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THE MAIZE AND SUNFLOWER CROPS, STUDIED IN CENTRAL MOLDAVIA AREA, IN DIFFERENT CLIMATIC CONDITIONS

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Abstract

The breeding activity for obtaining maize and sunflower hybrids, having high genetic potential for the grain yield, also good stability, in different environment conditions is of great importance for the management of these crops. The yield potential brings the highest contribution to the crop efficiency. To increase the grain yield it is necessary to have a good developing of the plants in different growing conditions, respectively the plants need to have favourable growing conditions to express their yielding potential. The objective of the present paper is to present the results obtained at 4 maize and 4 sunflower hybrids studied in the field conditions of the Central Moldavia (East Romania), during three years (2018, 2019 and 2020). It was intended to find out the influence of climatic conditions on the grain yield of the studied hybrids, but also on the oil and protein content of the grains. Comparing the three years, regarding the air temperatures and the amount of rainfall in the growth period of the two crops (maize and sunflower), the year 2018 was dryer comparing with 2019 year, and the 2020 year was the driest from all three at the beginning of the growing period despite the fact that later there were registered important rainfall. The studding of genotypes under different climatic conditions allows to identify the genotypes with good adaptation capacity. The grain yields of the maize and sunflower hybrids were influenced significantly by year, respectively by the climatic conditions of the year. The protein content in the maize hybrids and the oil content both for maize and sunflower hybrids are much more stable than the grain yield in different growing conditions.

Key words*: maize; sunflower; yield; oil content; protein content.*

INTRODUCTION

Maize (*Zea mays* L.) is among the most important crop worldwide, and it can be considered a reference crop for the benefits of different management patterns characterized by different degrees of intensification.

Romania plays an important role in the international maize market, being in full ascendency in terms of production and export (Popescu et al., 2018).

So, the breeding activity for obtaining maize hybrids having high genetic potential for the grain yield, but also with a very good stability, in different environmental conditions is of a great importance for the management of this crop (Iordan et al., 2016). To increase the grain yield it is necessary to have a good developing of the plants in different conditions of growing, good tolerance to biotic and abiotic stress, adaptability to the cultivation technology (Cristea et al., 2004; Horhocea et al., 2020).

Very important are the local biotic factors, which can produce high seed yield losses (Bărbulescu, 2000).

Sunflower (*Helianthus annuus* L.) crop has an important place in the world agriculture, due to many advantages, the most important being the

capacity to produce high seed yield and good oil content (Anton et al., 2015).
Sunflower grains are used in industry for obtaining good oil for human consumption, as well as the secondary matter used in animal feeding (Vrânceanu, 2000).
Sunflower oil has a very good quality, with high percent of the unsaturated acids and capacity to maintain stability and long-time conservation (Skoric et al., 2012).
The open pollinated varieties, with oil contents up to 50%, are well recognised as the main genetic base of modern sunflower breeding (Vear, 2016).
In the practical selection, which is part of the production of hybrids with high yielding potential, as well as high adaptive potential, a strong influence belongs to the adaptive reactions to the ecological environment they are located (Hera et al., 1989).
The achievements related to the sunflower hybrids in terms of number and performances are excellent (Pacureanu-Joita et al., 2007).
Weed and Orobanche control with HT-tolerant sunflowers offers an excellent opportunity to increase sunflower yield in different countries (Kaya, 2015).
The objective of the present paper is to present the results obtained at 4 maize and 4 sunflower hybrids studied in the field conditions of the Central Moldavia (East Romania), during three years (2018, 2019 and 2020).

MATERIALS AND METHODS

We studied 4 maize and 4 sunflower hybrids cultivated in 3 years, at the Agro Tora society, in Negresti, Vaslui county, eastern Romania.
Negreşti is situated in central Moldavia, being characterized by cambic chernozem soil, well supplied with potassium and mid supplied with phosphorus and nitrogen.
The climate is characterized by an annual average of 9.5ºC and 420 mm rainfall.
The maize hybrids which have been cultivated and studied are: P 9911, Olt, P 9241 and F 423.
The studied sunflower hybrids are: PR64LE99, FD15E27, PR64LE25, and Neoma.
The climatic conditions were very different, from year to year in terms of temperatures and rainfall. We made our study in 2018, 2019 and 2020 years.
The sowing was performed in all studied years and both for maize and sunflower in the first decade of April. The hybrids were cultivated in the farming system. The plants density was 65,000 plants/hectares for maize and 55,000 plants/hectares, for sunflower.
Both for maize and sunflower hybrids, before sowing there was applied the herbicide Dual Gold 960 EC (960 g/l S-metolaclor) in a rate of 1.5 l/ha. In vegetation, the weed control (dicotyledonous and monocotyledonous) in the maize plots was performed by applying the herbicide Adengo 465 SC (isoxaflutol 225 g/l + tiencarbazon-metil 90 g/l + ciprosulfamide (safener) 150 g/l) in a rate of 0.35 l/ha and in the 2 leaves growth stage, while in the sunflower plots the weed control (monocotyledonous) was performed by applying the herbicide Select Super (cletodim 120 g/l) in a rate of 2.0 l/ha and in the 6 leaves growth stage.
Also both for maize and sunflower hybrids, before seed bed preparation there were applied 70 kg of nitrogen/ha and 70 kg of P_2O_5/ha as complex fertilizer 20:20:0. For maize, it was applied supplementary in the 6 leaves growth stage 34 kg of nitrogen/ha as ammonium nitrate.
There have been determined, for the studied hybrids, the grain yield, the oil content and the protein content of the grains.

