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DIVERSIFICATION OF SUNFLOWER GERMPLASM FOR DIFFERENT ECONOMICALLY IMPORTANT CHARACTERISTICS

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Abstract

Sunflower is a very important crop in the world agriculture. Taking into consideration the high seed yield and oil yield, thanks to the extension of sunflower cultivated varieties and hybrids having a high oil content, this crop has a good place in the hierarchy of dominant crops over the world. Genetic resources may be used as initial germplasm for obtaining new sunflower inbred lines or as genes donor sources for the value increasing of some lines.
Sunflower wild species are the most rich and varied source of favorable genes for the important characteristics of cultivated species. Sunflower interspecific hybrids are very important in breeding, thanks to a very good genetic variability. As the result of our research work, we have obtained many interspecific populations, after crossing sunflower wild species Helianthus argophyllus with Helianthus annuus cultivated variety Record. There have been studied different characteristics, in two years of experiments for the wild species, for the cultivated variety and for the interspecific populations. Observations regarding flowering duration and vegetation period were recorded. There have been analyzed different morphological characteristics (plant height, number of leaves, petiole length, head diameter, seed wide, seed length, and number of branch) as well as other characteristics, including the seed oil content. Regarding the resistance of the hybrid populations and of the parental lines to the pathogen Phomopsis helianthi and the parasite Orobanche cumana, it was found that, after 5 generations of selfpollination, some hybrid populations presented good resistance to the tested pathogens and parasites.
The data obtained during the experiments has shown that in the most cases, the differences referring to the cultivated sunflower are statistically significant. Similar results were obtained with the hybrid populations for all analyzed characteristics.

Key words*: sunflower, genetic resources, wild species, analyzed characteristics*, *bromrape.*

INTRODUCTION

Sunflower crop has an important place in the word agriculture, due to many advantages, as the capacity to release high seed yield and good oil content.
Sunflower kernels are used in industry for obtaining good oil for human food as well as, the secondary matter used in animal food.
Sunflower oil has a very good quality, with high percent of the unsaturated acids and capacity to maintain stability and long time conservation.
After being obtained first sunflower hybrids with high oil content (Vrânceanu, 2000), area cultivated with sunflower crop has increased over the world, including our country, Romania. There have been obtained and sunflower hybrids with low oil content and high protein content, these being used as confectionary sunflower.
Sunflower crop is important as well as, for agriculture technology purpose, in doing a good crop rotation (Sin, 2002).
For obtaining good commercial sunflower hybrids, the breeding work must to be accelerated. In the breeding work, the genetic variability in sunflower germplasm is of a great importance.
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 a good resistance to dry conditions (Belhassen et al., 1996; Singh, 2000).
The pathogen *Phomopsis helianthi* which produce brown spot and parasite *Orobanche cumana* are producing losses in sunflower seed

yield, breeding for resistance being very important for this crop (Vrânceanu, 2000).
To assure the variability in sunflower germplasm, there are used different genetic resources, as: sunflower old cultivars with low oil content, varieties with high oil content, hybrids and inbred lines, synthetic populations, induced mutations and sunflower wild species, which are the most important genes donor for many important characteristics for cultivated sunflower (Vrânceanu, 2000; Skoric et al., 2012).
In this paper there are presented some results of our work for genes transferring from wild species into cultivated sunflower.

MATERIALS AND METHODS

There have been used some wild species (*Helianthus argophyllus* and *Helianthus maximiliani*) and Record variety belonging to cultivated sunflower. The purpose was to transfer genes for resistance to drought as well as for resistance to the pathogen *Phomopsis helianthi*, from *H. argophyllus* and genes for resistance to the parasite *Orobanche cumana* (broomrape), from *H. maximiliani*.
It has been done the measurement of different morphological characteristics of the obtained interspecific hybrids as well as the vegetation period, flowering duration, one thousand seeds weight and the oil content.
For the interspecific hybrids with resistance to the pathogen *Phomopsis helianthi*, as well as to the parasite *Orobanche cumana*, there have been done the tests of resistance in natural infection/infestation conditions, as well as in the artificial infestation for broomrape parasite.
For testing sunflower resistance to broomrape resistance in the artificial infestation, we used the Pancenko method (Păcureanu-Joița et al., 1998), by planting sunflower genotypes in pots of 5 litters capacity with a soil mixture and sand, including 2 grams of broomrape seeds, in each of them. The broomrape attack could be seen on sunflower roots after 35 days from planting time.

RESULTS AND DISCUSSIONS

The interspecific hybrids in sunflower breeding have an important role because of a large genetic variability, which assure a base for success in this field.
Due to our research work there have been obtained some interspecific populations which help us to create restorer inbred lines (from crossing wild sunflower *Helianthus argophylluys* with cultivated variety Record). The obtained populations have been studied for different characteristics important for cultivated sunflower.
The data presented in table 1 are showing that the flowering time for the wild specie is closely populations HI 398 and HI 363. The vegetation period for the hybrid populations was between 93 and 104 days.

