WILD SUNFLOWER GERMPLASM COLLECTED FROM THE CENTRAL GREAT PLAINS OF THE UNITED STATES

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SUMMARY

The genus *Helianthus* constitutes the basic genetic stock from which cultivated sunflower (*H. annuus* L.) originated, and continues to contribute to the improvement of cultivated sunflower. Much genetic variability remains to be exploited. Since the hypothesized origin of wild and cultivated sunflower is from the Central Great Plains, wild populations from this area have potential for increasing genetic variability of cultivated sunflower. One hundred-forty populations representing two annual and six perennial species were collected from the Central Great Plains. The most frequently collected species was wild *H. annuus* (82 accessions), followed by *H. petiolaris* ssp. *petiolaris* Nutt. with 25 accessions. The remaining populations were perennial. Seed from the populations has been deposited at the UDSA-ARS, NPGS Regional Plant Introduction Station at Ames, Iowa; NBPGR at New Delhi, India; and the IFVC at Novi Sad, Yugoslavia for evaluation and enhancement. The addition of these populations to the germplasm collection will greatly increase the available genetic diversity and preserve it for future improvement of cultivated sunflower.

INTRODUCTION

Wild *Helianthus* spp. are the direct progenitor of the modern day cultivated sunflower. The Central Great Plains area has been proposed as the center of origin of the genus *Helianthus* and

cultivated sunflower. Wild sunflower populations collected from this area would be a valuable genetic resource for the improvement of cultivated sunflower. Wild species have provided a continued source of desirable agronomic characteristics for cultivated sunflower (Thompson et al., 1981; Rogers et al., 1982; Seiler, 1988). Cultivated sunflower has a narrow genetic base, based on a single cytoplasm, making it vulnerable to a disaster as was experienced in corn with southern corn leaf blight (Tatum, 1971). As sunflower production expands and intensifies throughout the world, it will require enhanced pest resistance, stress tolerance, and environmental adaptability. The genetic variability of cultivated sunflower can be increased by infusions of genes from the wild species. The wild species possess considerable variability for disease, insect, and stress tolerance, as well as seed quality characteristics.

It is not only important to utilize wild sunflower species for improvement of cultivated sunflower now, but it is also important to collect and preserve it for future use even though it may not appear to have immediate use in a breeding program (Burton, 1979). Natural habitats and populations are continually being destroyed by man's activities, so it is imperative that we collect germplasm while it is still available (Chang, 1985). Since we cannot, as of yet, predict the occurrence, severity, or even the nature of future disaster situations with acceptable levels of confidence, we must collect and assemble all possible genetic diversity now and have it in a useable form for future needs (Jones, 1983). This paper documents the collection of wild sunflower species from the Central Great Plains of the United States and provides field observations to facilitate its introgression into cultivated sunflower.

MATERIALS AND METHODS

The sunflower exploration took place from September 4 to 17, 1991. The exploration was a joint project of: USDA-ARS, Fargo, ND; USDA, National Plant Germplasm System (NPGS), Ames, Iowa; Institute of Field and Vegetable Crops (IFVC), Novi Sad, Yugoslavia in cooperation with the International Board for Plant Genetic Resources (IBPGR), Rome, Italy; National Bureau of Plant Genetic Resources (NBPGR), New Delhi, India; and USDA Office of International Cooperation and Development (USDA-OICD), Washington, DC. The exploration covered 7200 km. in seven states: North Dakota, South Dakota, Nebraska, Kansas, Montana, Wyoming, and Colorado. Seed heads were collected from 10 to 100 individual plants within each population. Seed was bulked into one accession per population.

Herbarium specimens were deposited in the USDA-ARS wild *Helianthus* herbarium at Fargo, North Dakota. The seed samples from the exploration were deposited at the USDA-ARS Regional Plant Introduction Station at Ames, Iowa where they will be maintained and distributed. Duplicate collections will be maintained at the IFVC and NBPGR.

All populations collected were from the known distributional range of the species. The general species distribution maps were used to locate populations (Heiser et al., 1969; Rogers et al., 1982; Great Plains Flora Assoc., 1986). Species populations were collected as they were encountered and usually a species was not re-collected within a 16 km radius. Population size (number and extent), habitat, soil type, seed set per head, and presence of other wild sunflower species in the immediate area were recorded for each population.

RESULTS AND DISCUSSION

One hundred-forty accessions of wild sunflower were collected during the exploration (Table 1). One hundred-seven populations were annual, while 33 were perennial. Almost 60% of the accessions were wild annual *H. annuus*. The geographic area explored was vegetated by grasslands with a few broad-leaf deciduous and coniferous trees with the exception of the Black Hills of South Dakota. This area is mostly coniferous trees at higher elevations. In general, the area explored was very sparsely populated, but with considerable agricultural activity, i.e. farming and ranching. Much of this area, particularly the western half of the area, is ecologically fragile, but appears to be in fair to good condition. The area has experienced drought for the past three to five years, but this year, due to timely and plentiful rain, much of the area was in very good condition and had an abundance of wild sunflowers.

