THE INFLUENCE OF SOWING TIME ON SORGHUM YIELD DURING THE STUDY PERIOD 2018–2020

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RESEARCH ARTICLE

Abstract

The paper presents the results of a study conducted during the period 2018–2020 in an experimental field located in Inand, Bihor County. The aim of the research was to determine the influence of sowing time on the average yield per hectare for five sorghum hybrids (Armorik, Moussone, Alizee, Arsenio, and Lupus), at a sowing density of 300,000 seeds/ha and a row spacing of 70 cm.
The results obtained show that the sowing time significantly influences yield, with hybrids reacting differently depending on climatic conditions and the timing of sowing. In general, sowing carried out between May 1–15 led to yield increases compared to early sowing (April 15–30), with values ranging between +1.11% and +2.33%, the differences being statistically significant at the 5%, 1%, and 0.1% confidence levels.

Keywords: sowing time, sorghum, yield per hectare, agricultural hybrids.
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INTRODUCTION

The sowing time represents one of the most important technological factors influencing the level and stability of yields obtained in sorghum cultivation (Drăghici, 1994; Antohe et al., 1989). Choosing the optimal sowing moment has a direct impact on the dynamics of plant growth and development, the flowering period, and the grain maturation process (Drăghici, 1999; Pochiscanu, 2015). Therefore, determining the sowing time cannot be done uniformly for all regions or agricultural years; it must be correlated with local pedoclimatic conditions and the specific requirements of each cultivated hybrid (Drăghici, 2009; Nica, 2011).

In the current context of Romanian agriculture, where climate change is becoming increasingly evident, the timing of sowing is gaining growing importance (Pochiscanu, 2015; Drăghici, 1999). In recent years, spring seasons have been characterized by frequent temperature fluctuations, prolonged cold periods, or temporary soil moisture deficits, which may delay or unevenly accelerate the processes of germination and emergence. Furthermore, early drought episodes followed by heavy rainfall can negatively affect the uniformity of emergence and crop density, thus reducing the productive potential of hybrids (Drăghici, 2009; Nica, 2011).

Establishing the optimal sowing time must also take into account the physiological characteristics of each sorghum hybrid. Early-maturing hybrids respond differently than late-maturing ones to soil temperatures and the hydric regime in spring, and choosing an unsuitable sowing time can lead to a significant decrease in yield per hectare. In this context, adapting cultivation technology to new climatic conditions becomes essential for achieving high and stable yields every year.

The present paper aims to highlight the influence of sowing time on the average yield per hectare in sorghum cultivation under the specific pedoclimatic conditions of Inand, Bihor County, during the period 2018–2020. Through a comparative analysis of two sowing times and five different hybrids, the study seeks to establish the relationship between sowing time and yield level, while also providing practical recommendations for farmers in the northwestern region of the country regarding the optimal period for establishing sorghum crops.

MATERIALS AND METHODS

The research was conducted during the period 2018–2020 in an experimental field located in Inand, Bihor County. The area has a moderately temperate-continental climate with oceanic influences, characterized by hot summers and dry periods during the second part of the growing season.

The experiment aimed to study the influence of sowing time on yield per hectare, analyzing five hybrids: Armorik, Moussone, Alizee, Arsenio, and Lupus.

For each agricultural year, two sowing periods were applied:
Period I: April 15–30
Period II: May 1–15

The sowing density was 300,000 seeds/ha, with a row spacing of 70 cm. Maintenance work, fertilization, and plant protection were carried out according to the recommended technology for the hybrids used. Harvesting was performed at physiological maturity, and yields were expressed in kg/ha and calculated as multiannual averages.

Climatic data were obtained from the National Meteorological Administration and refer to the monthly average temperatures and the amounts of precipitation recorded during the production cycles (September–August) for the agricultural years 2018, 2019, and 2020.

