ProEnvironment Original Article
ProEnvironment 16/54 (2023) 76 - 86

Sowing Season-Year Important Link in Maize Cultivation Technology

ȘIMON[1] Alina, Ana-Maria, VĂLEAN[1*], Ioana CRIȘAN[1], Laura ȘOPTEREAN[1], Andrei VARGA[1], Alin POPA[1,2], Adrian CECLAN[1], Adrian NEGREA[1]

[1]Agricultural Research and Development Station Turda, 27 Agriculturii St., 401100, Turda, Romania
[2]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, 3-5 Mănăștur St., 400372 Cluj-Napoca, Romania

* Corresponding author e-mail: anamaria.valean@scdaturda.ro

Received 10 April 2023; received and revised form 5 May 2023; accepted 21 May 2023; Available online 30 June 2023

Abstract

Climate change, through continuous rising temperatures and variability in rainfall, is a challenge for agriculture. Adapting some agricultural practices and technologies to the new environmental conditions can be one of the effective methods to reduce the effects of climate change. In this context, during 2020-2022 at Agricultural Research and Development Station Turda an experience with 7 maize hybrids was placed (Turda 248; Turda 165; Turda 201; Turda Star; Turda 332; Turda 344; Turda 335), which were sown in 3 different sowing dates (at 6ºC, 8ºC and 10ºC in the soil), following the effect of the time of sowing on the development of the maize crop but also the impact of the environmental conditions on the yield. During the research period, the number of days from sowing to emergence, the emergence of the panicle, respectively the physiological maturity, was higher in the case of the first sowing date. The sum of useful thermal degrees (SUTG) (Σº≥10ºC) was inversely proportional to the number of days for each physiological stage. The yield obtained by the 7 hybrids used was higher for the hybrids from the FAO 380 maturity group. The greatest increases in yield were recorded in the third age, but some hybrids performed better in the second sowing season. In the specific conditions of the Transylvanian Plateau, sowing maize earlier, even if it manages to avoid the negative impact of stress factors during the growing season, does not contribute to increasing of yield.

Keywords: sowing season, maize hybrids, climatic conditions, yield.

1. Introduction

It is known that in recent years the climate has changed, by increasing average annual temperature and precipitation distribution, that is why we need to turn our attention to new technological options or improvements to existing ones, with a direct result of quantitative and qualitative production.

Variation in environmental conditions during the growing season can have a major effect on yield, with temperature, precipitation, humidity, and sunshine duration being the most important climatic elements affecting a crop's production [16].

In addition to the genetic factor, crop technologies adapted to regional ecological conditions can make an important contribution to limiting production losses, but which can be variable depending on the environmental conditions during the vegetation period.

In Romania, maize is the most extensive crop [10], with use in human and animal nutrition, therefore an analysis of the effect of climate change on the maize crop is necessary.

Studies on the relationship between temperature and maize development have been carried out since 1914, which established that corn can survive between 00C and 430C [4]. Although maize grows between these temperatures, below 10ºC and above 30ºC growth is slow [9].Maize needs to be sown when the soil temperature is consistently >10ºC [18], after this soil temperature threshold, the best germination of corn seeds is achieved. Since the heat requirement accumulates slowly, an early sowing of the crop can cause significant delays in emergence [19].

2. Material and Method

During 2020-2022, a bifactorial experience was organized at the Turda Agricultural Research and Development Station, with the following factors: factor A - the sowing season with three graduations: sowing season I (Ss 1) - when 6ºC are recorded in the soil for three consecutive days; sowing season II (Ss 2) - when 8ºC are recorded in the soil for three consecutive days; sowing season III (Ss 3) - when 10ºC are recorded in the soil for three consecutive days; factor B - corn hybrids with seven graduation: Turda 248 (FAO 300); Turda 165 (FAO 270); Turda 201 (FAO 340); Turda Star (FAO 370); Turda 332 (FAO 380); Turda 344 (FAO 380); Turda 335 (FAO 380), where was studied the effect of sowing time and climatic conditions on plant development and yield.The experiment was located on a chernozem type soil, characteristic of the Transylvanian Plateau. As a chemical description, the soil has a weakly alkaline neutral pH, neutral to high humus content, well supplied with nitrogen and potassium, medium supplied with phosphorus.

Fertilization was executed in two moments: basic fertilization at sowing, with 150 kg/ha NPK (20:20:0) and in the phenophase of 6-8 leaves, an additional fertilization with 200 kg/ha CAN (27%). The sowing rate was 70,000 plants/ha. The predecessor plant was winter wheat.Because in this experiment the sowing is done after recording a number of degrees of temperature, the low temperatures of the last years have caused that every year the sowing is done on different calendar dates (Table 1).

