RESULTS OF THE CROSSING OF H. EGGERTII SMALL (2n=102), H:LAEVIGATUS TORREY & GRAY (2n=68), H.SALICIFOLIUS DIETR. (2n=34) WITH H.ANNUUS L. (2n=34)

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SUMMARY

The results show that the crossing of H.eggertii, H.laevigatus and H.salicifolius with H.annuus is difficult but yet possible. The weakest germination of the hybrid seeds is in H.salicifolius. Some of the flowers die in different phases of F_1 development. The inheritance of the characters in the first generation is of an intermediate type and with a highly expressed phenotype similarity with the wild parent. The hybrids are perennial, branched with male and female expressed sterility. The pollen viability is low. After a backcrossing with cultivated sunflower single viable seeds are obtained producing plants also with high-expressed sterility and after a backcrossing or free pollination single seeds are also obtained. These plants have a different vegetation period as being mostly annual. The hybrids of F_1 and BC_1 produced by H.eggertii and H.laevigatus phenotipically are very similar suggesting a close genetic relation and a same origin.

The results of the crossing of wild species used with cultivated sunflower and the investigations on the hybrids show that the genetic material transfer in cultivated sunflower is possible after determination of certain positive qualities.

INTRODUCTION

A series of investigations show that the sunflower wild-growing species are a rich source of the sunflower culture improvement (Pustavojt, 1975; Georgiev-Todorova, 1976; Seiler, 1984; Skoric, 1984) etc.

On the other side the hybridization between species and the study of the hybrids obtained can throw additional light upon their origin and the interrelation between them (Heiser, 1969; Georgieva-Todorova, 1976; Rogers, Thompson, Seiler, 1982) etc. In this sense the hybridization between H.eggertii, H.laevigatus and H.salicifolius with H.annuus is of interest.

MATERIALS AND METHODS

Perennial species H.eggertii (2n=102), H.laevigatus (2n=68), and H.salicifolius (2n=34) were included in the investigation, used as mother parent and H.annuus (2n=34) presented by Soviet and Bulgarian cultivars and lines, used as father parent. The hybridization is conducted with florets castration done beforehand. Seed production from F_1 generation plants was realized after selfpollination, pollination by pollen from cultivated sunflower and free pollination.
The hybrid plants obtained from F_1 and BC_1 generations were studied on the most important morphological characters together with studying of possibilities for the combining ability of H.eggertii, H.laevigatus and H.salicifolius with H. annuus L. The hybrid plants were read according to the basic diseases severity and also towards orobanche cumana.

RESULTS

The data of the investigation on the gametal compatibility and the opportunity to obtain viable hybrid seeds and hybrid plants are given in Table 1.
Seeds and hybrid plants were produced in three groups of crosses and in the three-year periods, as those originated from H.salicifolius were least.
To the inheritance characteristic the hybrids obtained from the first generation had an intermediate type of expression but the wild parents characters were more highly marked (Table 2).

Table 1. Crossing ability of H.eggertii Smal, H.laevigatus T.& G., H.salicifolius Dietr. with H.annuus L.

Hybrid combination in years	2n of cross. mater.	Pollinated inflorescences			Seeds obtained			Hybrid plants produced	
		TOTAL No.	WITH SEEDS	SEED SET %	TOTAL No.	IN ONE INFLOR.	SEED SET %	No.	IN % TO THE SEEDS
1984 - 1985									
H. eggertii X H.annuus	102 X 34	9	5	55.56	53	10.6	14.13	1	1.89
H. laevigatus X H.annuus	68 X 34	12	10	83.33	130	13.0	19.12	5	3.85
H. salicifolius X H.annuus	34 X 34	24	5	20.83	7	1.4	1.94	0	0.00
1985 - 1986									
H.eggertii X H.annuus	102 X 34	13	7	53.85	70	10.0	13.33	2	2.86
H.laevigatus X H.annuus	68 X 34	9	7	77.78	45	6.4	9.41	17	37.78
H.salicifolius X H.annuus	34 X 34	16	6	37.50	8	1.3	1.81	2	25.00
1986 - 1987									
H.eggertii X H.annuus	102 X 34	55	24	43.64	149	6.2	8.27	53	35.57
H.laevigatus X H.annuus	68 X 34	40	18	45.00	93	5.2	7.65	23	24.73
H.salicifolius X H.annuus	34 X 34	45	5	11.11	14	2.8	3.89	2	14.28

Table 2. Characteristic of some hybrids of F_1 and BC_1 produced by the crossing of H.eggertii Smal., H.laevigatus T.& G., H.salicifolius Dietr. with H.annuus L. - 1987