The annual species of sunflower are typically associated with disturbed areas. The basic habitat for the annual species was disturbed roadside ditches, with *H. annuus* usually found in clay-loam soils, and *H. petiolaris* ssp.*petiolaris* being found in sandy soil. Both annual species were abundant in harvested wheat fields of Kansas, Colorado, and Nebraska, often covering several hectares. The perennial species generally inhabit roadside ditches, edges of cultivated fields, waste areas, edges of wooded areas, streams, and swampy areas. The perennial species were found in species-specific habitats where they have become part of the vegetation of the region (Table 1).

Species identification was generally not difficult. The annual species overlap in their areas of major distribution in

Kansas, Colorado, Nebraska, North Dakota, and South Dakota. In these areas, the potential for interspecific hybridization and introgression exists. Some populations appeared to be mixed, but were assigned to one species or another with a high degree of confidence due to past experience with these species. In areas of major sunflower cultivation, North and South Dakota, wild populations appear to have been introgressed with cultivated sunflower. In a few wild annual populations, some plants with cultivated characteristics were observed. Identification of the perennial species was generally not difficult. The identification of only two populations was somewhat questionable, one from Montana of *H. maximiliani* Schrad. and one from Nebraska of *H. grosseserratus* Martens. As additional populations of these species were located, it became clear that the questionable populations were extremes in variations of the species in question.

The best seed set was found in the annual species *H. annuus* and *H. petiolaris* ssp. *petiolaris*, as expected. The lowest seed set appeared to be in *H. tuberosus* L., which is consistent with previous observations (Seiler et al., 1990). Seed set in the other perennials was typical for the species. Ample seed of most populations was available for collection.

It was somewhat surprising to observe the high frequency of rust (*Puccinia helianthi)* Schw. in the Central Great Plains. Infection ranged from very light to loss of leaves because of a heavy infection within a population. Rust was present on 70% of the wild *H. annuus* populations, and 65% of the *H. petiolaris* ssp. *petiolaris* populations. About 50 % of the perennial species populations were infected with rust. Sixty-two percent of *H. maximiliani* populations had rust, while all populations of *H. nuttallii* T.& G. ssp.*rydbergii* (Britton) Long, *H. tuberosus* and *H. pumilus* Nutt. were infected. All three populations of *H. nuttallii* ssp. *nuttallii* T.& G. did not have rust. Thirty-three percent of *H. pauciflorus (=rigidus)* Nutt. ssp. *subrhomboideus* (Rydb.) Spring & E. Schilling populations had rust infection. Because these are field observations, caution should be noted because of the small number of populations observed and the time of year of the observations. Some populations may have been escapes, and the absence of rust may not be related to genetic resistance. Attempts were made to collect rust spores to characterize the races, but most pustules had already produced teliospores and could not be collected.

The occurrence of other diseases was sporadic. Powdery mildew (*Erysiphe cichoracearum* DC.) was observed in a few populations. Due to the advanced maturity of many of the populations, it was difficult to distinguish the classical disease symptoms of many of the diseases that might have been present.

The most frequent insect damage observed was caused by the seed weevil (*Smicronyx* spp.). Seed weevil characterization and identification will be studied by Dr. Larry Charlet, USDA-ARS,

Fargo, ND. Insect damage to piths of stems was frequently observed, and also insect damage to receptacles of heads by the *Suleima* bud moth. Frequent damage to heads and bracts, as well as leaf feeding damage was observed, which was probably due to grasshopper feeding.

The present exploration was the most successful exploration in terms of the number of accessions collected, the greatest number of populations for distance traveled and time spent collecting. The addition of 82 accessions of wild *H. annuus* from a major production area of cultivated sunflower will be a valuable asset. Twenty years ago, several wild annual accessions were collected from this area, but few of the accessions are available for distribution at present. The addition of several perennial species, especially *H. pauciflorus* ssp. *subrhomboideus* and *H. maximiliani* increased the number of accessions of these species in the germplasm collection. Since there is a continuing need for additional populations of wild sunflower, future explorations are planned for the Prairie Provinces of Canada, and the Baja and Sonoran regions of Mexico.

CONCLUSIONS

One hundred-forty populations of wild sunflower were collected, representing eight species. *Helianthus annuus* was represented by 82 populations and *H. petiolaris* ssp. *petiolaris* by 25. The annual species are particularly valuable because they were collected close to the proposed center of origin of wild and cultivated sunflower. These populations will be valuable genetic resources for future improvement of cultivated sunflower. Future explorations are planned for Canada and Mexico with the continuing goal of collecting and preserving genetic diversity for future utilization in cultivated sunflower. Detailed information concerning the exploration and a copy of the official report can be obtained from the senior author.

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