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WILD SUNFLOWER GERMPLASM COLLECTED FROM THE GREAT LAKES REGION OF THE UNITED STATES

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SUMMARY

Eighty-four populations of wild sunflower were collected from the Great Lakes Region of the United States. Twelve diferent species are represented in the populations. *Helianthus tuberosus was* represented by 13 accessions and *H. giganteus* by 10 accessions, significantly increasing the number of accessions of *H. giganteus* in the collection. Additional accessions of *H. divaricatus, H. decapetalus, H. mollis*, and *H. hirsutus* were also collected. The addition of these populations to the wild sunflower germplasm collection will greatly increase the available genetic variability for improvement of cultivated sunflower. Future collection explorations are planned for Canada and Mexico with the goal of preserving significant portions of the natural genetic diversity of wild sunflowers.

INTRODUCTION

Wild *Helianthus* spp. germplasm, besides constituting the basic genetic background from which cultivated sunflower (*Helianthus annuus* L.) originated, has contributed specific agronomic characteristics for sunflower improvement (Thompson et al., 1981). Since the cultivated sunflower has a very narrow genetic base, it is potentially vulnerable to a disaster as was experienced in corn with the southern corn leaf blight of 1970 (Tatum, 1971). Increasing the genetic variability of cultivated sunflower by an infusion of wild genes, especially for disease and insect resistance, will become more important as cultivated sunflower production intensifies in different areas of the world.

Heterosis generally increases as the genetic diversity between parents increases (Fehr, 1987). Wild sunflower species can provide the needed diversity to obtain maximum heterosis for cultivated sunflower. Wild species of the genus *Helianthus* possess considerable variability for many agronomic characteristics, disease and insect resistance, and seed quality factors. The wild species of *Helianthus* have the potential for markedly improving commercial hybrid sunflower through interspecific hibridization.

This report documents the collection of wild sunflower species from the Great Lakes Region of the United States and provides field observations which may facilitate the intergration of the wild germplasm into cultivated sunflower.

MATERIALS AND METHODS

The sunflower exploration took place from September 13-26, 1989. The exploration was a joint project of the USDA - Agicultural Research Service (ARS), USDA - National Plant Germplasm System (NPGS), Institute of Field and Vegetable Crops, Novi Sad, Yugoslavia with cooperators from the FAO (Sunflower Subnetwork), and the International Board for Plant Genetic Resources, European Cooperative Program for Conservation of Crop Genetic Resources (IBPGR, ECP/GR). The exploration covered 7200 km, while collecting in five states of the Great Lakes Region of the United States. The states included were Wisconsin, Michigan, Ohio, Illinois and Indiana (Fig. 1). Seeds were collected from 84 populations, and rootstocks were collected from 5 populations. Herbarium specimens for all populations were deposited in the USDA-ARS wild *Helianthus* herbarium at Fargo, North Dakota.

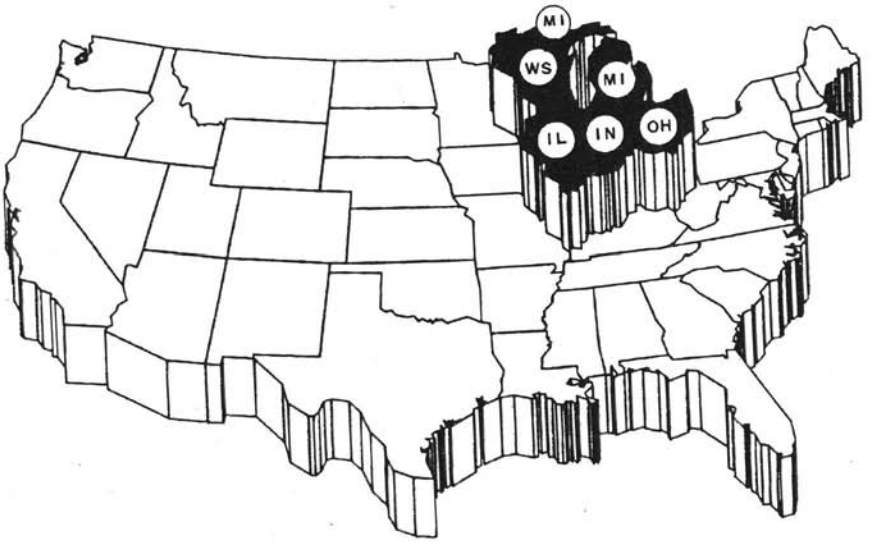

Figure 1. Wild sunflower exploration - 1989.

All collections were from the known distributional range of the species. The general species distribution maps (Heiser et al., 1969; and Rogers et al., 1982) were used to locate populations. Specific collection sites were suggested by local botanists familiar with wild sunflower populations in their areas as well as local flora maps. Species populations were collected as they were encountered and usually a species was not recollected within a 16 km radius. Population size (number and extent), habitat, seed set per head, presence of any diseases or insect damage, and other wild sunflower species in the immediate area were recorded for each sample collected.