Table 1. Date of sowing

Sowing season	2020	2021	2022
Ss 1 (6ºC)	03 April	12 April	14 April
Ss 2 (8ºC)	13 April	22 April	02 May
Ss 3 (10ºC)	23 April	07 May	17 May

(Ss 1 - sowing season I; Ss 2 - sowing season II; Ss 3 - sowing season III)

The obtained results were processed statistically by the variance analysis method and establishing the smallest significant difference - LSD - (5%, 1% and 0.1%) (ANOVA, 2015) [20].

Climatic conditions are one of the most important factors that determine the productivity of an agricultural crop, an analysis of climatic factors being justified in the context in which climate change has become a global problem. The climatic data presented come from the Turda Weather Station [21], located at the coordinates: longitude 23º47'; latitude 46º35'; altitude 427 m.

Average monthly temperatures over the three years of the study show a cooling trend in the spring weather as well as a marked warming in the summer months, a phenomenon that is part of a global warming process. Most of the months of the maize growing season are warm, except for the spring months which are cool (Table 2).

The biggest temperature deviation was recorded in the months of June-July of 2023 (3,1-3,3ºC), year when four consecutive months had positive deviations from normal.

Precipitation during the maize vegetation period has a high variability, passing from a dry month to a rainy one, the dry character being encountered more often in the spring months (during the sowing period) and in the summer months (the period of the formation of the generative organs - filling grains) (Table 3).

The lack of precipitation is very often correlated with high summer temperatures, having a direct effect on the formation of maize yield.

Table 2. The mean air temperature during the maize vegetation period (Turda, 2020-2022)

Experimental years	Average air temperature (ºC)						
	Month	**April**	**May**	**June**	**July**	**August**	**September**
2020	Monthly average	10.3	13.7	19.1	20.2	21.5	17.8
	Average 65 years	10.0	15.0	18.0	19.8	19.5	15.2
	Deviation	0.3	-1.3	1.1	0.4	2.0	2.6
	Characterization	normal	chilly	warmly	normal	warm	warm
2021	Monthly average	7.8	14.1	19.8	22.7	19.7	15.0
	Average 65 years	10.0	15.0	18.0	19.8	19.5	15.2
	Deviation	-2.2	-0.9	1.8	2.9	0.2	-0.2
	Characterization	cold	normal	warmly	warmly	normal	normal
2022	Monthly average	8.8	16.3	21.1	23.1	22.3	14.3
	Average 65 years	10.0	15.0	18.0	19.8	19.5	15.2
	Deviation	-1.2	1.3	3.1	3.3	2.8	-0.9
	Characterization	cold	warmly	warm	warm	warm	normal

Table 3. The amount of precipitation for the maize vegetation period (Turda, 2020-2022)

Experimental years	Rainfall (mm)						
	Month/decade	**April**	**May**	**June**	**July**	**August**	**September**
2020	Monthly average	17.8	44.4	166.6	86.8	58	57.4
	Average 65 years	45.6	69.4	84.6	78.0	56.1	42.4
	Deviation	-27.8	-25.0	82.0	8.8	1.9	15.0
	Characterization	excessively dry	very dry	excessively rainy	a little rainy	normal	very rainy
2021	Monthly average	38.4	80.8	45.0	123.1	52.9	39.1
	Average 65 years	45.6	69.4	84.6	78.0	56.1	42.4
	Deviation	-7.2	11.4	-39.6	45.1	-3.2	3.3
	Characterization	a bit dry	a little rainy	very dry	excessively rainy	normal	normal
2022	Monthly average	42.5	82.9	41.8	25.2	94.6	119.9
	Average 65 years	45.6	69.4	84.6	78.0	56.1	42.4
	Deviation	-3.1	13.5	-42.8	-52.8	38.5	77.5
	Characterization	normal	a little rainy	excessively dry	excessively dry	excessively rainy	excessively rainy

3. Results and Discussions

Early sowing of agricultural crops has recently become one of the most current measures to avoid climatic stress in the growing season, however, it is not clear whether the trend of sowing dates will continue to progress in the future towards earlier dates because this practice is limited by temperature and soil moisture at the time of sowing [8].

Although there is a warming of the weather, the fact that the average temperatures in spring (April and May) record variable annual values means that in certain years the sowing of maize cannot be executed earlier or even in the optimal period (the second and third decade of April).

Analysis of average monthly temperatures over a period of 65 years shows that spring temperatures vary from year to year, moving from one extreme to another. In the three experimental years, the average monthly temperatures of April (Fig. 1) and May (Fig. 2) recorded lower values than the multiannual average, which caused the sowing of the maize crop to be executed late.

