b_2$ - $N_{40}P_{40}$ | 251 | 138 | 113 |
| | $b_3$ - $N_{80}P_{80}$ | 292 | 189 | 103 |
| | $b_4$ -$N_{120}P_{120}$ | 325 | 224 | 101 |
| $a_5$ (KSH2G06) | $b_1$ - $N_0P_0$ | 173 | 75 | 98 |
| | $b_2$ - $N_{40}P_{40}$ | 218 | 123 | 95 |
| | $b_3$ - $N_{80}P_{80}$ | 252 | 159 | 93 |
| | $b_4$ -$N_{120}P_{120}$ | 276 | 201 | 75 |

Table 4

**The influence of the interaction between the hybrid x fertilization on grain production at *Sorghum bicolor* L. species**

| Factor A (Hibryd) | Factor B (Fertilization) | Yields (kg/ha) | Diff. | Sign. | Factor A (Hibryd) | Factor B (Fertilization) | Yields (kg/ha) | Diff. | Sign. |
|---|---|---|---|---|---|---|---|---|---|
| $a_1$ (Fundulea 32) | $b_1$ - $N_0P_0$ | 4165 | Control | - | $a_4$ (Quebec) | $b_1$ - $N_0P_0$ | 3736 | Control | - |
| | $b_2$ - $N_{40}P_{40}$ | 6139 | 1974 | *** | | $b_2$ - $N_{40}P_{40}$ | 6023 | 2287 | *** |
| | $b_3$ - $N_{80}P_{80}$ | 7017 | 2852 | *** | | $b_3$ - $N_{80}P_{80}$ | 7691 | 3955 | *** |
| | $b_4$ -$N_{120}P_{120}$ | 9668 | 5503 | *** | | $b_4$ -$N_{120}P_{120}$ | 8997 | 5261 | *** |
| $a_2$ (Armida) | $b_1$ - $N_0P_0$ | 3697 | Control | - | $a_5$ (KSH2G06) | $b_1$ - $N_0P_0$ | 2925 | Control | - |
| | $b_2$ - $N_{40}P_{40}$ | 6039 | 2342 | *** | | $b_2$ - $N_{40}P_{40}$ | 4701 | 1776 | *** |
| | $b_3$ - $N_{80}P_{80}$ | 8705 | 5008 | *** | | $b_3$ - $N_{80}P_{80}$ | 6097 | 3172 | *** |
| | $b_4$ -$N_{120}P_{120}$ | 10279 | 6582 | *** | | $b_4$ -$N_{120}P_{120}$ | 7043 | 4118 | *** |
| $a_3$ (Alize) | $b_1$ - $N_0P_0$ | 2910 | Control | - | LSD AxB (kg/ha) | | | 5% = 188<br>1% = 254<br>0,1% = 337 | |
| | $b_2$ - $N_{40}P_{40}$ | 4757 | 1847 | *** | | | | | |
| | $b_3$ - $N_{80}P_{80}$ | 6483 | 3573 | *** | | | | | |
| | $b_4$ -$N_{120}P_{120}$ | 8436 | 5526 | *** | | | | | |

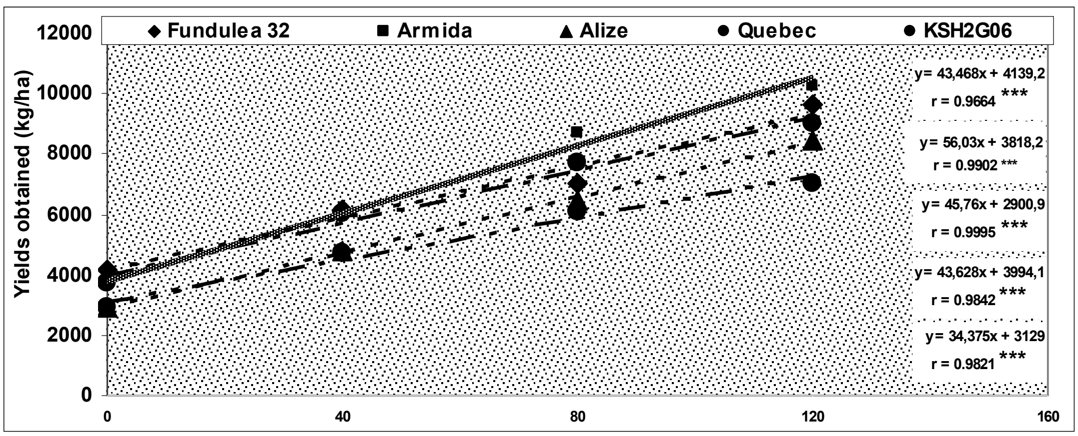


Figure 3 **Graphic of correlations established between production obtained and doses of fertilizers**

## CONCLUSIONS

Climatic conditions of the agricultural year 2013 were characterized as normal in terms of rainfall, but the unevenness of distribution of rainfall during the growing season had negative influences on sorghum grain production;

Grain yields obtained were influenced by hybrid studied, as well as the fertilizer rates and densities tested, ranging variation in grain yields 2910 kg / ha (KSH 2G06 - unfertilized) and 10279 kg/ha (Armida - $N_{120}P_{120}$);

On the interaction genotype x fertilizer, the highest level of production was recorded in variants fertilized with $N_{120}P_{120}$ dose variation in yields is between 7043 kg/ha ( KSH 2G06 ) to 10279 kg/ha (Armida);

The genotypes studied responded differently to the climatic conditions of the area, the hybrids with high adaptability to the Center of Moldova being Armida and Fundulea 32 (control);

At the romanian hybrid (control), Fundulea 32, the average yield obtained was 7185 kg / ha, with highs (9668 kg/ha) at the dose of fertilizer $N_{120}P_{120}$;

Correlations between productions and doses of fertilizers are direct and very significant.


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