Table 1. Phenological data for some interspecific hybrids obtained by crossing cultivated sunflower *H. annuus* (Record variety) with *H. argophyllus* (2012- 2013)

Genotype	Beginning of flowering (days from emergence)	Flowering time (days from emergence)	Duration of central head flowering (days)	Vegetation period (days)
Cultivated sunflower				
Record	54	54	5	108
Wild specie				
H. argophyllus	108	115	6	142
Interspecific hybrids				
HI 321	51	53	4	95
HI 398	51	52	6	93
HI 363	52	53	6	104

The morphological characteristics of the interspecific populations are presented in tables 2, 3 and 4.
There are presented the average values of the most important characteristics, frequently analyzed in the breeding programs. The data are showing that in most of cases, the difference regarding the cultivated genotype is statistically important. A positive significance it has been determined for the characteristics as: number of branches, the branches head diameter (HI 321 and HI 398). These characteristics are very important in sunflower breeding work, for the restorer inbred lines. Due to these data we can to say that the hybrid populations are closely the parent belonging to the cultivated sunflower, regarding all analyzed characteristics, after 5 generations of self-pollination.

Table 2. Different characteristics for some interspecific hybrids obtained by crossing cultivated sunflower *H. annuus* (Record variety) with *H. argophyllus* (average 2011-2013)

Genotype	Plant height (cm)	No. of leaves	Leave wide (cm)	Leave length (cm	Petiol length (cm)
Cultivated sunflower					
Record	177.2	32.0	21.1	22.0	16.2
Wild specie					
H. argophyllus	236.5	261.0	0.6	20.7	0
Interspecific hybrids					
HI 321	121.6***	28.0***	16.7***	17.5***	14.4***
HI 398	129.4***	32.0	15.1***	16.0***	14.2***
HI 363	90.3***	20.0***	16.7***	17.2***	10.2***

DL: 0.1%; 1%; 5%

Table 3. Different characteristics for some some interspecific hybrids obtained by crossing cultivated sunflower *H. annuus* (Record variety) with *H. argophyllus* (average 2011-2013)

Genotype	Distance between knots (cm)	Stem diameter (mm)	Head diameter (cm)	Number of branchs (n)	Length of branchs (cm)	Number of flowers ranges (n)
Cultivated sunflower						
Record	5.8	29.4	23.0	0	0	51.0
Wild specie						
H. argophyllus	15.6	12.1	1.2	14.0	12.8	16.0
Interspecific hybrids						
HI 321	5.8	22.0***	13.2***	25.0***	28.4***	50.0
HI 398	5.5	25.0***	12.6***	24.0***	21.2***	53.0
HI 363	4.7***	21.0***	15.0***	0	0	46.0***

DL: 0.1%; 1%; 5%

Table 4. Different characteristics for some some interspecific hybrids obtained by crossing cultivated sunflower *H. annuus* (Record variety) with *H. argophyllus* (average 2011-2013)

Genotype	Lateral heads diameter (cm)	Kernel wide (mm)	Kernel length (mm)	Kernel diameter (mm)	Oil content (%)	TKW (g)
Cultivated sunflower						
Record	0	5.9	11.2	3.9	48.0	78.3
Wild specie						
H. argophyllus	1.1	2.2	5.0	1.3	28.4	5.8
Interspecific hybrids						
HI 321	7.1***	5.0***	11.0	3.5*	45.4**	35.4***
HI 398	8.6***	5.3**	11.5	3.6*	45.0**	37.3***
HI 363	0	5.0***	8.8***	3.5*	44.1***	40.3***

DL: 0.1%; 1%; 5%

Crossing the wild sunflower *Helianthus maximiliani* with cultivated sunflower (Record variety) we obtained different hybrid populations which can to help us in obtaining some lines with good resistance to the most virulent populations of the parasite broomrape.

In figures 1, 2 and 3 there are presented the results obtained by testing different populations among some differentials for broomrape races, in 3 locations situated in areas infested with populations of the parasite which have different virulence. In figure 1, the test made in Tulcea area, has showed that the attack degree of the parasite was higher in 2013 year and the best populations regarding the resistance are IS 604 and IS 581. In Ialomita area, the broomrape populations are less virulent and the resistance are very good for most of hybrid populations, excepting IS 557 (Figure 2).

In Constanta area, the broomrape virulence is high and the sunflower interspecific hybrid populations are less resistant, but, the populations IS 604 and IS 581 have a good resistance (Figure 3).

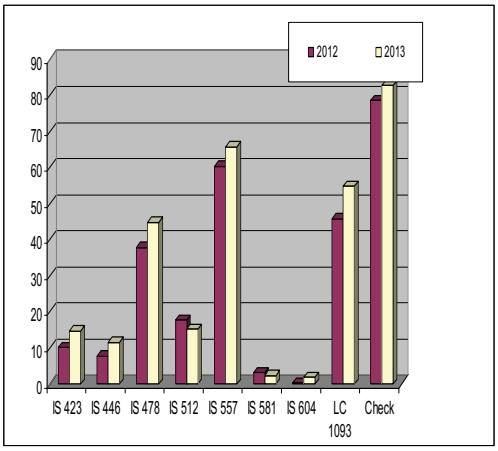

Figure 1. The attack degree of broomrape parasite on interspecific sunflower hybrids in Tulcea area (2012-2013)

