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SUNFLOWER HYBRIDS WITH HIGH GENETIC POTENTIAL FOR THE SEED YIELD, IN DIFFERENT ENVIRONMENTAL CONDITIONS

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ABSTRACT

Sunflower breeders, working for a model of sunflower, must know the main characteristics of the environment for which they are developing the hybrids, starting from soil type, potential growing season length, mean, minimum and maximum temperatures (per month) and the amount and distribution of rainfall, during the year.

The creation of hybrids with high potential of productivity, must take into consideration the high adaptive potential to the ecological environment.

We studied a set of 18 sunflower hybrids, in two years (2018 and 2109), in four locations, situated in different areas of Romania: Cogealac (south Romania), Şimleu Silvaniei (western Romania), Negreşti (eastern Romania) and Mircea Vodă (south-eastern Romania). The hybrids were cultivated in two randomized replications.

Comparing the two years, 2018 and 2019, regarding the air temperature and the amount of rainfall, in sunflower vegetation period, year 2018 was generally dryer, compared with 2019.

Results showed that the seed yield for the eighteen hybrids was different by year and by location. In 2018 the difference between locations was not so high compared with 2019. The highest seed yield in 2019 was obtained by almost all hybrids, in two locations (Negreşti and Mircea Vodă). The lowest seed yield was obtained by all hybrids in Cogealac location, due to drought and also to the high infestation with broomrape parasite.

Keywords: sunflower, genetic potential, environmental conditions, hybrids, seed yield.

INTRODUCTION

Sunflower 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.

Sunflower kernels 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).

After the first sunflower hybrids with high oil content were created (Vrânceanu, 2000), area cultivated with sunflower crop increased over the world, including Romania.

Sunflower crop is important as well as, for agriculture technology purpose, by contributing to a good crop rotation (Sin et al., 2002).

For obtaining good commercial sunflower hybrids, the breeding work must be accelerated.

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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 (Skoric et al., 2012).

There is no ideal hybrid and it is difficult to work on breeding with many characteristics, so it is necessary to define which of them are most important.

Taking into consideration the climate changes in the last years, in all breeding programs from research institutes or private companies there is interest in obtaining sunflower hybrids with good resistance to dry conditions (Singh, 2000).

The pathogen *Plasmopara halstedii* which produces downy mildew and parasite *Orobanche cumana* produce losses in sunflower seed yield, breeding for resistance being very important for this crop (Virany et al., 2015; Joiţa-Păcureanu, 2018).

Sunflower hybrids created in the last years are well adapted to different conditions of soil and climate and have a good resistance to important diseases.

In this paper we are presenting the behavior of a sunflower hybrid set, created by NARDI Fundulea and several private seed companies, in different soil and climatic conditions in Romania, for two years.

MATERIAL AND METHODS

A set of 18 commercial sunflower hybrids, were studied during two years (2018 and 2109), in four locations, situated in different areas of Romania: Cogealac (south Romania), Şimleu Silvaniei (western Romania), Negreşti (eastern Romania) and Mircea Vodă (south-eastern Romania). Cogealac is placed in north-eastern side of Constanţa district, being characterized by chernozem soils, well supplied with potassium and mid supplied with nitrogen and phosphorus.

Mircea Vodă is situated in central western side of Brăila district, with chernozem soils, mid supplied with phosphorus and nitrogen.

Şimleu Silvaniei is placed in north-eastern Crişana region, in Sălaj district. The soils are clay type, well supplied with potassium, mid supplied with phosphorus and less supplied with nitrogen.

Negreşti is situated in central Moldavia, Vaslui district, being characterized by cambic chernozem soil, well supplied with potassium and mid supplied with phosphorus and nitrogen.

The hybrids were cultivated in two randomized replications. The sowing was done in rows at distance of 70 cm and 28 cm between plants/row. The plants density was 54,000-55,000 plants/hectare.

Herbicides were applied before emergence and fertilization was made with complex fertilizers (phosphorus and nitrogen).

All experiments were placed in non irrigation conditions.

