

CHARACTERIZATION OF F1 PLANTS OBTAINED FROM CROSSES BETWEEN CULTIVATED SUNFLOWER AND WILD ANNUAL *HELIANTHUS ANNUUS*

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Abstract

Hybrid plants were obtained by crossing cultivated sunflower lines 6075 and 2607 and three accessions of wild annual species *Helianthus annuus* L. Plants were grown in field conditions as well as in quarantine plots. Morphological, biological and some chemical traits were investigated. Differences in biomorphological characters were established between plants from different crosses and among plants from the same cross. There were differences in plant height, head size, leaf shape and indentation, branching and type of branches, pollen fertility, 1000-seed weight and mass. Differences in seed oil content were registered too. Transfer of fertility restorer genes for the CMS PET1 occurred. Data obtained from the quarantine plots showed that plants from some of the crosses were not attacked by rust, downy mildew, Sclerotinia, Alternaria or broomrape.

Introduction

Helianthus species are not only the material the sunflower varieties originated from, but they still continue to be the source for certain characters in sunflower improvement (Thompson et al., 1981). Many investigations by scientific researchers in the field of interspecific hybridization in sunflower (*Helianthus annuus* L.) confirmed that wild species are an abundant source of genes determining important agricultural characters in sunflower (Pustovoit, 1975; Laferriere, 1986; Skoric, 1988; Seiler, 1988, 1992; Skoric, 1992; Christov, 1996a, b; Christov et al., 1996, etc.). Variability in the wild *H. annuus* is high and represents some specific adaptations that play an important role in the study of its genetic potential. Wild *H. annuus* and some other annual sunflower species are often pointed out as sources of disease resistance and are widely used in sunflower breeding programs (Christov, 1996; Seiler, 1992; Skoric, 1992). The present study aimed to determine the variability and similarities in morphological characters of the crosses as well as among plants within the crosses.

Materials and Methods

In this investigation three accessions of wild *H. annuus* L. included: E-114 originating from Missouri, USA; E-167, obtained from the National Genebank, and MXO-1 originating in Mexico, as well as the sterile analogues of two lines of cultivated sunflower, 2607 and 6075, used as female forms.

The hybridization between lines 2607 and 6075 and the three wild forms *H. annuus* was carried out under field conditions in the breeding field. Hybrid plants were obtained

in Mexico, as well as the sterile analogues of two lines of cultivated sunflower, 2607 and 6075, used as female forms.

The hybridization between lines 2607 and 6075 and the three wild forms *H. annuus* was carried out under field conditions in the breeding field. Hybrid plants were obtained after seed was planted in pots and later transplanted in the field and in the quarantine plot after the second pair of true leaves appeared.

The following morphological characters were observed and described: plant height; number of plants; anthocyanin coloration of the hypocotyl; leaf size, shape, and color; leaf blistering and fineness of serration; wings, angle of lateral veins and shape of cross section of the leaf; stem hairiness; time of flowering; ray flower number, shape, length and color; disk flower color, anthocyanin coloration of stigma; presence of pollen; bract shape, and length of the tip; external color; position of lateral head; head attitude, size, and shape of the grain side; type of branching; seed size, shape, thickness, color and stripes; 1000-seed weight and seed oil content. The phenological evaluation of plants was made during their vegetation period in the field and in the quarantine plots.

Results and Discussion

This study was carried out during 2002 and 2003. The first year the crosses between two lines of cultivated sunflower and three wild forms of *H. annuus* were made. A study of the F1 plants was carried out in 2003.

Table 1. Pedigree and number of studied F1 plants from crosses between cultivated sunflower (*Helianthus annuus*) and wild forms of *H. annuus*.

Crosses	Total number of plants studied
L 2607 A x <i>H. annuus</i> E-114	25
L 2607 A x <i>H. annuus</i> E- 167	15
L 2607 A x <i>H. annuus</i> MXO-1	12
L 6075 A x <i>H. annuus</i> E- 114	14
L 6075 A x <i>H. annuus</i> E- 167	12

The number and pedigree of the F1 plants studied was pointed out in Table 1. The results from the investigation gave the reasons for confirming the statement already established by different authors (Satziperov, 1916; Georgieva-Todorova, 1964, 1976; Bohorova, 1983; Christov, 1988, etc.) that after crossing between wild *Helianthus* species and cultivated sunflower a diversity in F1s was observed. From these five groups of crosses the total number of F1 plants was 78. All F1 plants had erect and branched stems. Their height varied from 160 cm to 210 cm. The differences in plant height were found, as well as in some other characters due to the fact that the wild *Helianthus* forms were populations. The differences appeared between hybrid plants obtained after inclusion of populations in hybridization was a normal occurrence, because their heterozygosity was well expressed.