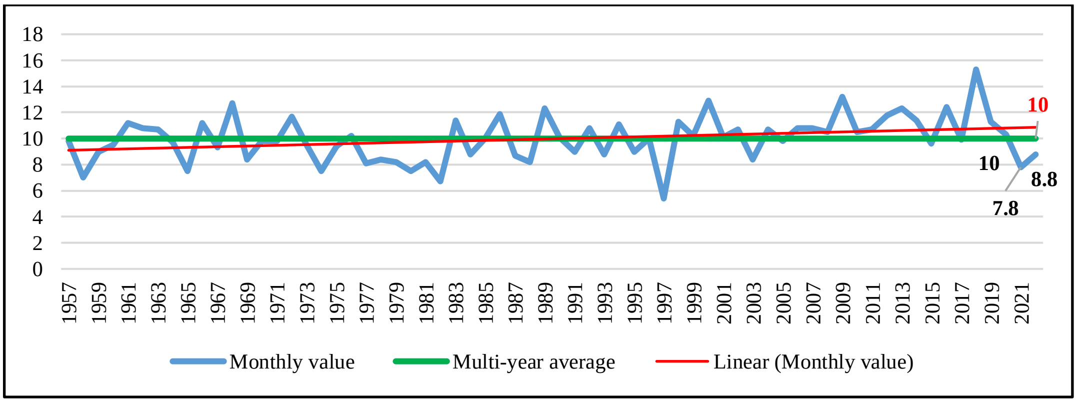

Figure 1. Average monthly and multiannual April temperature (°C)

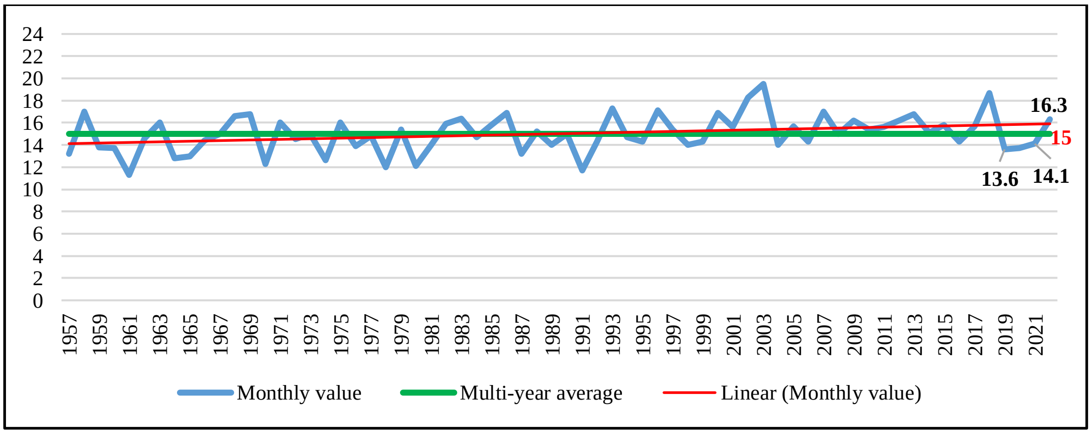

Figure 2. Average monthly and multiannual May temperature (°C)

Even if the temperatures in the soil are sufficient to sow maize, for good development it needs temperatures higher than 10ºC, because low temperatures in the 4-6 leaf phase can cause the leaves to turn red (blocking the absorption of phosphorus, an important element in plant nutrition, with a direct effect on the normal growth of the plant), the discoloration of the leaves or even the slowing down of the process of plant growth and development.

Maize is considered to develop normally at temperatures between 20 and 25°C. During the period of formation of the generative organs, high temperatures (>25°C) can increase the gap between the appearance of the panicle and that of the stigmas.

Germination, emergence and early growth stages of maize plants are more influenced by soil temperature [3] than the air temperature, so the seven hybrids sown in 2020 show that although in the third sowing season a sum of useful thermal degrees (SUTG) was recorded almost double compared to the first sowing season, for the emergence the seven hybrids needed the same number of days (Table 4). A greater difference in the number of days from sowing to emergence was observed in the year 2022, when maize needed a greater number of days to emergence (20-22) for the first sowing season compared to the third sowing season when the maize emergence in 8-10 days.

From the data obtained, it can be observed that the number of days from sowing to emergence is inversely proportional to the amount of the sum of useful thermal degrees (SUTG), where the amount of SUTG was higher, the emergence of the crop took place in a shorter time.