Table 1

Temperatures and precipitation for the 2018 production cycle

Month	Temperatura ˚C				Precipitation mm				
	Decade I	Decade II	Decade III	Monthly Average	Decade I	Decade II	Decade III	Total	Rainy Days
September 2017	19.3	20.9	11.4	17.2	23.1	-	28.2	51.3	4
October 2017	12.2	14.8	8.4	11.8	-	-	37.9	-	4
November 2017	6.1	6.4	2.5	5	5.8	8.9	39	53.7	5
December 2017	2.1	3.6	3.2	2.9	28.2	42.5	-	70.7	7
January 2018	4.9	1	1.1	2.3	8.6	14.3	3.8	26.7	4
February 2018	2.9	1.3	-2.9	0.4	41.8	12.2	8.8	62.8	9
March 2018	1.4	4.1	3	2.8	28.8	25.1	22.4	76.3	11
April 2018	14	18.2	20.7	17.6	27.3	-	9.8	37.1	4
May 2018	22	17.8	22.1	20.6	-	33	-	33	5
June 2018	23.2	23.2	22.2	22.9	13.2	25.9	10.1	49.2	4
July 2018	21	22.6	23.3	22.3	34.5	22.9	22.3	79.7	9
August 2018	25.9	26.6	23.7	25.4	-	-	-	-	0

Source: Romanian Meteorological Agency

During the period September 2017 – August 2018, a total of 540 mm of precipitation was recorded in Inand over 66 days, and the average temperature for the cycle was 12.6°C.

During the period September 2018 – August 2019, a total of 526.6 mm of precipitation was recorded in Inand over 62 days, and the average temperature for the cycle was 12.8°C.

Table 2

Temperatures and precipitation for the 2019 production cycle

Month	Temperature ˚C				Precipitation mm				
	Decade I	Decade II	Decade III	Monthly Average	Decade I	Decade II	Decade III	Total	Rainy Days
September 2018	21.3	20.2	13.3	18.5	40.7	-	10.8	51.5	4
Octomber 2018	11.6	15	13	13.2	-	-	-	-	-
November 2018	13.3	8.2	3.7	8.4	-	-	39.1	39.1	4
December 2018	1.4	-1.2	0.9	0.4	3.6	18.2	21.9	43.7	5
January 2019	-3.2	-0.6	-0.1	-1.3	8.6	30.5	21.9	61	9
February 2019	3.4	3.9	1.9	3.1	-	4.1	4.7	8.8	2
March 2019	9	6.4	7.3	7.6	-	3	-	3	1
April 2019	14.8	10.7	15.7	13.7	-	21.4	21	42.4	7
May 2019	11.8	15.8	17.2	14.9	54.5	13.3	61.6	129.7	15
June 2019	22.1	26.3	25.4	24.6	43.8	11.4	41.2	96.4	9
July 2019	24.1	20	24.8	23	3.4	24.1	17.1	44.6	5
August 2019	26	27.5	28.9	27.5	-	-	6.4	6.4	1

Source: Romanian Meteorological Agency

During the period September 2019 – August 2020, a total of 459.7 mm of precipitation was recorded in Inand over 48 days, and the average temperature for the cycle was 12.4°C.