RESULTS AND DISCUSSIONS

In the three years the climatic conditions were different in Negresti location. The highest air temperature was registered in 2020 year followed by 2018 year (Figure 1).
The rainfall registered in 2019 year were moderate in all vegetation period of maize and sunflower, comparing with 2018 when the most quantity was registered in June-July (Figure 2).
In 2020 year it was registered a small rainfall in the first period of vegetation of the studied crops (maize and sunflower), having influenced the amount of the grain yields, despite the fact that later in the vegetation period there were registered important rainfall.

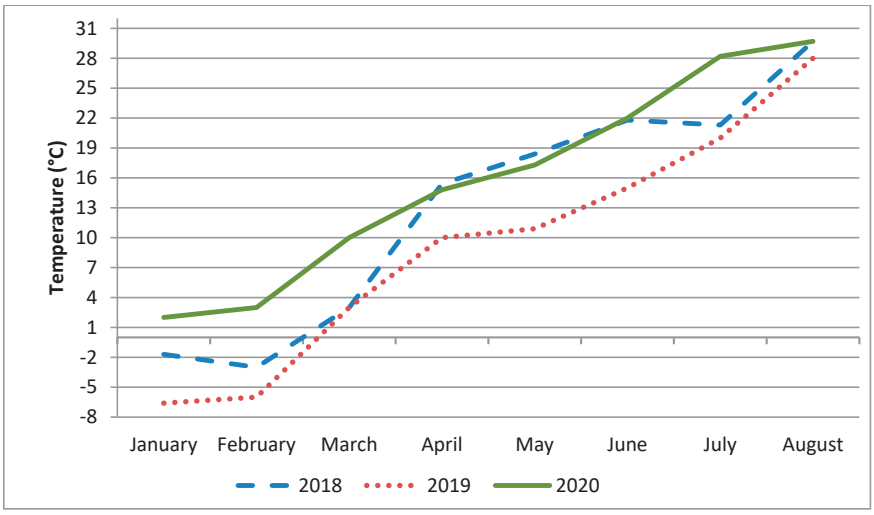

Figure 1. The average of monthly air temperature in three years, Negresti

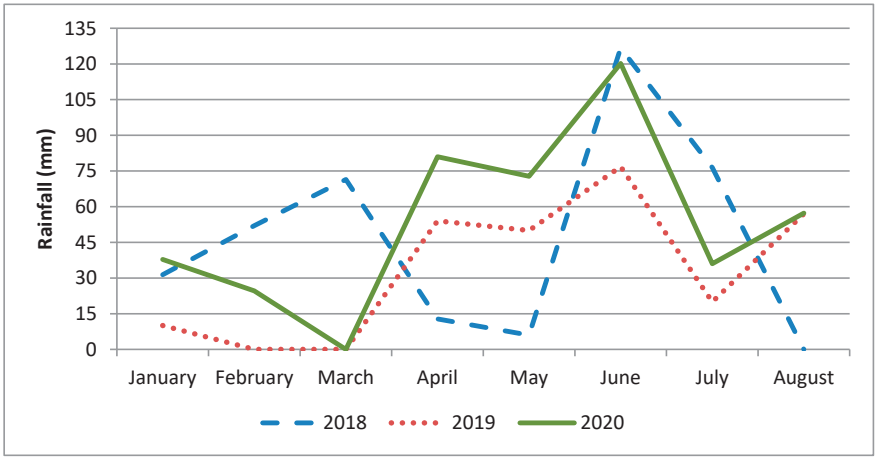

Figure 2. Monthly rainfall in three years, Negresti

Grain Yield

Looking at the average yield of the maize studied genotypes, there are obviously differences in the three years (2018, 2019 and 2020) (Table 1). That means the year had significant effect on the grain yield level.

In the year 2019, for all maize hybrids there were registered the highest yields. The hybrids P 9911, Olt, and P 9241 recorded greater yield variability, the variation coefficient being higher than 17%. The highest yield stability was registered at hybrid F 423 (coefficient of variation less than 10%, respectively of 8.32%), but this hybrid being characterised by the smallest yield obtained in all three years.

In Table 2, there is presented the grain yield for sunflower hybrids, in the three years. The genotypes FD15E27 and Neoma have the best stability (the variation coefficient less than 15%, respectively 12.84% for FD15E27 hybrid and 13.38% for Neoma hybrid). The hybrids PR64LE99 registered the highest variability (coefficient of variation of 18.95%). As in the case of maize, the highest grain yields were registered in the climatic conditions of the year 2019, and the smallest grain yields ere registered in the year 2020.

