HELIA, **33**, Nr. 53, p.p. 17-24, (2010) UDC 633.854.78:631.547
DOI: 10.2298/HEL1053017O

THE CHARACTERIZATION OF SOME WILD SPECIES OF *Helianthus* FOR SOME MORPHOLOGICAL TRAITS

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Received: April 10, 2010
Accepted: August 10, 2010

SUMMARY

This present investigation was undertaken to determine some plant characters in six wild *Helianthus* genotypes and their test hybrids in 2007 and 2008. *Helianthus petiolaris* spp. *petiolaris* (E-142), *Helianthus neglectus* (E-017) and four wild *Helianthus annuus* (E-060, E-173, E-174 and E-175) were used as the material. The morphological characters observed in the wild *Helianthus* genotypes were plant height, head diameter, lateral number, number of days to 50% flowering, flowering period length, and presence of anthocyanin in the cotyledons. In the second year, test hybrids of E-017, E-142, E-173 and E-175 with the female line 2453-A were evaluated for seed yield, seed weight and some morphological traits. The results showed that plant height, head diameter and lateral number for these wild genotypes ranged from 63 to 171 cm, 2.4 to 8 cm and 43 to 324.3, respectively. The wild sunflower genotypes needed 82-105 days after emergence to reach 50% flowering and had flowering periods of 67-91 days. E-142 (*Helianthus petiolaris* spp. *petiolari*s) and its test hybrid with the female line 2453A were similarly in the early group for days to 50% flowering. E-017 (*Helianthus neglectus*) and its test hybrids were similarly late for days to 50% flowering. Interestingly, although E-173 had medium plant height, its test hybrid had the shortest plants.

Key words: ***Helianthus, H. petiolaris, H. neglectus, H. annuus*, morphology**

INTRODUCTION

Sunflower (*Helianthus annuus)* is one of the most important oil crops of the world. *Helianthus annuus* L. is grown on around 20 million hectares in the world and presents one of the most important crops for oil production. *Helianthus* could be considered one of the most diverse genera of the Asteraceae family. The genus *Helianthus*, is native to North America, with the majority of species within the con-

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fines of the United States. However, wild sunflowers have been inadvertently introduced into several countries and have become naturalized, most notably in Argentina, Australia, and South Africa (Anonymous, 2005; Sanchez, 2008). Sunflower has probably been first introduced to Europe through Spain in the sixteenth century as an ornamental garden flower, after which it gradually moved eastward and northward in the European continent until it reached Russia in the 18th century where it was readily adapted for increasing oil content (Seiler, 1997).

Wild species are adapted to a wide range of habitats and possess a considerable amount of genetic diversity that may be a rich adequate source of alleles for continued improvement of the cultivated sunflower (Seiler and Rieseberg, 1997; Burke *et al.*, 2002; Škorić, 2009). Wild sunflower species have the potential to contribute to renewable resources. During the past three decades, the narrow genetic base of cultivated sunflower has been broadened by the infusion of genes from wild relatives, which have provided a continuous source of agronomic traits for crop improvement (Seiler, 2007; Škorić, 2009). Wild *Helianthus* species serve as potential sources of novel genetic variability and several desirable characteristics such as resistance to biotic and abiotic stresses, cytoplasmic male sterility, fertility restorer genes and oil quality have been successfully introgressed into cultivated sunflower (Thompson *et al.*, 1981; Seiler, 1997).

The genus *Helianthus* consists of 51 species with 14 annual and 37 perennial species (Seiler, 2007; Jan and Seiler, 2007). Spontaneous hybridization and introgression are recurrent genetic process in their habitat resulting in morphological intergradations and broad diversity in the genus (Heiser, 1976; Sanchez, 2008). The cultivated species, *H. annuus,* also known as the sunflower, has close wild species relatives. The genus *Helianthus* is an economically and evolutionarily important taxon than contains not only one of the world's most important crops but also a number of wild species that have become models for the study of the genetic adaptation and speciation (Rieseberg *et al.*, 1996; Burke *et al.*, 2004; 2005; Sanchez, 2008). There have been many attempts at reconstructing the phylogeny of the genus using a range of different characters: morphological (Heiser, 1976), whether characters found in crops and wild relatives were caused by introgressive hybridization or by convergent evolution, phenotypic plasticity, or common descent (Sanchez, 2008; Škorić, 2009).

The growing need for additional genetic variability to improve the cultivated sunflower makes it necessary to collect, maintain, characterize, evaluate and utilize the wild sunflower germplasm (Sujatha, 2006). This study aimed to characterize and examine the use of some wild sunflower species and some morphological characteristics were determined.

