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SUNFLOWER BREEDING FOR WELL DEVELOPING IN CONDITIONS OF THE CLIMATE CHANGE

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Abstract

There are many problems due to the climat changes, in the Romanian agriculture. The water deficit and high or low temperatures, reduce the yield level. The adaptability of sunflower to the environmental conditions, with the purpose to obtain hybrids with high seed yield stability, in all ecological cultivated areas involves a good resistance to drought and low temperatures, specially in germination time.
In our research work we have used different sources from our sunflower germplasm collection.
Some of our best elite lines have been introduced in a process of improvement of resistance to drought. Each generation of selection was planted in drought natural conditions (missing water in soil and high air temperature). All generations of selection were tested for resistance to low temperatures in germination and emergence time. There have been selected the more tolerant ones.

Key words*: sunflower, drought, elite lines, low temperatures, resistance.*

INTRODUCTION

Sunflower is considered to be moderately resistant to drought, but in hot conditions, the plants suffer reduction in fertility, yield performance and quality of products (Vrânceanu, 2000; Popa et al., 2013; Popa et al., 2017). In literature there are mentioned some adoptive mechanisms of plants to drought: escape, avoidance and tolerance, as well as their genetic variability (Skoric, 2012).
Singh (2000) considered it difficult to define the parameters that affect the expresion of drought. Miller (1997) stated that it is important to identify and incorporate into breeding material characteristics that contribute to physiological drought resistance. Different morphological and physiological characteristics were used in study of sunflower resistance to drought (Baldini et al., 1991; Griveau et al., 1996; Chimenti et al., 2004; Sauca et al., 2018). Sunflower breeders believe that drought avoidance can be achieved by developing very early hybrids or by moving the sowing date, in order to avoid the dry period (Skoric, 2012).
Practical results in sunflower breeding for drought resistance have been achieved by using the stay-green phenomenom (Vrânceanu, 2000). For sunflower it is very important to increase the cold resistance in early development stages, at stage of germination, emergence and the stage of 2-3 leaves, in order to facilitate an early sowing.
Wild *Helianthus* species are a very valuable source of resistance in increasing drought resistance as well as resistance to low temperatures in sunflower.

MATERIALS AND METHODS

In our research work we have used different sources from our sunflower germplasm collection, some of them coming from the interspecific hybrids between wild *Helianthus argopyllus* and cultivated sunflower.
Some of our best elite lines have been introduced in a process of improvement of resistance to drought, using recurrent selection. We have used several parameters or characteristics in selection of the tolerant plants: deeper rooting depth and more efficient root uptake of water, area of lives and number of lives, plant ability to recover after wilting under heat stress. Each generation of selection was planted in drought natural conditions (missing water in soil and high air temperature).
For breeding we have used a scheme which has helped us to select the best genotypes, regarding the tolerance to drought (Figure 1).
All generations of selection were tested for resistance to low temperatures in germination and emergence time. There have been selected the more tolerant ones.

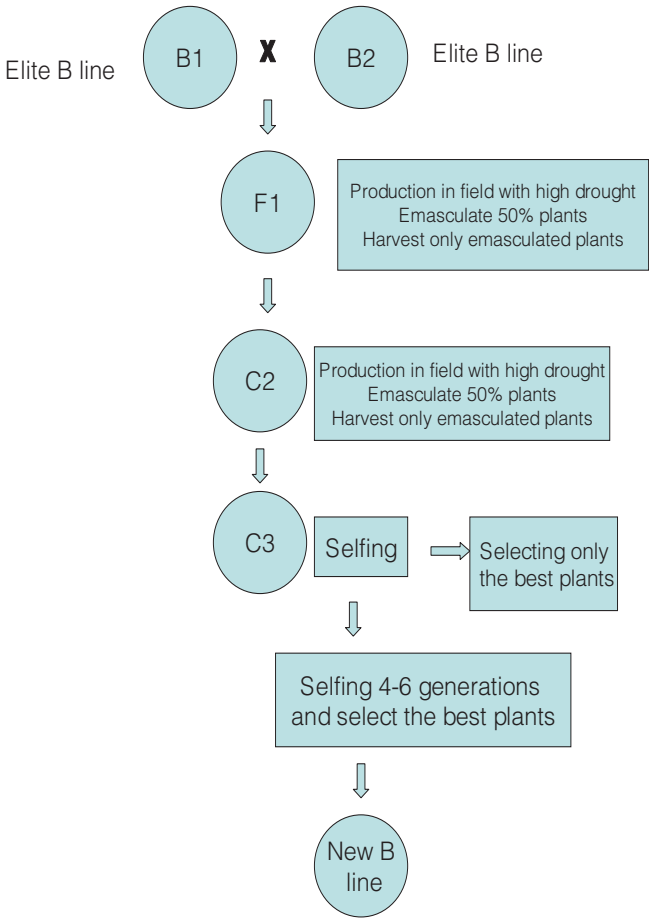

Figure 1. Scheme for breeding to tolerance to drought

RESULTS AND DISCUSSIONS

Using the scheme presented in Figure 1, we have improved the resistance to drought and to cold, in some elite lines from our institute germplasm collection. In table 1 there are presented the results regarding the resistance/tolerance to drought, for some lines (CMS and restorer) this testing being done in natural conditions of drought in area Constanţa in year 2017. Some of these lines have very good tolerance to drought (LCS 253, RS 114).