The stem was angular, dark green, and covered with short, sharp hairs with a high intensity just before flowering, 5 cm below the head for all plants from the crosses 6075A x E-114 and 6075A x E-167. The peduncle was longer than that of parental forms. The type of branching was varied for the different crosses. Basal branching of plants from crosses 6075A

x E-114 and 6075A x E-167 was observed. All other crosses were distinguished by full branching.

The leaves had an intermediate type of inheritance. Their size varied from short (15 cm by 18 cm) for the crosses 2607A x MXO-1 and 2607A x E-114, and medium (18 cm by 21 cm) for the cross 2607A x E-167 to large (28 cm by 35cm) for the crosses 6075A x E-114 and 6075A x E-167. Leaf shape for crosses 6075A x E-114 and 6075A x E-167 was cordate and for the rest it was triangular. Leaf blistering and serration fineness were observed for the crosses 6075A x E-114, 6075A x E-167 and 2607A x MXO-1.

The natural position of the closest lateral head to the central head at the end of flowering for all crosses was below, with the exception of crosses 6075A x E-114, and 6075A x E-167. Days to flowering varied between different crosses and within plants and the same cross. The inflorescence had medium inheritance. Number of ray flowers was medium for all plants. Their shape was ovoid for the cross 2607A x MXO-1 but for the rest of the crosses it was elongated. Ray flowers of 2607A x MXO-1 were the longest (9 cm). The disk flowers were yellow and strong anthocyanin coloration of the stigma was observed for crosses 6075A x E-114, 6075A x E-167, and 2607A x MXO-1, and partial coloring for separate plants from crosses 2607A x E-114 and 2607A x E-167. Bract flowers were wide, prolonged, green and rarely covered with short, sharp hairs, thickened on the edge. The heads were medium sized with a flat shape on the grain side. Crosses 6075A x E-114, 6075A x E-167 and separate plants from 2607A x E-167 had the longest vegetative period.

Regarding fertility, the F1 plants showed typical interspecific hybridization differences. Plants with sterile florets and inflorescences and other plants with pollen dissociated from florets were obtained.

Sterile inflorescences were obtained since the included female plants were in CMS PET-1 and populations of wild *H. annuus* possessed genes controlling the stabilization of CMS PETt-1. The presence of a greater percentage of fertile plants showed that Rf genes for the CMS PET-1 in these populations were transferred into the hybrid plants. These plants could be used for creation of new R lines for the purpose of heterosis breeding in sunflower.

Seeds obtained were of medium size and different colors, from reddish-brown to dark violet. Seeds from different plants varied in length, thickness and oil content. Seed oil content of plants from the cross 2607A x E-114 varied from the first plant, 37.57%, second plant, 37.57%, to the 11th plant, 29.73% and the 15th plant with 36.98%. The same results were observed for other crosses: 2607A x MXO-1, first plant 32.64%; first plant of 2607A x E-167, 32.14%; and for the first plant of 6075A x E-114, 33.30%.

Our observations showed that in the quarantine plots F1 plants were not attacked by downy mildew (*Plasmopara halstedii* [Farl.] Berl. and de Toni), Phoma black stem (*Phoma macdonaldii* Boerema) or Phomopsis stem canker (*Phomopsis helianthi* Munt.-Cvet. et al.). Only one plant from the cross 2607A x E-114 was attacked by Sclerotinia wilt (*Sclerotinia sclerotiorum* [Lib.] de Bary) and one by broomrape (*Orobanche cumana* Wallr.).

Conclusions

Inheritance of characters of hybrid plants obtained from crosses between lines 2607A and 6075A and three forms of wild *H. annuus* was intermediate. Diversity of many characters was registered between plants from different crosses and among plants within the cross. Restorer genes for the CMS PET1 were transferred for some of the hybrid plants.

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