Table 3

Temperatures and Precipitation for the 2020 Production Cycle

Month	Temperature ˚C				Precipitation mm				
	Decade I	Decade II	Decade III	Monthly Average	Decade I	Decade II	Decade III	Total	Rayni Days
Septembrie 2019	23.1	18.7	15.7	19.2	7.1	-	8.6	15.7	2
Octombrie 2019	11.3	16.2	14.2	13.9	3.1	-	-	3.1	1
Noiembrie 2019	10.9	10.9	5.9	9.2	25.1	-	9.9	35	7
Decembrie 2019	0.2	5.8	3.9	3.3	9.1	3.4	29.6	42.1	6
Ianuarie 2020	-3.3	-2.5	0.2	-1.9	-	-	12.3	12.3	2
Februarie 2020	3.8	4.2	5.7	4.6	23.9	5.3	13	42.2	5
Martie 2020	7.3	8.4	5.4	7	42.7	3	-	45.7	5
Aprilie 2020	8.1	10.4	12.4	10.3	-	7.8	-	7.8	1
Mai 2020	13.2	14.9	13.3	13.8	1.9	-	2.6	4.5	2
Iunie 2020	17.6	20.3	23.9	20.6	-	78.9	57.4	136.3	7
Iulie 2020	23.8	20.8	27.1	24.2	5.9	27.6	11.3	44.8	6
August2020	26.6	24.1	24.5	25.1	3.1	57.5	9.6	70.2	4

Source: Romanian Meteorological Agency

During the period September 2019 – August 2020, 14.5% less precipitation was recorded compared to the period September 2018 – August 2019, and 17% less compared to the period September 2017 – August 2018. Figure 4 illustrates the precipitation chart for the three production cycles.

The determinations were carried out annually by weighing the grain yield per hectare for each hybrid and each sowing period. The multiannual average values (2018–2020) are presented in Table 4 – The influence of sowing time on yield per hectare, at a sowing density of 300,000 seeds/ha and a row spacing of 70 cm.

The yields obtained were expressed in kg/ha, and the differences between variants were analyzed statistically, with the significance of the differences established at the 5%, 1%, and 0.1% significance levels (LSD 5%, LSD 1%, LSD 0.1%).

The results show a clear variation in yield depending on the sowing time, the tested hybrid, and the climatic conditions of each year.

Table 4

The influence of sowing time on yield per hectare (2018-2020), at a density of 300,000 seeds/ha and a row spacing of 70 cm

No. crt.	Variant	Sown to 15-30 april				Sown to 1-15 may				% Compared to control(mean of sowing dates)			
		Production - kg/ha				Production - kg/ha				Sown to 15-30 april		Sown to 1-15mai	
		2018	2019	2020	Media	2018	2019	2020	Media	%	Statistical semnificance	%	Statistical semnificance
1	Armorik	8303	7642	6967	7637	8557	7849	7312	7906	98,27	o	101.73	***
2	Moussone	9322	8458	8027	8602	9913	8668	8333	8971	97,90	oo	102.10	***
3	Alizee	9608	8596	7932	8712	10125	8739	8304	9056	98,07	oo	101.93	***
4	Arsenio	8800	8195	7163	8053	9192	8431	7688	8437	97,67	ooo	102.33	***
5	Lupus	8079	7367	6879	7441	8298	7404	7123	7608	98,89	o	101.11	*
	Average	8822	8052	7393	8089	9217	8218	7752	8396	91,48	ooo	108.52	***