Among the seven hybrids studied, there are no very large differences in terms of the date of emergence in a certain sowing season, all hybrids having a similar behavior in all three-sowing season, in terms of requirements for emergence

Table 4. Number of days and sum of useful thermal degrees (Σ°≥10°C) from sowing to emergence

Sowing season	Hybrid	2020		2021		2022	
		No.days	Σ°≥10°C	No.days	Σ°≥10°C	No.days	Σ°≥10°C
Ss 1	Turda 248	20	26.8	22	29.7	20	35.9
	Turda 165	18	25.8	25	36.2	20	35.9
	Turda 201	20	26.8	24	35.1	22	46.4
	Turda Star	19	25.8	24	35.1	20	35.9
	Turda 332	19	25.8	23	32.8	21	41.0
	Turda 344	19	25.8	22	29.7	20	35.9
	Turda 335	20	26.8	21	29.1	21	41.0
	Average	19	26.2	23	32.5	21	38.9
Ss 2	Turda 248	21	36.3	12	24.3	10	59.5
	Turda 165	21	36.3	13	27.4	10	59.5
	Turda 201	20	36.3	13	27.4	11	68.8
	Turda Star	22	37.9	13	27.4	10	59.5
	Turda 332	23	37.9	14	29.7	10	59.5
	Turda 344	22	37.9	14	29.7	10	59.5
	Turda 335	21	36.3	14	29.7	10	59.5
	Average	21	37.0	13	27.9	10	60.8
Ss 3	Turda 248	19	53.4	11	45.9	8	56.5
	Turda 165	19	53.4	12	50.0	8	56.5
	Turda 201	19	53.4	12	50.0	10	74.8
	Turda Star	18	48.1	12	50.0	9	66.3
	Turda 332	19	53.4	13	50.3	9	66.3
	Turda 344	19	53.4	12	50.0	8	56.5
	Turda 335	19	53.4	12	50.0	9	66.3
	Average	19	52.6	12	49.5	8.7	63.3

Ss 1 – sowing season 1; Ss 2 – Sowing season 2; Ss 3 – Sowing season 3.

The same difference in the number of days, as in the previous case, also exists in the case of the number of days between sowing and the sprouting phase, for the first sowing season a greater number of days is determined compared to the third sowing season, but a smaller number of degrees of temperature than for the other sowing season (Table 5).

The data recorded in the three years show that between the seven hybrids there is a difference in development, due to the FAO maturity group, for the hybrids in the 380 group being observed a greater number of days from sowing to the appearance of the ear, but also a greater number of the sum of useful thermal degrees (SUTG), for all three-sowing season.

For maize, rainfall in the summer months has a decisive influence on production, and their uniform distribution is more important than the total amount of rainfall, because when drought intervenes during earing and grain formation, the harvest is halved [11].

Tigchelaar et al. (2018) combined empirical models of maize production with future warming scenarios and showed that maize yield is predicted to decrease by 20-40% and 40-60% respectively for a temperature increase of 2-4°C, therefore it is very important that the existing biological material is studied and improved regarding high temperature and drought tolerance [17].

From the analysis of the rainfall recorded for 65 years, in the months of July and August (formation of the reproductive organs-filling of the grains), a significant variability of the amount can be observed, a value that has an overall upward trend, due to the large amounts of precipitation that fell in 24 hours and not of uniformity and distribution throughout the month (Figs. 3, 4).

Some studies [6] missed that the amount of rainfall from April to August affects maize production more than nitrogen fertilizer. Significant decreases in maize production are recorded if water is missing during the critical period between the first and second week before heading and milk-wax maturity, a period when maize has the highest water consumption, represented 50% of the entire consumption during the vegetation period [14].

Table 5. Number of days and sum of useful thermal degrees (Σº≥10ºC) from sowing to panicle emergence

Sowing season	Hybrid	2020		2021		2022	
		No.days	Σº≥10ºC	No.days	Σº≥10ºC	No.days	Σº≥10ºC
Ss 1	Turda 248	92	466.8	88	522.5	80	580.5
	Turda 165	91	455.2	87	507.8	78	549.6
	Turda 201	93	476.0	88	522.5	81	595.7
	Turda Star	95	501.1	91	566.0	81	595.7
	Turda 332	99	538.2	94	610.7	85	648.3
	Turda 344	98	525.4	94	610.7	84	637.8
	Turda 335	102	566.4	95	625.3	86	659.6
	Average	96	504.2	91	566.5	82	609.6
Ss 2	Turda 248	87	504.6	78	517.1	66	593.0
	Turda 165	88	514.3	77	502.4	63	560.5
	Turda 201	88	514.3	78	517.1	65	581.8
	Turda Star	93	562.3	81	560.6	66	593.0
	Turda 332	97	595.7	84	605.3	70	631.2
	Turda 344	96	589.1	83	589.1	69	624.0
	Turda 335	97	595.7	85	619.9	71	641.6
	Average	92	553.7	81	558.8	67	603.6
Ss 3	Turda 248	81	534.4	72	618.6	65	672.7
	Turda 165	81	534.4	70	590.2	60	609.7
	Turda 201	81	534.4	70	590.2	61	623.2
	Turda Star	85	566.3	74	648.5	62	633.5
	Turda 332	88	588.6	75	657.1	68	725.1
	Turda 344	88	588.6	74	648.5	66	689.6
	Turda 335	91	616.5	76	664.5	68	725.1
	Average	85	566.2	73	631.1	64	668.4