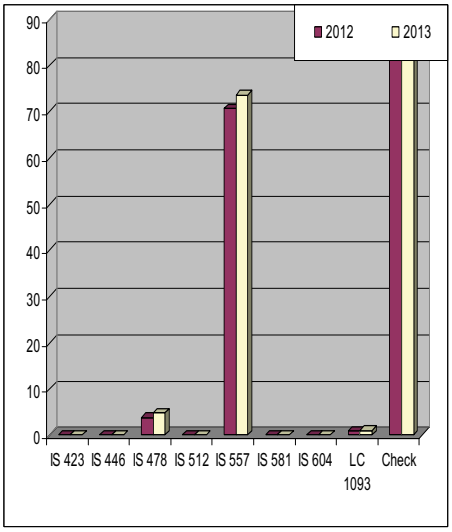

Figure 2. The attack degree of broomrape parasite on interspecific sunflower hybrids in Ialomița area (2012-2013)

These interspecific populations have been studied for resistance to broomrape in the artificial infestation conditions, too, with four populations of the parasite (Table 5). The results are showing that the same populations which have presented a good resistance in tests made in natural infestation conditions have a good resistance in the artificial conditions testing. The broomrape attack degree is a little higher, comparing with test in natural conditions.

The pathogen *Phomopsis helianthi* is un important risk factor for sunflower crop, so, it is necessary to find sources of resistance. In figure 4 there are presented results of testing for some sunflower interspecific populations (*H. argophyllus* x Record variety). The results are showing that some populations have a very good resistance (HI 321 and HI 398). The attack was higher in 2013 year.

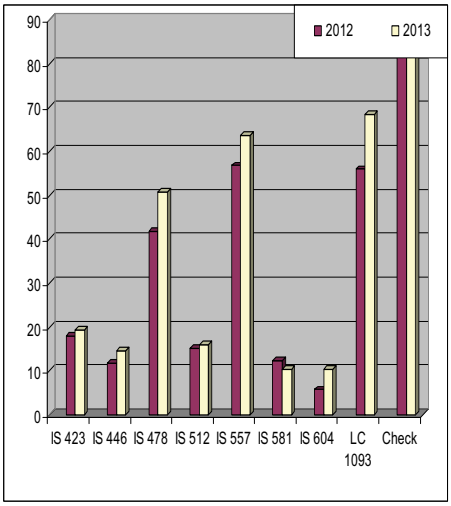

Figure 3. The attack degree of broomrape parasite on interspecific sunflower hybrids in Constanța area (2012-2013)

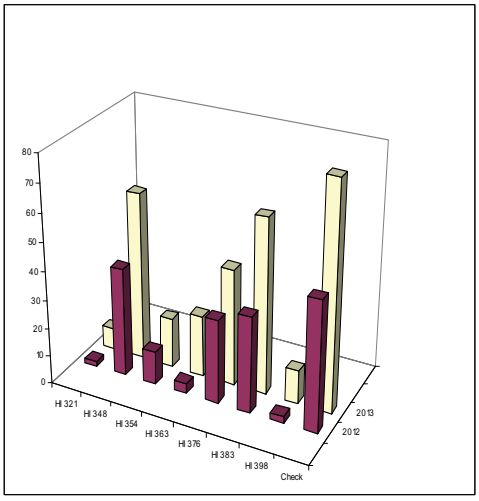

Figure 4. The attack degree of pathogen *Phomopsis helianthi*, in natural infection conditions (2012-2013)

Table 5. Broomrape attack degree in the artificial infestation condition

Sunflower Genotype	Attack degree (%)			
	Broomrape 1	**Broomrape 2**	**Broomrape 3**	**Broomrape 4**
IS 446	0.56	11.4	18.5	3.8
IS 478	11.42	48.6	61.2	19.5
IS 512	0.23	21.9	25.4	15.2
IS 557	51.7	77.8	61.4	55.6
IS 581	0.0	10.4	7.9	7.8
IS 604	0.34	9.3	8.5	6.9
LC 1023	1.87	19.6	21.7	16.3
LC 1044	0.0	8.7	8.4	5.5
LC 1112	2.67	17.8	15.6	14.6
LC 1145	1.98	21.8	25.9	18.3
LC 1093	0.45	55.4	31.4	34.8
LC 1003	56.7	71.6	67.8	62.4
LG 1	0.0	0.0	0.0	0.0
LG 2	0.0	6.9	7.5	4.2
Check	72.6	80.4	82.3	75.5

CONCLUSIONS

Sunflower wild species are very good sources of genes for important characteristics which must to increase the value of cultivated sunflower.

The interspecific populations obtained by crossing the wild sunflower *Helianthus argophyllus* with cultivated variety Record, have showed significant values for important characteristics. Some of these populations have a good resistance to the pathogen *Phomopsis helianthi.*

Some of hybrid populations obtained by crossing the wild sunflower *Helianthus maximiliani* with cultivated variety Record have a good resistance to the parasite *Orobanche cumana*.

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