EFFECTS OF FERTILIZATION AND ROW SPACING ON GRAIN SORGHUM YIELD GROWN IN SOUTH-EASTERN ROMANIA

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Abstract

The paper presents the results of a research conducted during 2014-2016 with the purpose of identifying the optimal interaction of technological factors for the cultivation of grain sorghum (sowing distance x fertilization level), in order to optimize the yield of crops grown in South-East Romania. The research was carried on a soil chromic luvisol using ten fertilization levels and two sowing distances between rows. Results show that both sowing distance and fertilization had a statistically significant influence on sorghum’s grain yield. The most favourable combination of technological factors, which ensured a maximum yield of 9.22 t/ha, was represented by sowing sorghum at the distance of 70 cm between rows and using a fertilization level $N_{120} P_{60} K_{60}$. Compared to the sowing distance of 50 cm between rows, the sowing distance of 70 cm between rows generated yield increases between 0.21 t/ha and 0.48 t/ha.

Key words: Sorghum bicolor L. (Moench), mineral fertilization, sowing distance, rainfall, yield.

INTRODUCTION

Although grain sorghum crop is well adapted to different environmental conditions, the need to optimize its yield is still a challenge. Sorghum grows in areas with rainfall below 450 mm/year (Aleminew, 2015), thus the specialized literature (Sarca et al., 2004; Staggenborg et al., 2008) recommends being cultivated in restrictive climatic and soil conditions. Research analyzing grain sorghum suitability to the conditions in South-East Romania (Pintilie et al., 1970; Matthew, 2011; Oprea et al., 2016) highlight yield levels that support crop’s cultivation opportunity in this region. However the variability of climatic conditions in the area and the tendency of aridity (Marin et al., 2016) affect yield’s stability, given that water scarcity is, nevertheless, a limiting factor for sorghum crop in terms of using nutrients obtained through fertilization (Lemaire, 1996). Moreover, in low rainfall conditions plants’ density is a factor that requires attention in terms of yield optimization (Stanggenborg, 1999; Fromme, 2012; Fernandez, 2012). In this context, the objective of the research is to identify cultivating factors interaction that ensures an optimum yield level in correlation to the climatic conditions of South-Eastern Romania.

MATERIALS AND METHODS

The research was conducted during 2014-2016 on a chromic luvisol at the Didactic and Experimental Farm Moara Domnească of USAMV Bucharest (44°30’ latitude, 26°13’ longitude). Weather conditions of the area are characterized by a yearly rainfall amount of 556.1 mm and an annual average temperature of 10.5°C.

Analysis of weather parameters (temperature and rainfall) during plants vegetative period, reflect some variability as compared with the normal values (Table 1). The average temperature during the growing season of sorghum plants has provided a number of useful thermal units (t>6°C) of 1923°C, higher than the hybrid requires (1850°C). Analyzing rainfall, their average volume in the months May to August was 38.3 mm (14.3%) lower than the normal value of the area, but showed a different distribution.

Thus, after sowing (May), at flowering and grain filling period (July) rainfall records were 5.2% and 75.0% lower than the multiannual values. In the vegetative growth stage (June) and near physiological maturity (August), the average rainfall recorded in 2014-2016 were by 9.9% and 7.9% higher than the normal values.
The biological material used was the hybrid Alize (provided by Euralis), a hybrid recorded in the official catalogue of varieties of crop plants in Romania since 2014. Alize is a grain sorghum hybrid (FAO 380-400) highly tolerant to drought.

The experimental design was built using the split plot method in four replications. The main factor investigated was fertilization, as active substance, with ten levels: a1 - N0P0K0 (Control), a2 - N60P0K0, a3 - N90P0K0, a4 - N120P0K0, a5 - N90P60K0, a6 - N90P60K0 + foliar fertilization (H), a7 - N90P60K60, a8 - N90P60K60 + foliar fertilization (H), a9 - N120P60K0, a10 - N120P60K60.

Factor B, with two graduations, was the sowing distance between rows, even though in terms of yield the differences being statistically insignificant (p<0.05). Only for the complex fertilization N120P60K60 the yield difference between the two sowing distances was not statistically significant, with a value of 0.21 t/ha, the yield was higher at the sowing distance of 70 cm between rows.

