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BEHAVIOUR OF SOME MAIZE HYBRIDS IN THE SOIL AND CLIMATE CONDITIONS OF SCDA LOVRIN

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Abstract: *In this study, we aimed at testing four early grain maize hybrids – Severo (FAO270), Kinemas (FAO350), Kornelius (FAO400) and KWS 3381 (FAO450) sowed at two consequent times to define their behaviour in the Banat's Plain conditions, the SCDA Lovrin area, and determine their production potential. The bifactorial trial was set in the experimental field after the subdivided plot method. The experimental field covers 768.4 m^2 and the four hybrids were sowed on six 8-m long lines with three replicas. The area cultivated with a hybrid measured 33.6 m^2. We sowed 5-7 cm deep in the soil. The sowing density was 60,000-65,000 harvestable plants per ha, and the row distance was 70 cm. For fertilisation, we used a complex 20:20:0 fertiliser, and we controlled the weeds mechanically, manually and using the herbicides Mustang – 0.5 l/ha and Gat Motion – 1.5 l/ha. During vegetation, we made observations in different pheno-phases – sprouting, blooming, silking, physiological maturation – and we correlated them with the soil and climate conditions. Sowing early maize hybrids in the third decade of April ensures temperatures above 10^0C and the necessary humidity for germination, resulting in high grain yields (STAS 6739 kg/ha) compared to sowing in the first decade of May (6642 kg/ha). The studied hybrids have a good tolerance to drought and heat, and the grain yields reached Severo 5968 kg/ha, Kinemas 6137 kg/ha, Kornelius 7154 kg/ha, with the most productive hybrid KWS 3381 with 7708 kg/ha. Upon harvesting, mean moisture of grain maize was 8.2-12.0%.*

Keywords: *production, sowing time, hybrid*

INTRODUCTION

Due to their high content in proteins, sugars, fibres, and even lipids, cereals are the basis of a healthy nutrition. Cereal production is closely related to meat, milk, and egg production. Cereals are also raw materials for the food industry.

Grain maize has a nutritious value of 1.17-1.30 (nutritious units) and ensures 70-80 g of digestible protein per kilo of maize grains [1,2]. Maize grains are concentrated feed for all animal species.

Maize has been and will always be an important crop due to its economic importance and favourable conditions. There has been a slight decrease of the areas cultivated with maize from 2,524,000.700 ha in 2007 to 2,098,000.4 ha in 2010. Starting with 2011, the areas increased significantly compared to the previous year with 23.41%, i.e. 2,589,000.7 ha, and in 2012, maize crops increased with 5.07%,–i.e. 2,721,000.2 ha compared to 2011 [12]. (Table 1).

Table 1

Data concerning the evolution of areas and maize productions in Romania Source: www.madr.ro

Specification	UM	2007	2008	2009	2010	2011	2012
Area	thousands ha	2524.7	2441.5	2338.8	2098.4	2589.7	2721.2
Mean production	Kg/ha	1526	3215	3409	4309	4525	2188
Total production	thousands t	3853.9	7849.1	7973.3	9042.0	11717.6	5953.4

Mean maize production per ha at national level depends largely on the evolution of climate conditions, soil fertility, cultivated hybrid, and cultivation technology.

Valorising effectively the natural resources for the cultivation of maize to produce in economically profitable conditions ask for a rigorous distribution of maize hybrids depending on climate conditions and biological requirements. Producing in optimal economic conditions also depends on the judicious choice of the most suitable hybrids for each cultivation area [5]. According to GAY and BLOC (1984), maize production is the result of six basic components: number of plants per ha, number of kernels per plant, number of ovules per kernel, number of ovules per row, percentage of fecundated ovules, and weight of 1,000 grains [8].

Maize (*Zea mays* L.) belongs to the family *Gramineae*, subfamily *Panicoideae* [1,2]. The advantages of cultivating this plant are high productivity and good adaptability to soil and climate conditions.

Hybrids valorise well fertilisers, and the plants have an even growth and high resistance to drought, diseases, pests, and fall, and yield high yields.

The role of fertilisers in the production of large amounts of crops with high quality indices is known and confirmed by numerous researchers: there is a close relationship between amount of fertilisers and production.