MATERIALS AND METHODS

Six wild sunflower genotypes (one of *Helianthus petiolaris* spp. *petiolaris* (E-142), one of *Helianthus neglectus* (E-017) and four of wild *Helianthus annuus* (E-060, E-173, E-174 and E-175)) were evaluated for some morphological traits. In addition, test hybrids of E-017, E-142, E-173 and E-175 with the cultivated female line 2453-A in 2007 were also evaluated in the second year (2008) with control cultivars (Sanbro and XF-4223). The seed sets were received from the Dobroudja Institute of Agriculture, General Toshevo, Bulgaria. In this research, days to 50% flowering, flowering period length, lateral number, head diameter, and plant height were determined on individual plants. In the test hybrids, seed yield, 100 seed weight, number of days from planting to flowering (50%), flowering period length, head diameter, and plant height were determined.

The present study was conducted in 2007 and 2008 in the research area (located at 48 m above the sea level with longitude of 26°34' S and latitude of 41°40' N) of the Trakya Agricultural Research Institute, Edirne, Turkey. During plant growth, total rainfall was about 200 mm in 2007 and 230 mm in 2008. Humidity was 56.8% in 2007 and 59.9 in 2008, and the average temperatures were 21.6°C and 21.13°C in 2007 and 2008, respectively. The soils for both years were a silty clay loam with a low organic matter content.

The trials were hand seeded on April 20, 2007 and April 29, 2008 with a 2 by 2 m spacing for fist year and 30 × 70 cm for second year between plants. The genotypes were overseeded with three to four seeds in each hill. At the four to six leaf stage, plants were thinned to one plant per hill. The experimental design in each case was a randomized complete block design with four replications.

Analysis of variance of the data was computed using the JMP program (JMP software-data analysis statistics, 2005). The least significant difference (LSD) test at the 5% level of probability was used to determine the differences among values.

In this study, six wild genotypes were used that belonged to three *Helianthus* species. *Helianthus annuus* is an annual wild sunflower that originated in North America. It has the highest number of different types and various morphological characters in different geographical regions. *Helianthus annuus* is the most common and widespread among the *Helianthus* species. Thus, it has no special names for its subspecies. The other annual species, *H. petiolaris*, occurs in patches and only occasionally becomes a weed. Both parental species, *H. annuus* and *H. petiolaris*, are widespread taxa that mainly grow at disturbed sites. *Helianthus petiolaris* typically occurs at higher elevations than *H. annuus*, but there are many locations where they overlap. They appear to have different ecological preferences as well, with *H. annuus* preferring heavier more mesic soils and *H. petiolaris* more xeric sandy habitats (Heiser, 1976). *Helianthus neglectus* grows in sandy soils and is not widespread. It is a newly found species. Female line 2453-A has 54-61 days to 50% flowering. It reaches flowering 4-7 days later than the earliest cultivars. The

yield potential of the female line is good. The line has high plant height and big heads. The control cultivars (Sanbro and XF-4223) have good performance and high yields in the research area. They are among the most highly preferred cultivars for production by farmers. Sanbro shows early maturing. The other control, XF-4223, is accepted as a late maturing cultivar.

RESULTS AND DISCUSSION

The wild *Helianthus* species evaluated for morphological characters were *H. petiolaris* spp. *petiolaris* (E-142), *Helianthus neglectus* (E-017) and *Helianthus annuus* (four genotypes: E-060, E-173, E-174 and E-175). In addition, test hybrids of E-017, E-142, E-173 and E-175 with cultivated female line 2453-A were also evaluated in the second year with control cultivars (Sanbro and XF-4223).

The anthocyanin of cotyledons was found to be heavy for E-174, medium for E-175 and E-142, and slight for E-173 and E-017. The anthocyanin of cotyledons of E-060 was not found.

Some morphological values and statistical groups of the six wild sunflowers are shown in Table 1. These are days to 50% flowering, number of flowering days, plant height, head diameter, and lateral number.

Table 1: Morphological traits of some wild *Helianthus* species

Genotypes	Days to 50% flowering	Flowering day number	Plant height (cm)	Head diameter (cm)	Lateral number
E-017	98b*	69c	123b	6.4b	324.3a
E-060	90d	81b	136b	2.7d	43e
E-142	82e	67c	83c	2.4d	132d
E-173	105a	87a	127b	7.2a	240c
E-174	96bc	91a	63c	5.9c	25.3a
E-175	93cd	80b	171a	8.0a	280b
	LSD (5%): 4.92	LSD (5%): 5.86	LSD (5%): 22.5	LSD (5%): 1.24	LSD(5%): 39.11
	VC**.: 29.06	VC.: 4.09	VC.: 10.43	VC.: 12.77	VC.: 12.39

* No differences with same letter at 5 % statistical level (LSD: Least Significant Difference)
** Variance coefficient

Analysis of variance revealed that the differences among wild *Helianthus* genotypes were significant for all the parameters.

Days to 50% flowering ranged between 82 and 105. Differences for this character among the mean values of the wild sunflower genotypes were significant. E-173 was the last genotype to reach to 50% flowering. The earliest genotype for days to 50% flowering was E-142. This genotype was followed for earliness by E-060 and E-175. There were significant differences in the flowering period duration. This period in the tested wild sunflowers ranged from 67 to 91 days. E-174 and E-173 had the longest flowering periods with 91 days and 87 days, respectively. The shortest flowering period was observed in E-142 and E-017 with 67 and 69, respectively.