Some characteristics which could have influence on the level of the seed yield of sunflower hybrids were studied.

RESULTS AND DISCUSSION

Comparing the two years, 2018 and 2019, regarding the air temperature, during sunflower vegetation period (Figure 1), at germination-emergence time, the highest temperatures were registered both years, at Negreşti and Şimleu Silvaniei, the lowest being at Mircea Vodă. In flowering-maturity period, the highest air temperature was registered at Negreşti and Cogealac, in both years. In 2018 year, the air temperature was highest at Negreşti, in both periods, compared with 2019.

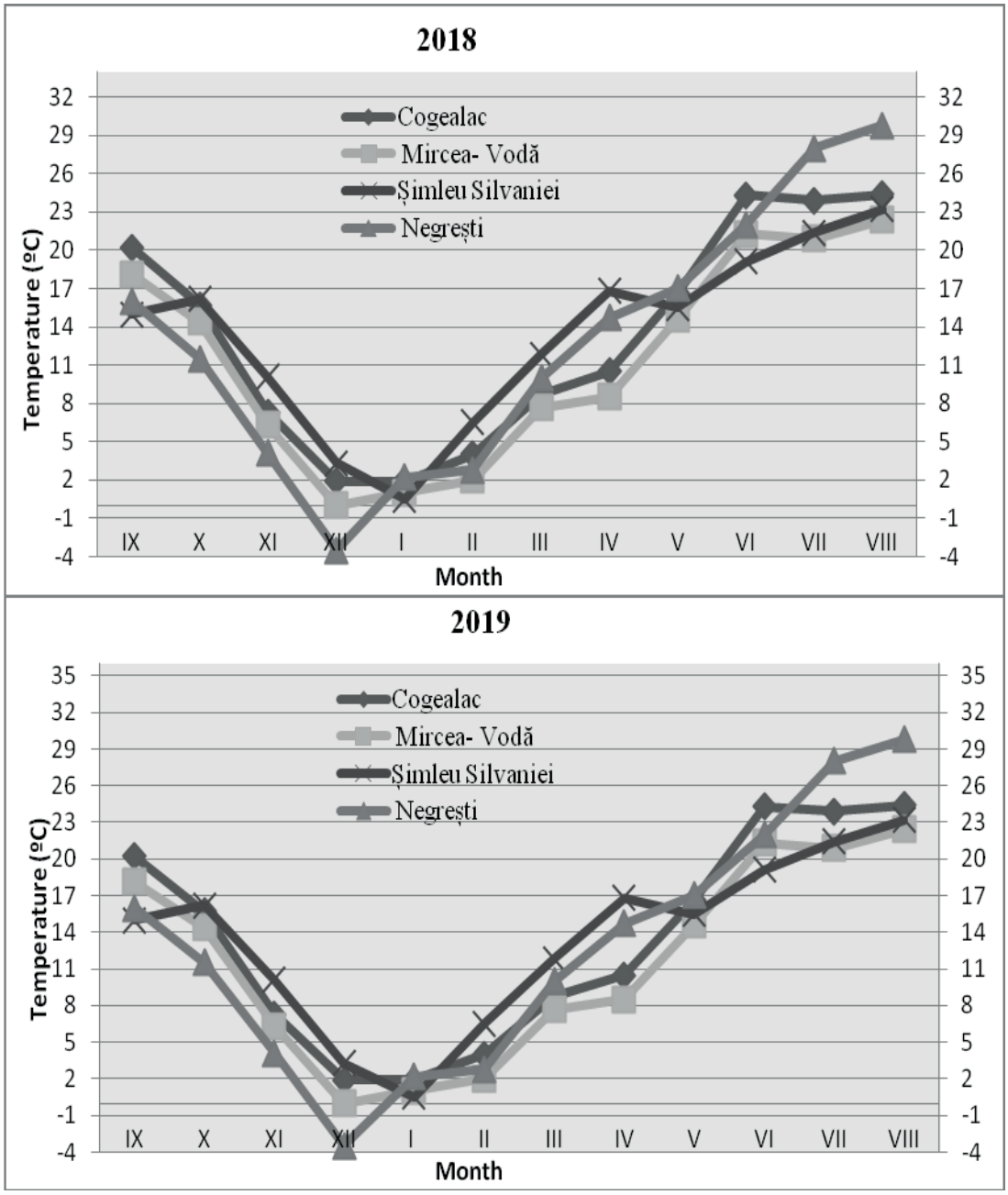

Figure 1. The average of monthly air temperature, in four locations and two years