RESULTS AND DISCUSSION

Eighty-four populations representing twelve species were sampled during the exploration (Table 1). Seventy-nine populations were perennial and only five (four *H. annuus* L. and one *H. petiolaris* ssp. *petiolaris* Nutt.) were annual.

Table 1. Summary of the wild sunfolwer species collected from the Great Lakes region of the Unated States during September 1989

Species	Number of populations	Location(s)[a]	General Habitat
H. annuus[b]	4	IL	disturbed roadside ditches
H. petiolaris ssp. petiolaris[b]	1	IL	sandy roadside ditch
H. decapetalus	2	OH	edge of shaded woods
H. divaricatus	4	OH, IN, IL	dry, open areas, sometimes along edge of woods
H. giganteus	10	WS, IL	moist roadside ditches
H. grosseserratus	18	WS, IL, IN, MI	moist to dry roadside ditches
H. hirsutus	1	IL	dry, usualy open habitat
H. maximiliani	2	IL	roadside ditch, dry prairies
H. mollis	1	IN	roadside ditch, dry open areas
H. strumosus	13	WS, IL, MI, OH, IN	moist to dry roadside ditches
H. tuberosus	18	WS, OH, IN, IL	moist to moderately dry, open or shaded areas
H. hirsutus (?)	1	OH	dry, usually open habitat
H. maximiliani (?)	2	OH, IL	roadside ditch, dry prairies
H. rigidus ssp. rigidus (?)	1	IL	moist roadside ditch
H. strumosus (?)	1	IL	moist to dry roadside ditches
H. tuberosus (?)	5	OH, IL	moist to moderately dry, open or shaded areas
Total	84		

[a] IL = Illionis, IN = Indiana, OH = Ohio, MI = Michigan, and WS = Wisconsin
[b] Annual species; remaining species perennial

The geographic area covered in the exploration was vegetated mostly by mixed deciduous and coniferous forests in the northern part of the area, deciduous forests to the east and grasslands to the west. In general, most of the area is not heavily populated except in concentrated areas of cities. There is considerable agricultural activity in the southern half of the area explored. There was a general lack of annual species over much of the explored area, since much of this area is climax forest. Wild annual sunflower species are usually associated with disturbed areas, but this was not the case in this section of the U.S. It was suspected that the intense use for agricultural chemicals and widely used crop rotations produced an environment unfavorable for annual species. Most wild sunflower observed were perennials surviving in roadside ditches, or edges of fields or wooded areas. Much of the present agricultural land has been cleared of trees, with wild sunflowers primarily surviving along the perimeters of the cultivated areas.

The states of Indiana, Illinois, and Ohio had greater species diversity and more numerous populations than other states in the region. The northern part of the exploration area, especially northern Michigan, produced few species.

Seed set was variable from population to population. Past experience has shown that perennials produce fewer seeds than annuals probably because perennial plants do

Figure 2. Helianthus maximiliani located along edge of soybean field near roadside ditch in Ilinois.

Figure 3. Typical habitat for *H. grosseserratus* along the edge of stream.

Figure 4. A large population of *H. mollis* in a dry open roadside ditch along edge of trees.

not need seeds for short term survival, but do need some seed production to facilitate the maintenance of genetic divesity in a population. Seed set in the perennial population may also be influenced by population size. Since wild sunflowers are self-incompatible, small populations may not have sufficient suitable pollen, or pollinators to adequately interpollinate (cross-pollinate) the population. In general, it was observed that larger populations did have better seed set; but this was not absolute and depended on the individual population. The lowest seed set appeared to be in *H. tuberosus* L. which is consistent with observations by Swanton and Cavers, 1989.

Identification of some populations was difficult because of the probable interspecific hybridization and introgression of several related species. The most confusing populations were those which appeared to be *H. tuberosus* and *H. strumosus* hybrids. Complicating the identification was the varyng ploidy level of *H. strumosus*. Accurate identification of *H. hirsutus* Raf. and *H. maximiliani* Schrader became problematic in some populations in this part of the U.S. A typical population of *H. maximiliani* can be seen in Figure 2. Voucher specimens colected from the original populations will be compared to plants grown in a common environment to assess the variability present within the species. Also, chemotaxonomic studies of the problematic populations will facilitate proper species identification.

Helianthus tuberosus and *H. grosseserratus* were the most frequently collected species (Table 1). *Helianthus grosseserratus* is typically located near a stream or moist area (Fig. 3). Previously, some populations of *H. tuberosus* have snown potential as sources of disease resistance and/or tolerance to some of the major diseases. The addition of populations of this species will increase the genetic diversity available to sunflower breeders for crop improvement. Most populations of *H. tuberosus* collected were considered wild populations, due to their small tubers. Several populations of *H. giganteus* were added to the wild sunflower germplasm collection.These represent a substantial increase in the number of populations of this species held in the collection. The addition of several accessions of *H. divaricatus* L., *H. decapetalus* L., *H. mollis* Lam., and *H. hirsutus* significantly increases the diversity within the sunflower germplasm collection. *Helianthus mollis* has a unique phenotype the wild sunflower species (Fig. 4). Many of these species were previously represented by only a few populations.