Ss 1 – sowing season 1; Ss 2 – Sowing season 2; Ss 3 – Sowing season 3.

An analysis of temperatures over 10 years shows that in the last 2 years (2021, 2022) heatwave temperatures as well as those that define the scorching phenomenon, temperatures harmful to corn production, were recorded in large numbers, in the months of June and July, months when maize has average temperature requirements of up to 23ºC [5], very high temperatures having a negative effect on physiological processes and on production formation.

An analysis of temperatures over 10 years shows that in the last 2 years (2021, 2022) heatwave temperatures as well as those that define the scorching phenomenon, temperatures harmful to corn production, were recorded in large numbers, in the months of June and July, months when maize has average temperature requirements of up to 23ºC [5], very high temperatures having a negative effect on physiological processes and on production formation(Table 6).

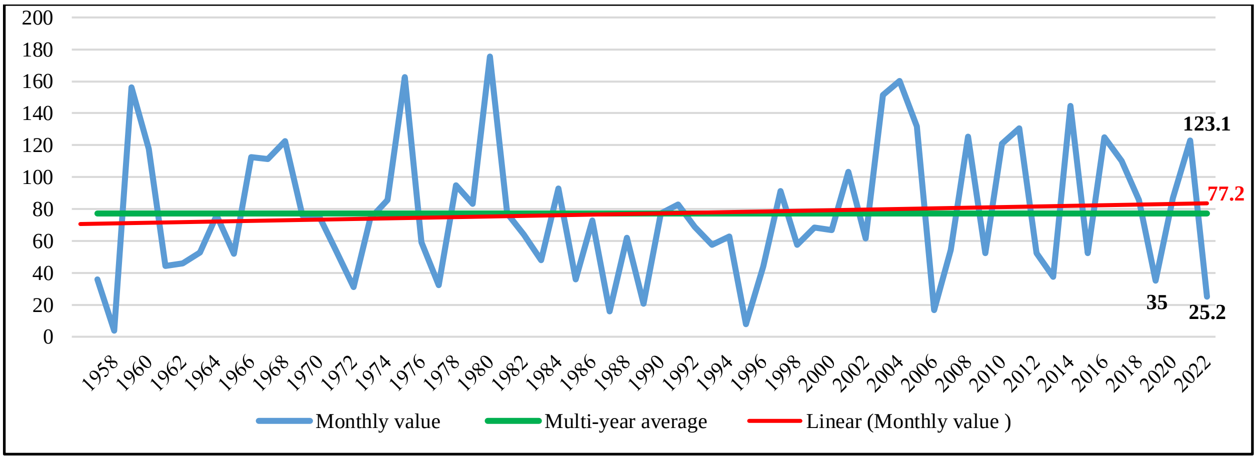

Figure 3. Sum of monthly and multiannual precipitation for July (mm)