Table 1. Sunflower genotypes in different generation of selection, tested for resistance to drought and high air temperatures, in field, area Constanţa, 2017 (Resistant=1; Sensitive=9)

Genotype	Generation	Total plants	Resistance to drought
LCS 234	(C3)4	56	2
LCS 241	(C3)4	44	3
LCS 244	(C3)5	52	2
LCS 253	(C3)5	41	1
LCS 259	(C4)2	58	5
LCS 272	(C3)4	62	2
LCS 279	(C4)3	55	2
RS 102	(C3)2	47	2
RS 108	(C3)3	42	2
RS 114	(C3)4	51	1
RS 122	(C3)4	59	2
Check sensitive	-	61	9
Check resistant	-	58	1

In Table 2 we are presenting the results regarding the resistance/tolerance to low temperatures, in germination and emergence time, of the obtained lines (CMS and restorer) in year 2017 in Fundulea. Most of them have very good behavior regarding this aspect (LCS 234, LCS 244, LCS 253, LCS 272, RS 108, RS 114).

Table 2. The inbred lines in different generations of selection for drought, tested for resistance to cold, Fundulea, 2017 (Resistant=1; Sensitive=5)

Genotype	Generation	Total plants	Resistance to cold
LCS 234	(C3)4	49	1
LCS 241	(C3)4	51	2
LCS 244	(C3)5	48	1
LCS 253	(C3)5	50	1
LCS 259	(C4)2	50	3
LCS 272	(C3)4	47	1
LCS 279	(C4)3	45	3
RS 102	(C3)2	50	3
RS 108	(C3)3	51	1
RS 114	(C3)4	49	1
RS 122	(C3)4	47	2
Check sensitive	-	56	5
Check resistant	-	52	1

Some of lines which for it has been improved the resistance/tolerance to drought as well as to low temperatures, have been used for obtaining the hybrid combinations. Some of these have been tested for resistance to drought as well as for resistance to cold.

In Figures 2 and 3 there are presented the climatic conditions in Fundulea area, in 2016 and 2017 years. It could be seen that in 2016 year the air temperature is lower in March, comparing with year 2017, also, the rainfall was higher in 2016 comparing with 2017 year. This is important, because the planting of the hybrids tested for resistance to cold, it has done at the first half of March.