Regarding the rainfall (Figure 2), in 2018 year, at Negreşti the situation was the best, as the water supply was good, for the emergence period, also quite good in flowering-maturity period. At Cogealac the situation was worse, taking into consideration the rainfall quantity in germination-emergence period. In 2019 year, the situation was quite different, taking into consideration the rainfall in period of emergence, this being higher in all locations, compared with 2018 year. In flowering-maturity period, the lowest rainfall was at Cogealac, this having a negative influence on the seed yield. The highest rainfall amount in this period was at Mircea Vodă.

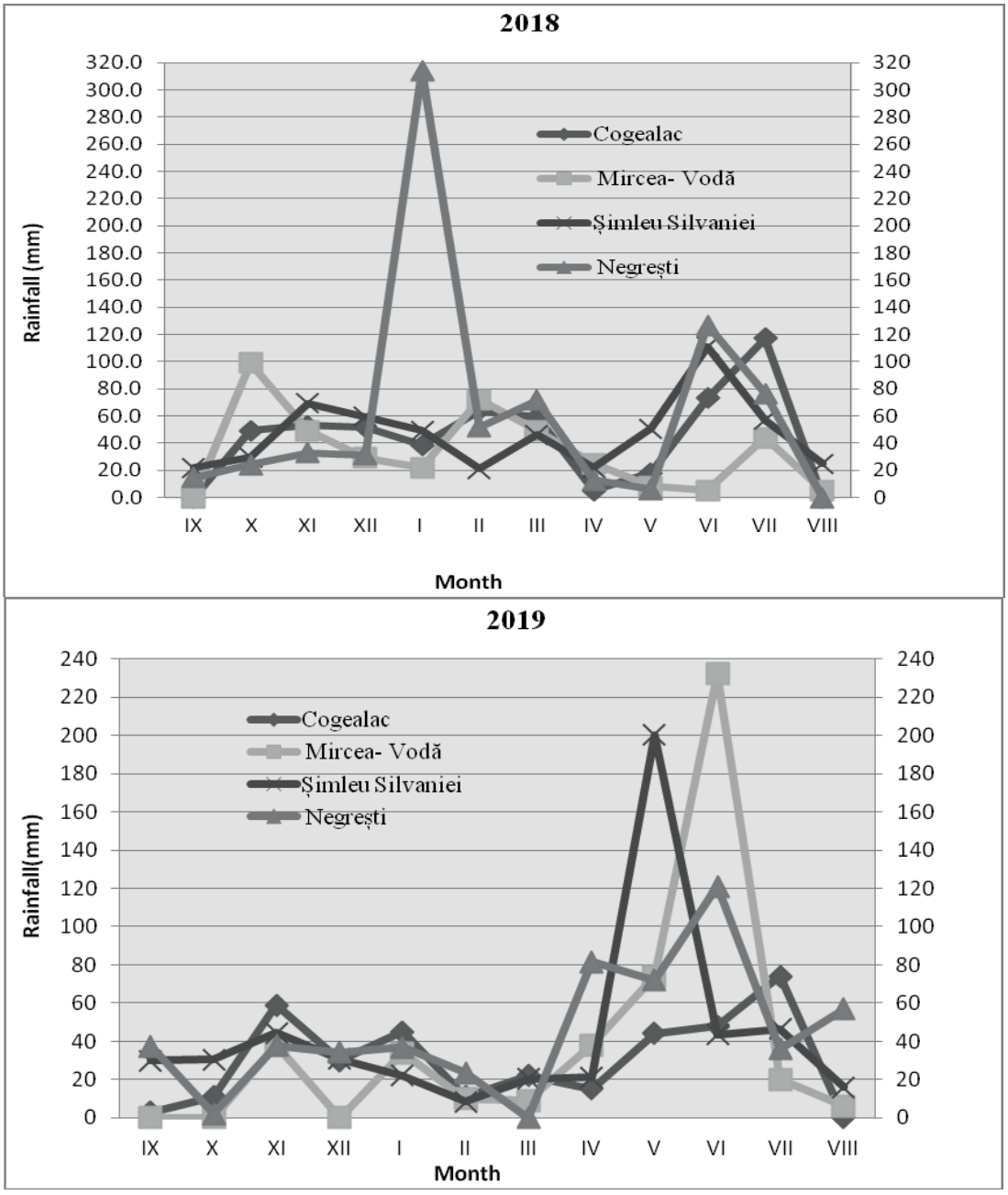

Figure 2. Monthly rainfall in four locations and two years

The seed yield of the studied hybrids was different by year and by location (Figure 3). In 2018, the difference between locations was not so high, compared with 2019. At Mircea Vodă, in both years the highest seed yield was obtained by almost all hybrids. The second location was Negreşti. The highest seed yields were registered in 2019, at these two locations. In 2019, the lowest seed yield for almost all hybrids was obtained in Cogealac. The seed yield of the hybrids in both years and four locations was not so different, all 18 hybrids producing a good seed yields and this means that all hybrids are good commercial hybrids.