Fertilising agricultural crops is one of the most important ways of influencing crops [4,10]. Nitrogen is the nutrient with the highest contribution to production of all fertilisers, on all soil types and in most crops [4,7,10].

Maize production is largely determined by nitrogen fertilisers, and it depends on the specific soil and climate conditions of the year and on the crop vegetation [5,9].

Sowing time also determines the amount and quality of the production in maize in the soil and climate conditions of the SCDA Lovrin area.

Optimal sowing time allows good physiological processes that affect plant growth and development.

MATERIALS AND METHODS

In 2012, at the Agricultural Research and Development Station in Lovrin, Timiş County, Romania, we sowed four maize hybrids (Severo, Kinemas, Kornelius, and KWS 3381), whose FAO maturity classes are Severo (FAO270), Kinemas (FAO350), Kornelius (FAO400), and KWS 3381 (FAO450).

Maize ensures the largest yields on fertile, deep soils that allow the development of a strong root system capable of supplying water and nutrient to the plants. Thus, the experimental field was set on a gley chernozem, moderately gleyed and with medium texture, with a slightly acid reaction (pH=6.60) in the Ap layer (0-27 cm), with 3.55% humus in the arable layer, with a nitrogen index of 3.07, a mobile phosphorus index of 75.7 ppm, and a high potassium content of 205 ppm.

The experimental field covers 768.4 m^2, with a distribution of the four hybrids into six 8-m lines, with three replicas. The area cultivated with a hybrid is 33.6 m^2.

The study relied on a bifactorial trial in which:

Factor A – maize hybrid, with four graduations:

– Severo;
– Kinemas;
– Kornelius;
– KWS 3381.

Factor B – sowing time, with two graduations:

- B_1 – 1st time – April 24-25, 2012;
- B_2 – 2nd time – May 1-2, 2012.

Soy was the pre-emergent crop. Basic ploughing was done 20-25 cm deep in the soil, and land levelling was done with a disc and harrow on April 25, 2012.

The germination bed was prepared with a combinator on April 4, 2012.

To ensure the nutrients in the soil, the fertilisation of the experimental field was done with 200 kg/ha complex fertiliser of the N:P:K=20:20:0 type.

Sowing was done between April 24 and May 2, 2012, 5-7 cm deep in the soil. Sowing density was 60,000-65,000 harvestable plants/ha, and row distance was 70 cm.

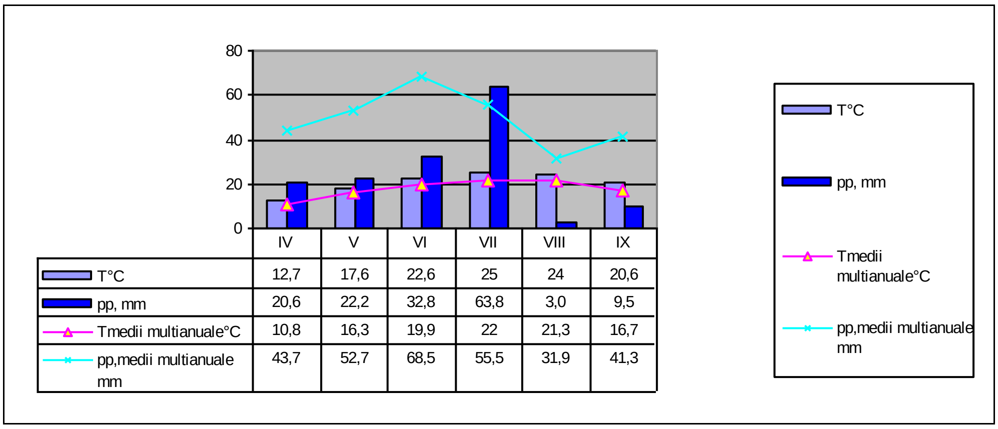

Figure 1. Mean monthly temperatures (°C) and mean monthly rainfall (mm) in 2012 at the SCDA Lovrin

Maize germination was good in the third decade of April (1st sowing time) with mean monthly temperatures of 16.3^{0}C, and in the first decade of May (2nd sowing time) with mean monthly temperatures of 17.5^{0}C. Under hydric stress conditions and at temperatures of 22.6-25^{0}C (above multiannual means), the panicle and silk develop in June-July (Figure 1).