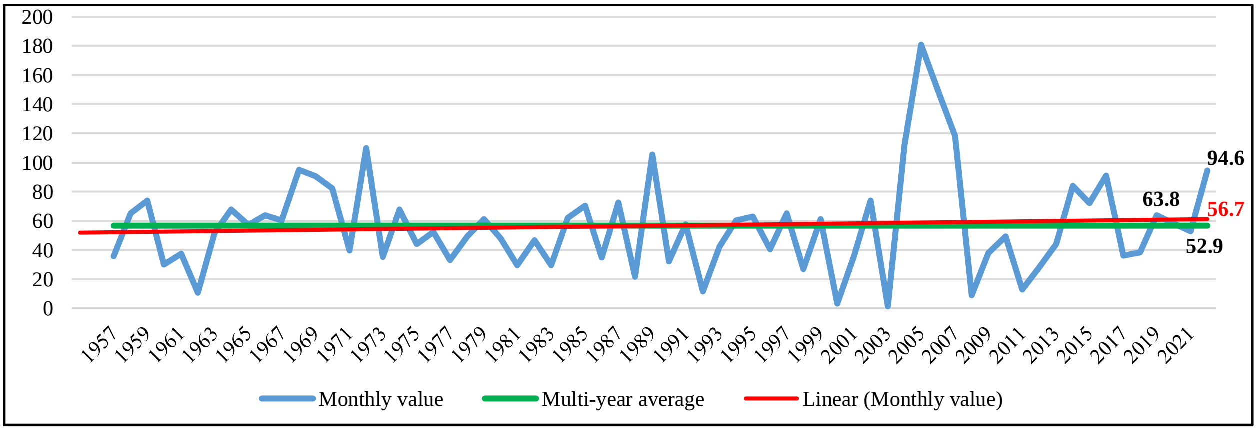

Figure 4. Sum of monthly and multiannual precipitation for August (mm)

The number of days between sowing and physiological maturity had the same trend as in for emergence and the appearance of the spike, except for the year 2022, when during the period of the formation of the generative organs, for the third sowing season, a significant amount of rainfall was recorded which led to the extension of the vegetation period of the 7 hybrids, compared to the two early sowing seasons, which experienced high temperatures and prolonged atmospheric drought during the period of production formation (Table 7).

In order to obtain high production results, maize has certain requirements regarding environmental factors but also regarding applied technology, as Scarsbrook and Doss (1972) also states, corn yield is a function of several plant and environmental factors that they are often interrelated [15].

From the research carried out in our study, all the hybrids analyzed, except for the hybrid Turda 201, in the first sowing season, recorded negative differences in production, statistically assured from distinctly significant to very significant. In the second sowing season, it was noted that in the year 2020, the hybrids Turda 248, Turda Star, Turda 332 and Turda 344 registered positive statistically assured differences, and the other three hybrids had statistically uninsured or negative differences.

In the year 2021, in the second sowing season, there were statistically assured increases, compared to the third sowing season, only for the hybrids Turda 165, Turda 201 and Turda 344, and for the other hybrids the differences were not statistically assured. In the year 2022, for five hybrids sown in the second sowing season, statistically assured production differences were recorded, at negative thresholds statistically assured, and for the other two hybrids in the experiment, the differences were not statistically assured (Table 8).

Table 6. The number of scorching heat and hot days recorded in Turda in recent years (2013-2022)

Year	No. of scorching heat days (T_{max} ≥32°C)		No. of heat days (T_{max} ≥35°C)	
	June	July	June	July
2013	1	2	0	1
2014	0	0	0	0
2015	1	7	0	0
2016	1	2	0	0
2017	1	2	0	0
2018	0	0	0	0
2019	3	3	0	0
2020	0	0	0	0
2021	3	11	0	0
2022	5	16	1	6

Table 7. The number of days and the sum of useful thermal degrees (Σº≥10ºC) from sowing to physiological maturity

Sowing season	Hybrid	2020		2021		2022	
		No. days	Σº≥10ºC	No. days	Σº≥10ºC	No.days	Σº≥10ºC
Ss 1	Turda 248	156	1143.7	152	1187.9	123	1129.5
	Turda 165	154	1126.1	152	1187.9	125	1152.9
	Turda 201	155	1134.6	152	1187.9	125	1152.9
	Turda Star	157	1153.3	152	1187.9	125	1152.9
	Turda 332	160	1182.5	161	1258.7	133	1251.6
	Turda 344	160	1182.5	161	1258.7	135	1278.3
	Turda 335	161	1191.0	161	1258.7	134	1235.6
	Average	158	1159.1	156	1218.2	129	1193.4
Ss 2	Turda 248	151	1179.9	147	1226.1	125	1331.9
	Turda 165	151	1179.9	148	1235.6	130	1367.6
	Turda 201	151	1179.9	148	1235.6	131	1375.7
	Turda Star	151	1179.9	149	1244.3	132	1382.7
	Turda 332	152	1189	150	1249.7	132	1382.7
	Turda 344	155	1222.3	148	1235.6	134	1390.9
	Turda 335	156	1234.1	146	1217.0	136	1404.9
	Average	152	1195.00	148	1234.8	131	1376.6
Ss 3	Turda 248	149	1248.4	132	1196.4	122	1315.6
	Turda 165	149	1248.4	132	1196.4	125	1329.7
	Turda 201	152	1265.4	135	1220.0	122	1315.6
	Turda Star	152	1265.4	136	1223.6	126	1329.7
	Turda 332	153	1272.9	138	1224.2	132	1331.7
	Turda 344	154	1281.4	141	1224.2	133	1335.8
	Turda 335	155	1296.5	142	1224.2	136	1346.4
	Average	152	1268.3	137	1215.6	128	1329.2

Ss 1 – sowing season 1; Ss 2 – Sowing season 2; Ss 3 – Sowing season 3.