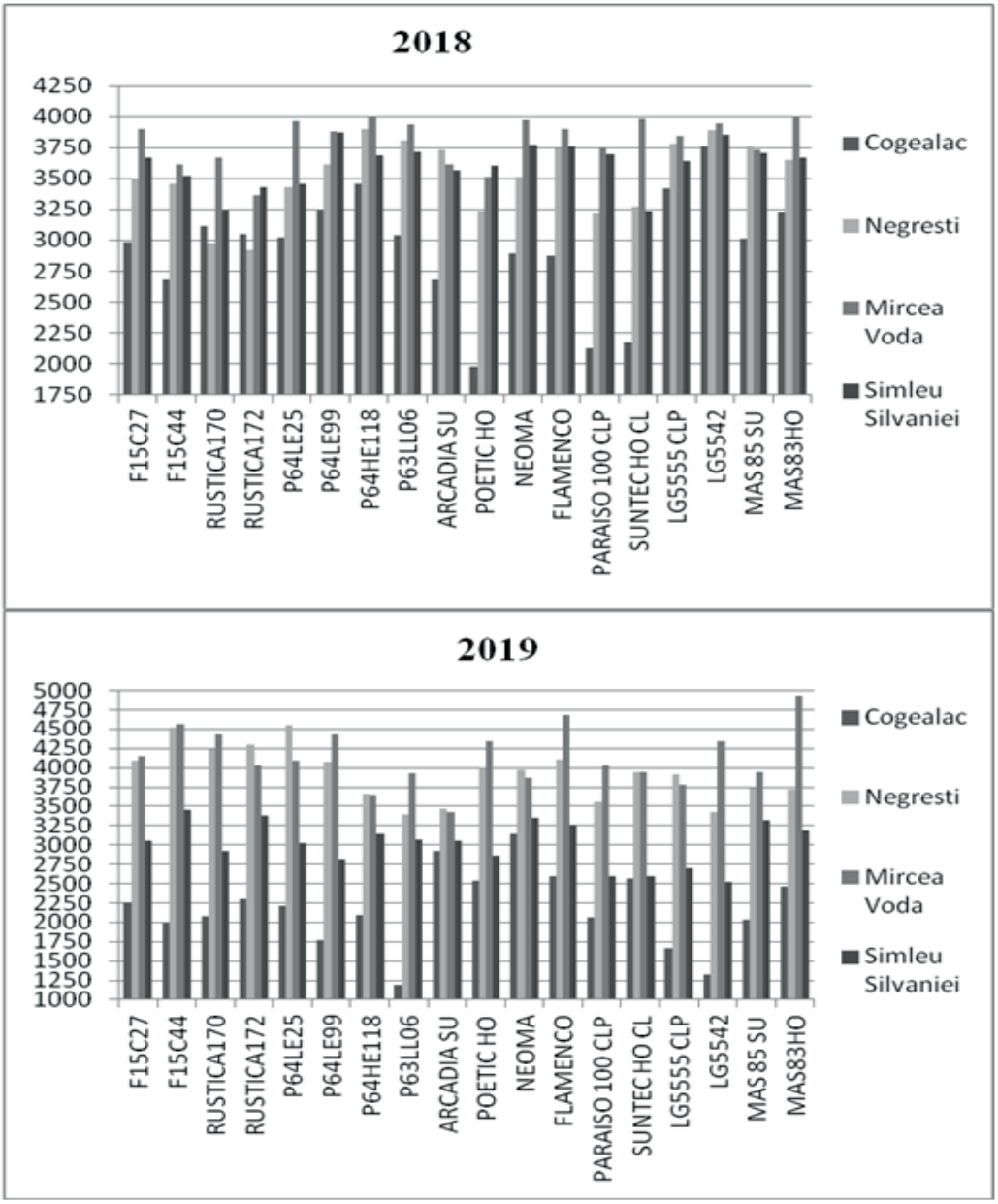

Figure 3. The seed yield of the studied hybrids, in four locations and two years

The analysis of variance, regarding the seed yield (Table 1) shows that the highest influence came from location, after that from year, the interaction location and year being very significant. The interaction between the hybrid and location or year was not significant.

Table 1. Analysis of variance for the seed yield

Source	Degrees of freedom	Sum of squares	Mean square	F Value
Replication	1	751844	751844	72.90
Factor A (year)	1	3415844	3415844	331.22**
Factor B (location)	3	72140589	24046862	2331.75***
AB	3	25900140	8633380	837.15***
Error	7	72189	10312	
Factor C (hybrid)	17	13452223	791307	158.65*
AC	17	5354678	314981	63.15
BC	51	15932404	312400	62.63
ABC	51	7108077	139374	27.94
Error	136	678326	4987	
Total	287	144806319		

The data presented in Table 2, show that the plant height was different, for all hybrids, by years and locations. At Negreşti and Mircea Vodă, in 2019, the plant height registered highest values, comparing with 2018. At Cogealac and Şimleu Silvaniei, the plant height was lower in 2019 than in 2018. In Cogealac and Şimleu Silvaniei, the highest values of the plant height were registered in 2018.

Table 2. The plant height of the studied hybrids, in 2018 and 2019, in four locations

No.	Hybrid	Location-year/plant height (cm)							
		Cogealac		Mircea Vodă		Negreşti		Şimleu Silvaniei	