Weed control was ensured through mechanical and manual works and with herbicides. Until sprouting, harrowing ensured the destruction of the sprouted weeds and the two manual weedings controlled the weeds in the maize field aerate the soil and improve soil permeability.

During vegetation, treatment was done with Mustang – 0.5 l/ha and Gat Motion – 1.5 l/ha.

Harvesting was done on September 9, 2012.

The goal of the paper was to quantify the real production differences in the four maize hybrids (*Zea mays* L.) studied from the point of view of the impact of sowing time and of soil and climate conditions at the SCDA Lovrin.

Data obtained in grain maize production were processed statistically through variance analysis [6].

RESULTS AND DISCUSSION

The four early maize hybrids studied have as blooming and maturation indices between 1200-1450°C (Table 2).

Table 2

Studied blooming and maturation indices in maize hybrids in 2012

Hybrid	Sowing time	Sprouting time	Blooming time	Silking time	Physiological maturation time
SEVERO Control	April 25	May 01	June 24	June 26	August 15
SEVERO I	April 25	May 01	June 24	June 26	August 15
SEVERO II	May 02	May 08	July 02	July 04	August 21
Blooming index/Maturity index °C	**1225**°C			**1242**°C	
KINEMAS Control	April 25	May 02	June 28	June 30	August 20
KINEMAS I	April 25	May 02	June 28	June 29	August 20
KINEMAS II	May 02	May 08	July 07	July 09	August 30
Blooming index/Maturity index °C	1422°C			1255°C	
KORNELIUS Control	April 25	May 02	June 28	June 29	August 20
KORNELIUS I	April 25	May 02	June 28	June 30	August 21
KORNELIUS II	May 02	May 08	July 06	July 08	August 28
Blooming index/Maturity index °C	**1394**°C			**1239**°C	
KWS 3381 Control	April 24	May 01	July 01	July 02	August 24
KWS 3381 I	April 24	May 01	July 01	July 02	August 25
KWS 3381 II	May 02	May 08	July 09	July 10	September 01
Blooming index/Maturity index °C	**1450**°C			**1268**°C	

Harvesting the maize grains was done mechanically at moisture ranging within 8.2-12.0% (Table 3).

Table 3

Mean moisture (%) of the maize grains upon harvesting

	Mean moisture %		
Hybrid	Control	I	II
SEVERO	10.8	11.1	11.7
KINEMAS	9.2	10.2	10.6
KORNELIUS	9.95	10.3	11.2
KWS 3381	11.3	11.3	12.0

Applying variance analysis [6] for the 1st and 2nd sowing times we found real production differences between the four studied maize hybrids (Tables 4 and 5). This is certified by the experimental value of the test F_{hybrid} 304.07 (1st time) and 296.55 (2nd time) larger than the theoretical value F1%=9.78. Compared to the control, the first sowing time did not determine significant production differences (experimental value F_e=4.42 lower than theoretical one F1%=13.34). The second sowing time resulted in statistic differences compared to the control, an idea supported by the calculated value of the test F_e=14.29 higher than the theoretical one F1%=13.34.

The difference of 105 kg/ha of the mean maize grain production after sowing on April 24, 2012, is not significant statistically compared to the limit difference (DL 5%) 106 kg/ha. (Table 4). The deficit of 202 kg/ha caused by the late sowing resulted in significant production differences (DL 1%=156 kg/ha) (Table 5).

Table 4

Maize hybrid productions (kg/ha) with 1st sowing time on April 24-25, 2012

Factor A Hybrid	Factor B - Time		Mean production kg/ha	Relative production %	Difference±	Significance
	Control	I				
SEVERO	6241	6022	6132	100	-	
KINEMAS	6373	6366	6370	104	238	**
KORNELIUS	6908	6900	6904	113	773	***
KWS 3381	7855	7668	7762	127	1630	***
Mean production	6844	6739	Factor A-			
Relative production	100	98	DL 5%=144 kg/ha, DL 1%=218 kg/ha, DL $_{01}$%=349 kg/ha			
Difference±	-	-105	Factor B-			
Significance	-	-	DL 5%=106 kg/ha, DL 1%=146 kg/ha, DL $_{01}$%=202 kg/ha			