Table 8. Influence of experimental factors on yield

The experimental variant	Yield	
	kg/ha	%
Ss 3 x 2020 x Turda 248 (C.v.)	9805^{mt}	100
Ss 2 x 2020 x Turda 248	11470***	117
Ss 3 x 2020 x Turda 165 (C.v.)	10667^{mt}	100
Ss 1 x 2020 x Turda 165	8697^{000}	82
Ss 3 x 2020 x Turda 201 (C.v.)	10162^{mt}	100
Ss 1 x 2020 x Turda 201	7941^{000}	78
Ss 2 x 2020 x Turda 201	9302^{000}	92
Ss 3 x 2020 x Turda Star (C.v.)	10186^{mt}	100
Ss 1 x 2020 x Turda Star	7948^{000}	78
Ss 2 x 2020 x Turda Star	11390***	112
Ss 3 x 2020 x Turda 332 (C.v.)	10164^{mt}	100
Ss 1 x 2020 x Turda 332	8950^{000}	89
Ss 2 x 2020 x Turda 332	10458*	104
Ss 3 x 2020 x Turda 344 (C.v.)	11404^{mt}	100
Ss 1 x 2020 x Turda 344	9863^{000}	87
Ss 2 x 2020 x Turda 344	12638***	111
Ss 3 x 2020 x Turda 335 (C.v.)	12505^{mt}	100
Ss 1 x 2020 x Turda 335	10596^{000}	85
Ss 3 x 2021 x Turda 248 (C.v.)	11532^{mt}	100
Ss 1 x 2021 x Turda 248	10343^{000}	90
Ss 3 x 2021 x Turda 165 (C.v.)	7678^{mt}	100
Ss 1 x 2021 x Turda 165	7234^{00}	94
Ss 2 x 2021 x Turda 165	8133**	106
Ss 3 x 2021 x Turda 201 (C.v.)	7803^{mt}	100
Ss 1 x 2021 x Turda 201	8251**	106
Ss 3 x 2021 x Turda Star (C.v.)	8904^{mt}	100
Ss 1 x 2021 x Turda Star	8569^{0}	96
Ss 3 x 2021 x Turda 332 (C.v.)	11247^{mt}	100
Ss 1 x 2021 x Turda 332	9537^{000}	85
Ss 3 x 2021 x Turda 344 (C.v.)	9990^{mt}	100
Ss 1 x 2021 x Turda 344	9531^{00}	95
Ss 2 x 2021 x Turda 344	10494**	105
Ss 3 x 2021 x Turda 335 (C.v.)	11365^{mt}	100
Ss 1 x 2021 x Turda 335	7378^{000}	65
Ss 2 x 2021 x Turda 335	10597^{000}	93
Ss 3 x 2022 x Turda 248 (C.v.)	7769^{mt}	100
Ss 1 x 2022 x Turda 248	6651^{000}	86
Ss 2 x 2022 x Turda 248	6831^{000}	88
Ss 3 x 2022 x Turda 165 (C.v.)	6781^{mt}	100
Ss 1 x 2022 x Turda 165	5354^{000}	79
Ss 2 x 2022 x Turda 165	5598^{000}	83
Ss 3 x 2022 x Turda 201 (C.v.)	6762^{mt}	100
Ss 1 x 2022 x Turda 201	5214^{000}	77
Ss 2 x 2022 x Turda 201	5791^{000}	86

Ss 1 – sowing season 1; Ss 2 – Sowing season 2; Ss 3 – Sowing season 3.

Table 8. Influence of experimental factors on yield – continued

The experimental variant	**Yield**	
	kg/ha	**%**
Ss 3 x 2022 x Turda Star (C.v.)	7182^{mt}	100
Ss 1 x 2022 x Turda Star	5408^{000}	75
Ss 3 x 2022 x Turda 332 (C.v.)	7756^{mt}	100
Ss 2 x 2022 x Turda 332	7259^{00}	94
Ss 3 x 2022 x Turda 344 (C.v.)	8507^{mt}	100
Ss 1 x 2022 x Turda 344	6219^{000}	73
Ss 2 x 2022 x Turda 344	8088^{0}	95
Ss 3 x 2022 x Turda 335 (C.v.))	8305^{mt}	100
Ss 1 x 2022 x Turda 335	6954^{000}	84
LSD (p 5%) 332	LSD (p 1%) 442	LSD (p 0.1%) 575

Ss 1 – sowing season 1; Ss 2 – Sowing season 2; Ss 3 – Sowing season 3.