		2018	2019	2018	2019	2018	2019	2018	2019
1	P63LL06	142	116	143	198	155	190	174	130
2	FLAMENCO	165	120	166	219	180	215	201	150
3	NK NEOMA	141	132	148	221	175	190	179	144
4	LG 5542	165	133	164	223	180	180	203	158
5	FD15C27	139	124	145	231	160	170	171	121
6	FD15C44	126	113	162	208	175	180	170	138
7	LG 5555 CLP	142	117	140	210	185	190	178	124
8	PARAISO1000	143	102	159	190	180	190	184	126
9	ARCADIA SU	167	157	170	227	185	215	180	155
10	P64LE25	154	149	173	212	170	220	192	148
11	P64LE99	156	145	168	210	165	210	195	142
12	MAS 85 SU	172	147	181	232	200	220	228	157
13	RUSTICA 172	159	144	165	211	170	205	192	137
14	RUSTICA 170	158	131	162	216	200	180	196	131
15	MAS 83 HO	183	142	188	212	220	220	215	148
16	SUNTEC HO CL	141	117	175	221	170	200	197	138
17	POETIC CLP	146	129	154	242	170	185	201	142
18	P64HE118	155	144	167	250	170	215	203	144
LSD 5%		5.7	11.4	12.9	9.3	14.6	7.5	8.6	7.7

Data regarding the head diameter for all hybrids, in two years and four locations are presented in Table 3. The highest difference of these values, in two years was registered at Cogealac. The main reason for this situation was the attack of the parasite broomrape (*Orobanche cumana*), which is very much present in this location. There are some hybrids (P63LL06, LG 5542, LG 5555 CLP), which registered very low values of the head diameter in this location, in 2019 compared with 2018. These hybrids produced very low seed yield in this year, at this location.