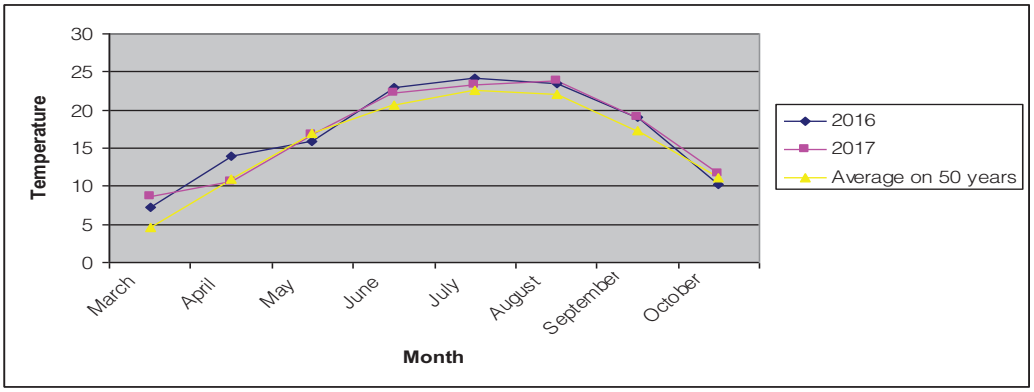

Figure 2. Temperature on two years 2016 and 2017, in Fundulea

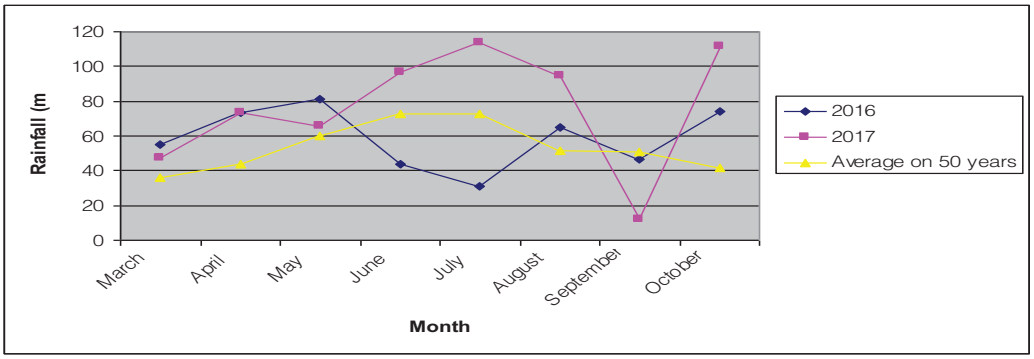

Figure 3. Rainfall on two years, 2016 and 2017, in Fundulea

In Figure 4 there are presented results regarding the behavior to cold, of the hybrids in these two years, 2016 and 2017 in Fundulea. Some of hybrids have good tolerance to cold in both years (HS1020, HS1110, HS1113), some others (HS1020, HS 1025, HS1027, HS1110, HS1113) have been more tolerant in 2017 year.

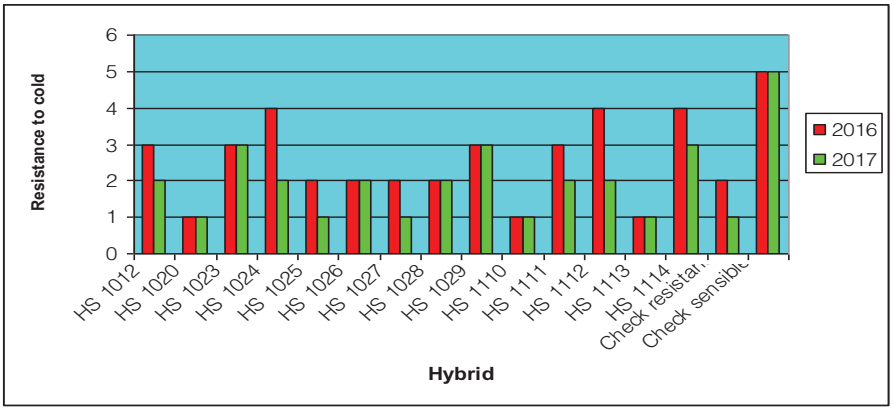

Figure 4. New sunflower hybrids tested for resistance to cold, Fundulea, 2016 and 2017 (Resistant=1; Sensitive=5)

In Figure 5 there are presented the results regarding the behaviour of the hybrids for resistance/tolerance to drought tested in area Constanţa in year 2017. Some hybrids have very good tolerance (HS 1020, HS 1025, HS 1027, HS 1028, HS 1110, HS 1113).

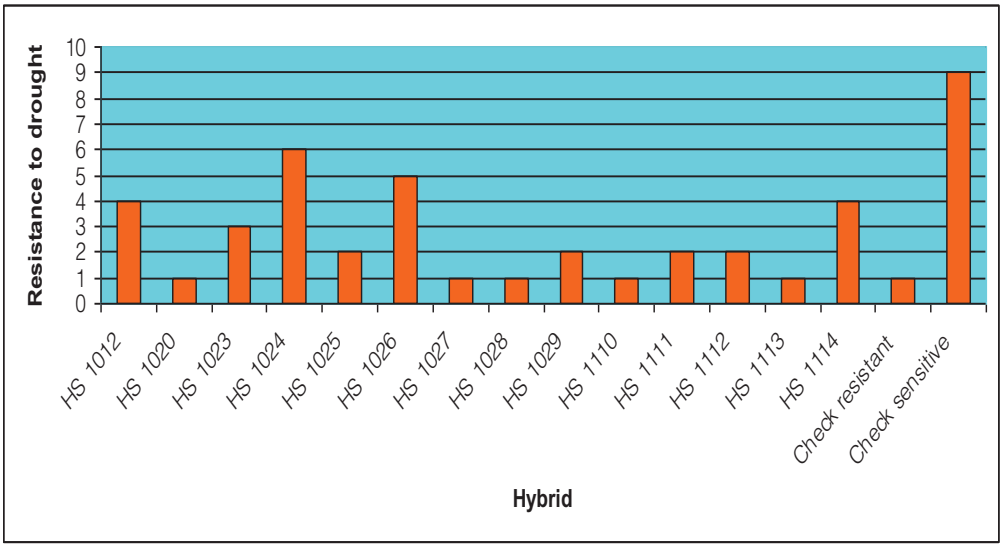

Figure 5. New sunflower hybrids, tested for resistance to drought and high air temperatures, area Constanţa, year 2017 (Resistant=1; Sensitive=9)

CONCLUSIONS

In our sunflower breeding program, at Fundulea Institute, an important objective is resistance/tolerance to drought and to low temperatures in germination and emergence time. In the last three years, there have been obtained good sunflower genotypes (lines LCS 253, RS 114 and hybrids HS 1020, HS 1110, HS 1113) which have a good tolerance to drought as well as to cold.

The released hybrids with this behavior can be cultivated and obtained good results regarding the seed yield and oil content in the climate change conditions.

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