Table 1. The grain yield (kg/ha) and maize hybrids stability (%)

No.	Genotype	Yield (kg/ha)			Average	C.V. (%)
		2018	2019	2020	2018-2020	
1.	P 9911	10340	12630	8340	10436	21.38
2.	Olt	10254	11945	8735	10312	17.24
3.	P 9241	9785	11200	7650	9545	18.45
4.	F 423	8058	9890	6580	8176	8.32
Average		9610	11416	7826	9617	16.84

Table 2. The seed yield (kg/ha) and sunflower hybrids stability (%)

No.	Genotype	Yield (kg/ha)			Average	C.V. (%)
		2018	2019	2020	2018-2020	
1.	PR64LE99	2890	3340	2050	2760	18.95
2.	FD15E27	3145	3860	2985	3330	12.84
3.	PR64LE25	3230	3895	2780	3300	15.76
4.	Neoma	2985	3650	2550	3060	13.38
Average		3062	3685	2590	3112	15.23

Table 3. The protein content (%) and maize hybrids stability (%)

No.	Genotype	Protein content (%)			Average	C.V. (%)
		2018	2019	2020	2018-2020	
1.	P 9911	11.7	11.9	11.0	11.5	1.82
2.	Olt	11.6	11.3	11.3	11.4	0.54
3.	P 9241	12.0	12.4	11.3	11.9	0.76
4.	F 423	11.2	11.8	11.0	11.3	0.89
Average		11.6	11.8	11.1	11.5	1.00

Table 4. The oil content (%) and maize hybrids stability (%)

No.	Genotype	Oil content (%)			Average	C.V. (%)
		2018	2019	2020	2018-2020	
1.	P 9911	5.1	5.6	5.8	5.5	0.94
2.	Olt	5.9	5.8	6.2	5.9	1.28
3.	P 9241	5.7	5.0	5.4	5.3	0.79
4.	F 423	4.9	5.2	5.0	5.0	0.68
Average		5.4	5.4	5.6	5.4	0.92

Table 5. The oil content (%) and sunflower hybrids stability (%)

No.	Genotype	Oil content (%)			Average	C.V. (%)
		2018	2019	2020	2018-2020	
1.	PR64LE99	49.7	48.4	49.8	49.3	1.67
2.	FD15E27	50.3	49.7	51.4	50.4	2.45
3.	PR64LE25	50.8	50.0	51.9	50.9	1.88
4.	Neoma	51.2	49.8	50.8	50.6	2.21
Average		50.5	49.4	50.9	50.3	2.05

Protein content

The protein content for the studied maize hybrids in the three years varied between 11.0 and 12.4%, and the average protein content for all the maize hybrids in all the studied years was of 11.5% (Table 3).

The highest protein content was registered in the year 2019, when it was also registered the highest grain yields.

Compared to the grain yield, the protein content was much more stable, the coefficient of variation being more than 1% only for one hybrid, respectively P9911 hybrid with a value of 1.82%. The highest stability for the protein content was registered for the Olt hybrid (coefficient of variation of 0.54%).

Oil content

The oil content for the studied maize hybrids in the three years varied between 4.9 and 6.2%, and the average oil content for all the maize hybrids in all the studied years was of 5.4% (Table 4).

The highest oil content was registered in the year 2020, when it was registered the smallest grain yields, which was on the contrary to the protein content.

As in the case of the protein content, the coefficient of variation was more than 1% only for one hybrid, respectively Olt hybrid with a value of 1.28%, this hybrid having the highest variability for oil content but the highest stability for the protein content.

The oil content for the studied sunflower hybrids in the three years varied between 48.4 and 51.9%, and the average oil content for all the sunflower hybrids in all the studied years was of 50.3% (Table 5).

As in the case of maize, the highest oil content of the sunflower hybrids was registered in the year 2020 (50.9% in average), when it was registered the smallest grain yields.

In average for the three years, the oil content was less than 50% only for one hybrid (49.3% for PR64LE99 hybrid).

The coefficient of variation registered higher values for the oil content of the sunflower hybrids compared to the maize hybrids. Thus, whether in the case of maize only one hybrid registered a value higher than 1%, in the case of sunflower hybrids the coefficient of variation registered values between 1.67 and 2.45%.

CONCLUSIONS

On the bases of the obtained results, the following conclusions can be drawing:

- The grain yields of the maize and sunflower hybrids were influenced by year, respectively by the climatic conditions of the year. The most favourable year was 2019, when the average yields was of 11,416 kg/ha for maize hybrids and 3,685 kg/ha for sunflower hybrids.
- The studding of genotypes under different climatic conditions allows to identify the genotypes with good adaptation capacity.
- The most suitable genotype for the grain yield for the studied area was P 9911 maize hybrid and FD15E27 sunflower hybrid.
- The most favourable maize genotype for the protein content in the studied area was P 9241 hybrid, while for the oil content was the Olt hybrid.
- The most favourable sunflower genotype for the oil content in the studied area was PR64LE25 hybrid.
- Compared to the grain yield, the protein content in the maize hybrids and the oil content both for maize and sunflower hybrids registered much more stable values.

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