Table 5

Maize hybrid productions (kg/ha) with 2nd sowing time on May 1-2, 2012

Factor A Hybrid	Factor B - Time		Mean production kg/ha	Relative production %	Difference±	Significance
	Control	II				
SEVERO	6241	5640	5941	100	-	
KINEMAS	6373	5672	6023	101	82	-
KORNELIUS	6908	7655	7282	123	1341	***
KWS 3381	7855	7601	7728	130	1788	***
Mean production	6844	6642	Factor A-			
Relative production	100	97	DL 5%=181 kg/ha, DL 1%=274 kg/ha, DL $_{01}$%=440 kg/ha			
Difference±	-	-202	Factor B-			
Significance	-	00	DL 5%=113 kg/ha, DL 1%=156 kg/ha, DL $_{01}$%=215 kg/ha			

The year 2012 was not favourable for maize because of the low level of rainfall during blooming: the mean production of the four maize hybrids reaching 6742 g/ha (Table 6).

Table 6

Mean productions (kg/ha) of maize grains in the studied hybrids

Hybrid	Production STAS Kg/ha	Relative production %	Difference±	Significance
SEVERO	5968	100	-	-
KINEMAS	6137	103	169	*
KORNELIUS	7154	120	1186	***
KWS 3381	7708	129	1740	***
Media	6742	DL 5%=157 g/ha, DL 1%=238 kg/ha, DL $_{01}$%=383 kg/ha		

Table 6 shows that the maize hybrids Kornelius (7154 kg/ha) and KWS3381 (7708 kg/ha) are very significantly superior to the control, the maize hybrid Severo (5968 Kg/ha) from the point of view of the hybrid studied. The maize hybrid Kinemas (6137 Kg/ha) produced an increase in yield superior to the control and ensured statistically.

Multiple comparisons between the studied maize hybrids show that the maize hybrid KWS 3381 (7708 Kg/ha) is very significantly superior to the other maize hybrids (Figure 2).

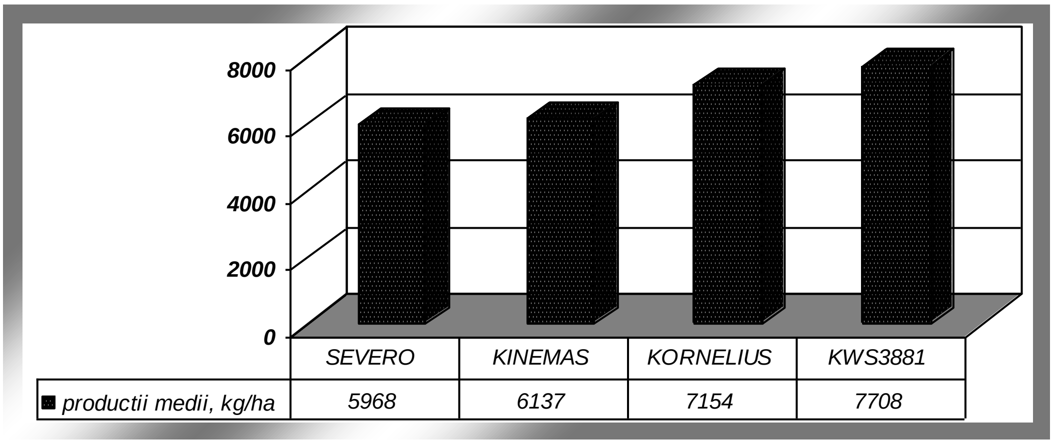

Figure 2. Mean productions (kg/ha) in the maize hybrids studied at the SCDA Lovrin in 2012

CONCLUSIONS

The yields of over 60,000 kg/ha show good adaptability of the grain maize hybrids even with a rainfall level of 188 mm, much below the necessary water level of 350 mm [1] during vegetation. The maize hybrids KWS 3881 and Kornelius are well tolerant to drought and produce over 70,000 kg/ha of maize grains.

Because of the speedy rate of water loss after harvesting, mean moisture ranged below 10.6%.

In the soil and climate conditions of the SCDA Lovrin, choosing the sowing time produces significant differences in the maize hybrids studied. Sowing early maize hybrids is better with low temperatures during germination, but the maize hybrids are more sensitive to the heat and dryness during summer.

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