There were significant plant height differences among the wild *Helianthus* genotypes. E-175 had the highest plant height with 171 cm, while E-174 and E-142 were the shortest genotypes with 63 cm and 83 cm, respectively. Plant height of the other groups ranged between 123 cm and 136 cm. The head diameters of wild *Helianthus* differed significantly, ranging from 2.4 cm to 8.0 cm. The head diameters of E-175 and E-173 were the largest, while E-142 and E-060 had the smallest head diameters. Differences in branch number were also significant. The wild *Helianthus* genotypes had a larger lateral number. E-017 had the highest number of branches with 324.3, while the number of branches of E-174 and E-060 was the lowest with 25.3 and 43, respectively.

Results of morphological traits showed that *H. petiolaris* spp. *petiolaris* (E-142) was a wild genotype with the earliest flowering, shortest flowering period and plant height, smallest head, and medium lateral number. *Helianthus neglectus* (E-017) was second in late flowering but had the shortest flowering period, medium plant height, the second biggest head diameter, and the highest lateral number. Wild genotypes belonging to *Helianthus annuus* had very large differences within themselves. Notable traits of *Helianthus annuus* included the latest flowering, the longest flowering period, highest plant height and head diameter for E-173, E-174 and E-173, E-175, and E-175 and E-173. The lateral number of these wild species ranged from 25.3 to 280. It was observed that some *Helianthus annuus* genotypes were in the same group for morphological traits. These were plant height of E-060 and E-173, lateral number of E-060 and E-174, days to 50% flowering and flowering period of E-060 and E-175, flowering period of E-173 and E-174, head diameter of E-173 and E-175, and days to 50% flowering of E-174 and E-175.

The results on wild *Helianthus* were similar to the previous studies (Heiser, 1976; Burke *et al.*, 2005; Perez *et al.*, 2007; Seiler, 2007).

The observations of some test hybrids of E-017, E-142, E-173 and E-175 with the female line 2453-A for seed yield, seed weight are shown in Table 2.

Table 2: Some yield and yield components of test hybrids of some wild *Helianthus* genotypes with the female line 2453A

Genotypes	Seed yield (kg / ha)	Number of days to 50% flowering	Plant height (cm)	Head diameter (cm)	1000-seed weight (g)
2453AxE-017	1677b	74	130	10	33.21
2453AxE-142	1913a	63	136	14	39.18
2453AxE-173	1813b	72	112	9	32.16
2453AxE-175	1890b	65	158	8	29.45
Sunbro *	2015a	59	156	19	49.76
XF-4223*	2237a	67	162	18	53.48

* Control cultivars

There were significant differences among the genotypes. Seed yield per hectare ranged from 1677 kg to 2015 kg. The controls (Sanbro and XF-4223) and the 2453-A × E-142 (*Helianthus petiolaris* spp. *petiolaris*) test hybrid were in the high-

est seed yielding group. 2453-A × E-142 also had the shortest time to 50% flowering, highest head diameter, and highest 1000-seed weight relative to the other test hybrids. The highest plant height within the test hybrids was observed in 2453A × E-175 (wild *Helianthus annuus* L.).

E-142 (*Helianthus petiolaris* spp. *petiolaris*) and its test hybrid with the female line 2453A were similarly in the early group for days to 50% flowering, although the test hybrid had earlier flowering than E-142. Although E-142 had the shortest plant height, its test hybrid was in the medium group. E-017 (*Helianthus neglectus*) and its test hybrids were similarly late and medium for days to flowering and plant height, respectively. The plant height of E-175 (*Helianthus annuus*) and its hybrids was similarly high. However, E-175 had medium days to 50% flowering, but its test hybrids were in the earliest group. By contrast, the head diameter of E-175 was the highest, but its test hybrids had the lowest head diameter. Interestingly, although E-173 had medium plant height, its test hybrid had the shortest plants.

Our study's results for plant characters, especially yield and early maturity of wild *Helianthus* and its test hybrids with the female line 2453-A are very encouraging for finding new genes for transfer to cultivated sunflowers. The diversity of the wild *Helianthus* species can make a significant contribution to sunflower and offers great possibilities for increasing the genetic resistance of the cultivated sunflower towards abiotic stresses, allowing the full expression of the yield potential (Thompson *et al.*, 1981; Škorić, 1992; Seiler and Rieseberg, 1997; Burke *et al.*, 2002; Sujatha, 2006; Hajjar and Toby, 2007; Seiler, 2007; Rauf, 2008; Škorić, 2009). More studies on wild *Helianthus* species are needed for good adaptation and increased yields and resistance to different stress factors.

ACKNOWLEDGEMENT

This article was submitted from the master's thesis Gucer, T., Determination of Morphologic, Physiologic Features of Some Wild Sunflower and Search Hybridization Facilities with Cultural Sunflower, Namik Kemal University, Graduate School of Natural and Applied Science, Tekirdag, Turkey 78 p (2009).

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