Research on the influence of the sowing distance on grain sorghum yield is inconsistent and often conflicting, influenced by experimental conditions. Thus, similar to the results presented in this paper, Fernandez et al. (2012) highlighted that grain sorghum grown in cereals (30 cm) generated higher yields than grain sorghum cultivated in the conventional system (5.5 cm between rows), but in the absence of rainfall the differences are not significant. In dry zones, reducing the distance between rows conserves soil’s water reserves up to the vegetative stages of reproductive growth of grain filling, which positively influences yield (Bandaru et al., 2006). Staggenborg (1999) shows that in years with high rainfall, the yield obtained for narrow rows is higher than that obtained for conventional sowing distances. Fromme (2012) also reported an enhanced efficiency in economic terms for growing sorghum at 51 cm between rows, even though in terms of yield research findings do not reveal significant differences.

Also, results obtained by Buah and Mwinkaara (2009) show that plant density had no significant influence on yield, whereas nitrogen fertilization caused a linear increase of the yield.
The experimental design was built using the sorghum hybrid (FAO 380-400) highly tolerant plants in Romania since 2014. Alize is a grain Alize (provided by Euralis), a hybrid recorded the biological material used was the hybrid control the application of mechanical hoeing. Pest (commercial product Dicopur Top, 1 l/ha) and with 344 g/l S-metolachlor 960 g/l (commercial product emerges weed control was performed using were applied using commercial product)

Factors investigated was fertilization, as active...
plants. The achieved growth is influenced mainly by significant distinct differences in yield between the two distances obtained for control. The efficiency of nitrogen use increases with the growth of the rate of fertilization both for 70 cm and 50 cm sowing distances (Table 3), from 20.33 kg grain/kg N and 20.50 kg grain/kg N (for the fertilization level N0P0K0) to 21.00 kg grain/kg N and 21.50 kg grain/kg N (for the fertilization level N120P0K0). Regarding phosphorus and potassium, there is a higher efficiency of their capitalization when used in combination with 120 kg N/ha. Research carried out by the Buah and Mwinkaara (2009), show that the efficiency of using mineral fertilizing elements (nitrogen) decreases with increasing dose of active substance and is not influenced by crop’s density.

<table>
<thead>
<tr>
<th>Fertilizer doses</th>
<th>70 cm</th>
<th>50 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GY (t/ha)</td>
<td>GYI/kg a.s.</td>
</tr>
<tr>
<td>N0P0K0</td>
<td>5.75</td>
<td>-</td>
</tr>
<tr>
<td>N60P0K0</td>
<td>6.97</td>
<td>20.33</td>
</tr>
<tr>
<td>N90P0K0</td>
<td>7.62</td>
<td>20.78</td>
</tr>
<tr>
<td>N120P0K0</td>
<td>8.27</td>
<td>21.00</td>
</tr>
<tr>
<td>Average</td>
<td>7.15</td>
<td>20.70</td>
</tr>
<tr>
<td>N90P60K0</td>
<td>8.00</td>
<td>-</td>
</tr>
<tr>
<td>N120P60K0</td>
<td>8.89</td>
<td>-</td>
</tr>
<tr>
<td>Average</td>
<td>8.45</td>
<td>-</td>
</tr>
<tr>
<td>N60P60K60</td>
<td>8.33</td>
<td>-</td>
</tr>
<tr>
<td>N120P60K60</td>
<td>9.22</td>
<td>-</td>
</tr>
<tr>
<td>Average</td>
<td>8.78</td>
<td>-</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Analyzing the results obtained in the three years of research, we see that yield is significantly influenced by both levels of fertilization and sowing distance between rows. At a distance of 70 cm between rows fertilization ensured an yield increase between 21.2% (N60P0K0) and 60.4% (N60P60K60), while at 50 cm between rows the same fertilization levels led to increases from 23.1% to 63.9%, compared to control (unfertilized variant). The yield obtained at a distance of 50 cm between rows was between 92.5% (N0P0K0) and 97.7% (N120P60K60) of the output value recorded at 70 cm sowing distance. Based on the results obtained, given the soil and climatic conditions in South-Eastern Romania, it is recommended for grain sorghum to be cultivated at the distance of 70 cm between rows, with a level of fertilization of N120P60K60.

**REFERENCES**


Pintilie C., Sin Gh., 1970. Rezultate experimentale privind influența adâncimii de lucrare a solului și a îngrășămintelor asupra producției de sorg boabe. AN. I.C.C.P.T. Fundulea, 26 (B).