LSD 5%	70.10	0.85
LSD1%	92.12	1.12
LSD 0.1%	117.68	1.43

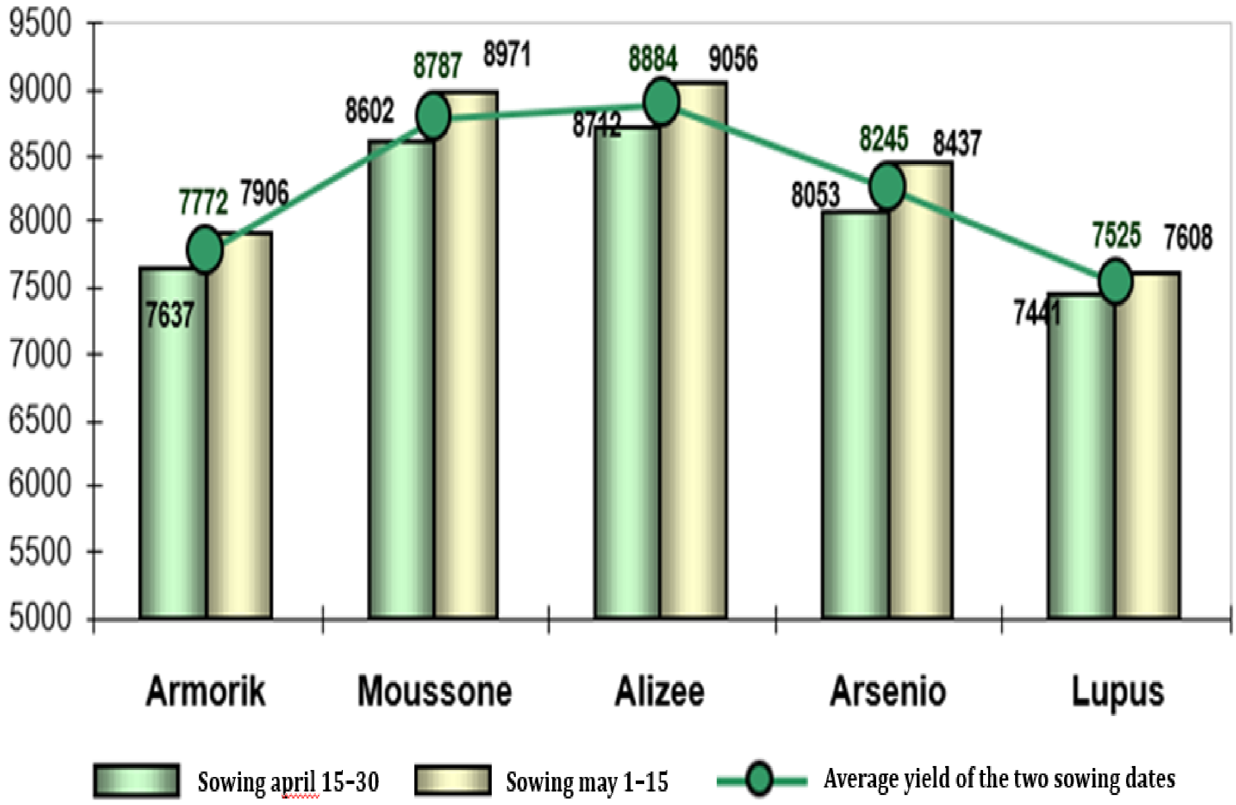

Figure 1 **Influence of sowing time on yield at a row spacing of 70 cm and a density of 300,000 seeds/ha**

RESULTS AND DISCUSSIONS

The results obtained from the experiment conducted during 2018–2020 are presented in Table 4, which highlights the influence of sowing time on yield per hectare, at a sowing density of 300,000 seeds/ha and a row spacing of 70 cm.

Overall, the data show that sowing time had a significant effect on sorghum yield, with differences between variants confirmed statistically at the 5%, 1%, and 0.1% significance levels.

Comparison between the two sowing periods:

For early sowing (April 15–30), multiannual average yields ranged from 7,441 kg/ha (hybrid Lupus) to 8,712 kg/ha (hybrid Alizee), with an overall average of 8,089 kg/ha.

For sowing during May 1–15, yields ranged from 7,608 kg/ha (Lupus) to 9,056 kg/ha (Alizee), with an overall average of 8,396 kg/ha.

The results indicate an average yield increase of approximately 3.8% for the later sowing, suggesting that under the pedoclimatic conditions of the Inand area, a moderate delay in sowing may be beneficial.

Percentage analysis relative to the control (overall average) confirms this trend:

Early sowing represented 91.48% of the overall average.

Late sowing reached 108.52%, the difference being highly statistically significant (LSD 0.1%).

Hybrids Alizee, Moussone, and Arsenio showed the best adaptability to the variable climatic conditions during the study period, achieving the highest yields in both sowing periods. The Lupus hybrid, although stable, showed lower productivity, likely due to its sensitivity to thermal and water stress during grain formation.