Table 3. The head diameter of the studied hybrids, in 2018 and 2019, in four locations

No.	Hybrid	Location/head diameter (cm)							
		Cogealac		Mircea Vodă		Negreşti		Şimleu Silvaniei	
		2018	2019	2018	2019	2018	2019	2018	2019
1	P63LL06	18	13	22	20	23	20	23	22
2	FLAMENCO	22	20	21	19	25	25	23	22
3	NK NEOMA	23	21	23	22	21	24	24	22
4	LG 5542	21	14	23	20	22	21	25	22
5	FD15C27	22	20	22	23	21	23	24	21
6	FD15C44	19	16	21	22	20	23	23	21
7	LG 5555 CLP	22	15	21	21	23	23	24	20
8	PARAISO1000	23	20	21	22	21	23	23	20
9	ARCADIA SU	22	21	19	19	22	23	22	19
10	P64LE25	22	19	20	20	21	23	22	22
11	P64LE99	19	18	22	23	23	24	24	22
12	MAS 85 SU	23	21	23	22	23	23	21	19
13	RUSTICA 172	21	20	19	24	20	22	20	22
14	RUSTICA 170	25	19	20	25	22	27	21	21
15	MAS 83 HO	23	21	23	25	23	22	23	21
16	SUNTEC HO CL	24	21	19	22	21	25	19	21
17	POETIC CLP	17	20	21	22	22	24	22	21
18	P64HE118	22	18	20	20	23	20	23	21
LSD 5%		4.3	7.6	3.8	3.2	2.9	3.1	2.6	3.6

Results regarding the attack degree of the parasite broomrape, at Cogealac in 2018 and 2019, are presented in Table 4. The data show that in 2019, the attack degree was much higher, than in 2018.

Some hybrids which had been resistant in 2018 lost their resistance in 2019. This situation had a high influence on the seed yield of the hybrids studied in this experiment.

Table 4. The attack degree of the broomrape (*Orobanche cumana*) parasite, at Cogealac, in two years

No.	Hybrid	Year/Attack degree (%)	
		2018	2019
1	P63LL06	2.9	7.7
2	FLAMENCO	3.2	5.9
3	NK NEOMA	5.7	9.6
4	LG 5542	0.0	1.8
5	FD15C27	1.9	5.2
6	FD15C44	6.8	10.7
7	LG 5555 CLP	0.8	4.6
8	PARAISO1000	8.6	25.7
9	ARCADIA SU	1.5	6.2
10	P64LE25	0.0	0.0
11	P64LE99	0.0	0.0
12	MAS 85 SU	1.9	7.2
13	RUSTICA 172	1.6	9.4
14	RUSTICA 170	4.9	13.6
15	MAS 83 HO	1.7	9.5
16	SUNTEC HO CL	9.6	14.8
17	POETIC CLP	10.4	18.2
18	P64HE118	0.9	12.7
LSD 5%		7.8	16.4

CONCLUSIONS

In the sunflower breeding programs from research institutes or from different seed companies, hybrids with high genetic potential for the seed yield are developed. For these hybrids, the reaction to different ecological environments is very important.

The tested sunflower hybrids proved a high genetic potential for the seed yield, in different soil and climatic conditions.

The height of the hybrids was different by years and by locations. For the head diameter, the highest influence came from the attack of the broomrape parasite.

Even if some of the new hybrids were resistant or tolerant to pathogens or parasite attack, increased virulence of these pests could determine lower seed yield in some locations.

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