Origin, Generation	Plant hight (cm)	Head diam. (cm)	Tubular florets (No.)	Pollen viabil. (%)	Seeds obtained - %		
					In self-pollinat.	BC_1 & BC_2 producing	Open pollin.
From H.eggertii							
F_1 - HM - 54/1	205	3.1	135-140	-	0.0	0.0-2.1	0.0-1.4
F_1 - HM - 67/1	290	3.2	135-192	42.86	0.0	0.0-2.1	0.0-8.9
F_1 - HM - 67/2 +	210	3.8	159-198	-	0.0-3.7	-	0.0-2.6
BC_1- HM - 321	160	4.0	161-229	-	0.0	-	0.0-0.8
From H.laevigatus							
F_1 x HM - 16 - 85 - 1	180	2.0	132-135	-	0.0	0.0-1.4	0.0-2.2
F_1 - HM - 16 - 85 - 2	325	2.7	142-147	36.36	0.0	0.0-7.5	0.0-8.2
F_1 - HM - 100 +	160	2.6	98-124	-	0.0-4.0	-	0.0-0.8
BC_1 - HM - 14	155	6.0	198-240	-	0.0	0.0-1.7	0.0-3.8
From H.salicifolius							
F_1 - HM - 251	140	1.3	119-132	37.39	0.0	0.0-0.8	0.8-7.1
BC_1 - HM - 45	180	4.0	135-182	-	0.0	3.0-9.3	0.7-6.0
H.eggertii - M - 001	240	1.6	55-84	-	0.0	-	0.0-21.4
H.laevigatus - N - 016	200	0.9	67-69	-	0.0	-	0.0-36.2
H.salicifolius - M - 045	270	1.0	62-82	-	0.0	-	3.2-24.4
Peredovik	210	21.0	1720-2056	93.44	0.3-17.4	-	85.7-97.9

+ treated by colchicine

According to the development cycle the hybrids inherited the characters of the perennial parent. One plant, produced by the crossing of H.salicifolius with cv. Peredovik (H.annuus L.) was an exception.
The stem of the hybrid plants by the participation of H.eggertii and H.laevigatus was vigorous, erected, with a dark anthocyan colour. It was covered by a wax coating and by hard, short and rare situated hairs. The stem of the hybrid plants by H.salicifolius is grey-green. The branches were situated from the base to the top or mainly in the low half of the stem.
The leaves were large, lanceolate, dentale on the margin, slightly folded and spirally situated on the stem.
These leaves obtained in crossing by H.eggertii were broader from the petiole's side. They were more green on the upside, had a short petiole in anthocyan colour and a main nerve. The hybrid plant leaves of H.eggertii and H.laevigatus had a particular flash. The hairs situated on both sides of the leaves were solid and sharp. During flowering period the inflorescence's lobe had an orange-green color. A part of the hybrid plants created by H.laevigatus died before or during flowering. A hybrid plant originating from H.salicifolius died at the beginning of budding phase.
In all hybrids the pollen viability was low (Table 2). The plants were completely sterile. During the second and third year of their growth these were developed rather well.
Single seeds and hybrid plants were obtained in backcrossing with cultivated sunflower and in free pollination. Among them there were plants with less or single branches, with larger in size leaves and inflorescences and also with increased number of tubular florets. All plants of the first backcross generation were completely sterile with a long vegetation and one-year cycle of development.
The seeds obtained from F_1 and BC_1 generation were larger than those of the wild parents and were coloured from grey-white to brown-black.
A part of amphidiploids possible produced were treated by a colchicine solution of 0.25% during first and second leaf pair phase. Hybrid plants in crossing by H.eggertii and H.laevigatus formed minimum number of seeds after self-pollination. In these hybrid plants grown in conditions of a infection plot in 1987 there was not an attack of the following diseases: Plasmopara helianthi, Puccinia helianthi, Phoma helianthi and orobanche cumana. An attack was found only on one plant by Sclerotinia sclerotiorum and Alternaria helianthi. After an artificial infection by orobanche cumana an attack was recorded on two hybrid plants crossed by H.eggertii.

DISCUSSION

The results obtained in the investigation confirm these of Pustavojt (1975): Georgieva-Todorova (1976); Skoric /1980). The data show that the self-fertilization has been incomplete has been due probably to the genetic isolators between these species and cultivated sunflower. The reason of hybrid plants killing might be due to lethal genes or a severe hybrid necrosis.
The inheritance of the characters in the first generation was of intermediate type with domination of the wild parents' properties. The hybrids developed by H.eggertii and H.salicifolius in first and BC_1 generation were phenotipically similar, which could suggest a close genetic relation between the two species.
That conclusion is supported by the studies of Heiser (1969), who has claimed that these two species have been closely related.
The plants produced after colchicine treatment expressed a partial fertility which indicated that amphidiploids could be obtained by the used species. These amphidiploids could be used as donors of different characters.
The resistance of the perennial species to Orobanche cumana is of interest but the resistance in hybrid plants, developed by H.eggertii has not been dominating. Probably it is determined by recessive factors. This conclusion is not in agreement with the resistance founded in other hybrids (P8stavojt, 1975).

It is possible the gene interaction for resistance to have a different character in the single species and hybrids.

CONCLUSIONS

On the base of the investigation it was found that the crossing of H.eggertii, H.laevigatus and H.salicifolius with the cultivated sunflower could be performed. The hybrid seeds produced had comparable a good viability, especially those developed by H.eggertii and H.laevigatus but some of the hybrid plants died in different phase of ontogenesis. The hybrid characteristics show that it is possible the wild species included in the study to be used as donors of useful characters for the breeding of H.annuus L.

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