Correlating these data with meteorological conditions reveals that:

2018 was favorable in terms of moisture and temperatures, resulting in high yields for all variants.

2019 had abundant precipitation in May (over 120 mm), promoting uniform emergence and vigorous vegetative growth; however, in some cases, excess water delayed maturation.

2020 was the driest year, with a precipitation deficit of over 17% compared to 2018. In this context, the second sowing period (May 1–15) provided higher yields because plants benefited from higher emergence temperatures and a more balanced rainfall regime during the growing season.

The results confirm that adapting the sowing time to the conditions of the agricultural year can lead to a significant yield increase. Too early sowing, under low soil temperatures, can cause uneven emergence and plant losses, whereas moderately delayed sowing in the first decade of May allows more vigorous vegetative growth and better utilization of water and heat resources.

CONCLUSIONS

Sowing time is a major technological factor that causes significant differences in sorghum yield.

During the period 2018–2020, under the pedoclimatic conditions of Inand, Bihor County, a general trend of increased yield was observed for sowing carried out between May 1–15, compared to sowing performed between April 15–30.

The average yield differences between the two sowing periods ranged from 1.11% to 2.33%, statistically significant at all confidence levels (LSD 5%, LSD 1%, and LSD 0.1%).

Hybrids Alizee, Moussone, and Arsenio demonstrated good adaptability, achieving the highest multiannual average yields.

The year 2020, marked by a pronounced rainfall deficit, highlighted the advantage of delayed sowing, which allowed better utilization of water resources and uniform emergence.

It is recommended that, under climatic conditions similar to those in western Romania, the optimal sowing period for sorghum should be between May 1 and 15, adjusted according to soil temperature and the weather forecast.

The results of this study can contribute to improving cultivation technology and increasing yield stability in years with variable meteorological conditions.

REFERENCES

Antohe, I., Hurduc, N., & Drăghici, I. (1986). Sorgul zaharat, planta tehnică şi de nutreţ, utilizabilă ca sursă de fitomasă energetică şi chimizabilă (etanol, sirop alimentar, zahăr cristalizat, celuloză, furfurol). Revista Economică, iulie 1986.

Antohe, I., Şerbanescu, E., Bâlteanu, Gh., Săndulescu, V., Matei, I., & Drăghici, I. (1989). Rezultate experimentale obţinute cu soiuri şi hibrizi autohtoni de sorg zaharat. Analele ICCPT Fundulea, LVII, 73–82.

Drăghici, I. (1999). Cercetări privind resursele ecologice şi tehnologice pentru creşterea producţiei de sorg pentru boabe pe solurile nisipoase din Sudul Olteniei [Teză de doctorat, Academia de Ştiinţe Agricole şi Silvice]. Bucureşti, România.

Drăghici, I. (2009). Sorgul pentru boabe, alternativă a culturii porumbului în condiţii de stres termic şi hidric specifice solurilor nisipoase. În Mediul şi agricultura în regiunile aride (Ed. I, pp. 85–93). Editura EstFolia, Bucureşti.

Drăghici, I., Drăghici, R., & Antohe, I. (1994). Cercetări privind stabilirea perioadei de semănat la sorgul pentru boabe pe nisipurile amenajate. Lucrări Ştiinţifice SCCCPN Dăbuleni, VII, 45–52.

Nica, V. (2011). Studiul comparativ privind productivitatea, calitatea producției și rentabilitatea culturilor de porumb și sorg în condițiile pedoclimatice din județul Ialomița [Teză de doctorat, Universitatea de Ştiinţe Agronomice şi Medicină Veterinară din Bucureşti].

Pochiscanu, S. (2015). Cercetări privind aplicarea unor secvențe tehnologice moderne la sorg (Sorghum bicolor L.) în condițiile pedoclimatice din Centrul Moldovei [Teză de doctorat, Universitatea de Ştiinţe Agricole şi Medicină Veterinară „Ion Ionescu de la Brad” din Iaşi].