Since many of the collected populations were perennial, and some probably with differing ploidy levels, difficulties will likely be encountered when hybridizing (crossing) with cultivated lines. Utilization of embryo rescue and chromosome doubling should facilitate the utilization of these materials in breeding programs (Jan and Chandler, 1989).

It was quite surprising to see the high frequency of rust, *Puccinia helianthi*, present at many collection sites. Infection severity ranged from very light, to populations which had lost leaves because of heavy infections. Rust was present on one *H. annuus* population, but not on the only *H. petiolaris* ssp. *petiolaris* population found. It was particularly interesting to see rust on several perennial species. Several collections of rust spores were made to allow identification of the races present on the wild species. This research is being conducted by Dr. Tom Gulya, USDA, ARS, Fargo, ND. Other diseases were observed but their occurrence was inconsistent. Powdery mildew was the second most frequent disease observed, while *Verticillium dahliae* was seen twice and *Alternaria helianthi* leaf spot once. It is important to note that the incidence of diseases in many

populations was variable indicating that populations are heterogeneous and generally segregating for resistance to the disease or that microclimate had a major effect on disease develompment. This supports the need for additional populations to adequately characterize a species for disease resistance and/or tolerance.

The most frequent insect damage observed was from the seed weevil (*Smicronyx* spp.). In the perennial populations which set few seeds per head with larger seeds, there appeared to be more seed weevil damage than in smaller heads with smaller seeds. The weevil may be more attracted by the larger seed, or the populations of the weevil were high in these areas. Occasional damage to heads was observed as well as leaffeeding damage, probably due to grasshoppers and aphids. Stem galls were seen in a few populations. Stems from selected populations were collected to survey for stem emerging insects. This research is being conducted by Dr. Larry Charlet, USDA-ARS, Fargo, ND.

All seeds and rootstocks collected have been deposited at the Regional Plant Introduction Station, Ames, Iowa, where they will be incorporated into the NPGS and assigned "PI" numbers. Accessions will be increased, maintained, and distributed from Ames. The cooperators from Yugoslavia and the Soviet Union also collected seeds from the same populations as those deposited at Ames. They will utilize the materials in their respective research programs.

Since there is a continued need for additional populations of wild sunflower, more explorations are planned for the Great Plains of the U.S., prairie provinces of Canada and the Baja and Sonoran regions of Mexico. Detalied information concerning the present exploration and a copy of the official report can be obtained from the senior author.

CONCLUSIONS

Eighty-four populations of wild sunflower were collected from the Great Lakes Region of the United States. Twelve different species are represented in the populations. *Helianthus tuberosus* was represented by 13 accessions and *H. giganteus* by 10 accessions, significantly increasing the number of accessions of *H. giganteus* in the collection. Additional accessions of *H. divaricatus, H. decapetalus, H. mollis,* and *H. hirsutus* were also collected. The addition of these populations to the wild sunflower germplasm collection will greatly increase the available genetic variability for improvement of cultivated sunflower. Future collection explorations are planned for Canada and Mexico with the goal of preserving significant portions of the natural genetic diversity of wild sunflowers.

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TOURNESOLS SAUVAGES COLECTES DANS LA REGION DES GRANDS LACS AUX ETATS UNIS.

Seiler, G. J., Pomeroy, J. S., Dozet, B. & Gavrilova, V.

Quarante quatre populations de tournesol sauvage ont ete récoltées dans la région des Grands Lacs aux Etates-Unis. Treize accèssions d'*Helianthus tuberosus* ont été trouvées, dix pour *H. giganteus* ce qui augmenté significativement le nombre d'accèssions pour cette espèce dans notre collection. De nouvelles accèssions ont été également déterminees pour les espèces suivantes: *H. divaricatus, H. decapetalus, H. mollis* et *H. hirsutus.* Ces nouvelles populations de tournesols sauvages vont grandement contribuer a l'augmentation de la variabilité génétique expéditions sont prévues pour le Canada et le Mexique afin de preserver une partie importante de la diversité génétique naturelle présente chez les sauvages de tournesol.

GERMOPLASMA DE GIRASOL SILVESTRE RECOLECTADO EN LA REGION DE LOS GRANDES LAGOS DE LOS EE.UU.

Seiler, G. J., Pomeroy, J. S., Dozet, B. & Gavrilova, V.

Ochenta y cuatro poblaciones de girasol silvestre fueron recolectadas de la zona de los grandes Lagos de los EE.UU. Doce diferentes especies estan representados en esta colección. *H. tuberosus* esta representado por 13 entradas y *H. giganteus* por 10, aumentándose considerablemente el número de entradas de esta especie en la colección. También se recolectaron varias entradas de *H. divaricatus, H. decapetalus, H. mollis* y *H. hirsutus*. La adición de estas nuevas entradas a la colección de girasol silvestre incrementa considerablemente las fuentes de germoplasma asi como la variabilidad genética disponible para el mejorador. Se estan planificando nuevas en Méjico y Canadá para reecolectar nuevas entradas.