The results obtained in the three years show that hybrids with a longer vegetation period had significantly higher yields than hybrids with a shorter vegetation period. In similar studies, [2] reported that early sowing resulted in higher yields of late maturing hybrids than early or mid-maturing hybrids.

4. Conclusions

In addition to the technological factors that could positively influence drought resistance, the genetics used have a significant role in reducing crop losses due to this phenomenon, which has recently increased in frequency.

The obtained results reveal the fact that early sowing in the specific conditions of the Transylvanian Plateau, even if it manages to avoid the negative impact of stress factors during the growing season, does not increase production.

Obtaining quantitatively and qualitatively stable harvests categorically depends on the climatic conditions and the adaptation of the technological links to these changes, therefore, it can be said that observing the sowing season is an important link in obtaining high corn productions in the Transylvanian Plateau.

References

[1] Assefa Y., K. L. Roozeboom, S.A. Staggenborg, J. Du, 2012, Dryland and irrigated corn yield with climate, management, and hybrid changes from 1939 through 2009, Agron. J. 104, 473–482.

[2] Baum M.E., S.V. Archontoulis; M.A. Licht, 2018, Planting date, hybrid maturity, and weather effects on maize yield and crop stage, Agron. J., 111, 303–313.

[3] Bollero G.A., D.G. Bullock, S.E. Hollinger, 1996, Soil temperature and planting date effects on corn yield, leaf area, and plant development, Agronomy Journal, 88, 385-390.

[4] Cristea, M., 2004, Fiziologia porumbului. Porumbul-Studiu monografic, Vol I, Ed. Academiei Române.

[5] Dincă D., T. Moscalu, 1967, Cultura Porumbului. Editura Agro-Silvica, București, Romania.

[6] Halmajan H.V., B. Sitaru, S. Dosinescu, E. Surca, I. Petre, 2017, Maize yield evolution in Romania and farmers ‘involvement to increase it. Scientific Papers-Series A, Agronomy 60, 270-274.

[7] Iqbal H., C. Yaning, M. Waqas, Z. Ahmed, S. Raza, M. Shareef, 2020, Improving heat stress tolerance in late planted spring maize by using different exogenous elicitors, Chilean Journal of Agricultural Research 80, 30-40.

[8] Kucharik C.J., 2008, Contribution of planting date trends to increased maize yields in the central United States, Agronomy Journal, 100, 328-336.

[9] Lehenbauer P. A., 1914, Growth of maize seedling in relation to temperature, Physiol. Res., 1, 247-288.

[10] Popescu A, 2018, Maize and Wheat-Top Agricultural Products Produced, Exported and Imported by Romania, Sci. Pap. Ser. Manag. Econ. Eng. Agric. Rural Dev., 18, 339–352.

[11] Popovici G., 1959, Influența regimului diferit de apă pe faze de vegetație la porumb, Comunicările Academiei R.P.R., IX, 40-45.

[12] Rao Prasada, 2008, G.S.L.H.V. Agricultural Meteriology. Prentice-Hall of India Private Limited, New Delhi, 110 001.

[13] Salontai A., L.S. Muntean, 1982, Curs de Fitotehnie, Tipo Agronomia, Cluj-Napoca.

[14] Săulescu N., L. Pop, T. Popa, 1971, Agrotehnică și Fitotehnie, Editura Didactică și Pedagogică București.

[15] Scarsbrook, C. E., B. D. Doss, 1972, Leaf area index and radiation as related to com yield, Agronomy Journal, 65, 459-461.

[16] Sowunmi F.A., J.O. Akintola, 2010, Effect of Climatic Variability on Maize Production in Nigeria. Research Journal of Environmental and Earth Sciences. 2(1), 19-30.

[17] Tigchelaar M., D.S. Battisti; R.L. Naylor, D.K. Ray, 2018, Future warming increases probability of globally synchronized maize production shocks. Proceedings of the National Academy of Sciences, 115(26), 6644-6649.

[18] White J., J. Millner, D. Moot, 1990, Cereals. In: New Zealand Pasture and Crop Science (J. White and J. Hodgson eds.), Oxford University Press, Auckland, 213- 234.

[19] Wilson D.R., R.C. Muchow, C.J. Murgatroyd, 1995, Model analysis of temperature and radiation limitations to maize potential productivity in a cool climate, Field Crops Research 43, 1-18.

[20] ANOVA, 2015, PoliFact and Duncan's test pc program for variant analyses made for completely randomized polifactorial experiences, USAMV Cluj-Napoca, Romania.

[21] Stația Meteo Turda.