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VALUABLE SUNFLOWER GERMPLASM COLLECTED FROM THE NORTHWESTERN UNITED STATES

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SUMMARY

Fifty populations of wild annual and perennial sunflower were collected from the northwestern region of the United States. Six different species were represented with 28 populations of annual *H. annuus*, three *H. petiolaris* ssp. *petiolaris,* four *H. cusickii, two H. maximiliani*, twelve *H. nuttallii ssp. nuttallii*, and one *H. pumilus*. The most significant contribution was the collection of *H. cusickii* and *H. pumilus* accessions, which have potential for drought tolerance. Future explorations are needed to preserve the natural diversity of wild sunflowers.

Key words: Sunflover, germplasm, wild species,

INTRODUCTION

The sunflower has a unique position among crop species of the United States since the wild progenitors and crop species are native to North America, more specifically the Great Plains. Cultivated sunflower has a narrow genetic base, based on a single cytoplasm, making it vulnerable to a disaster as was experienced in corn (Zea mays L.) 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 an infusion of genes from the wild species, which have provided a continued source of desirable agronomic characteristics (Seiler, 1988; and Thompson et al., 1981).

Natural habitats and populations are continually being destroyed by man's activity, so it is imperative that the remaining germplasm be collected while it is still available. It is important to collect sunflower germplasm even though it may not have immediate use since we can not predict the occurrence, severity, or even the nature of future disasters. This paper documents the collection of wild sunflower species form the northwestern United States and provides field observations to facilitate its introgression into cultivated sunflower.

MATERIALS AND METHODS

The sunflower exploration took place from 31 August to 14 September, 1987. The exploration was a joint project of USDA–Agricultural Research Service, Fargo, ND; USDA–ARS National Plant Germplasm System (NPGS), Ames, Iowa; and the Institute of Field and Vegetable Crops (IFVC), Novi Sad, Yugoslavia in cooperation with the

International Board for Plant Genetic Resources (IBPGR), Rome, Italy. The exploration covered 9600 km in five northwestern states: Wyoming, Montana, Idaho, Oregon and Washington (Figure 1). Seed heads were collected from 10 to 100 plants within each population. Seed was bulked into one accession per population. Seed was collected for all populations except one, and rootstocks were collected from 11 populations.

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 North Central Regional Plant Introduction Station (NCRPIS), Ames, Iowa where they will be maintained and distributed. Duplicate collections will be maintained at the IFVC, Novi Sad.

All populations collected were from the known distributional range of the species. General species distribution maps were used to locate populations (Heiser et al., 1969; Rogers et al., 1982; and Great Plains Flora Assoc., 1986). Species populations were collected as they were encountered and usually a species was not re–collected within a 20 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

Fifty accessions representing six different species were collected during the exploration (Table1). Thirty–one accessions were annual, while 19 were perennial. Almost 60% of the accessions were wild annual *H. annuus*. The geographic area explored was a coniferous–deciduous forest intermixed with sagebrush–grassland. In general, the area explored was not heavily populated, except in concentrated areas of cities. Habitat disturbance was not great in most of the area, except in areas of logging and agricultural activities. Disturbed habitats frequently provide an area for annual sunflowers to establish themselves, but this was not observed in the wooded areas, especially in Oregon and Washington.

Perennial species had become established in some of the more open habitats. 1987 was an unusually dry year in the Pacific northwest, with some areas not receiving rain in over 100 days.

The annual species of sunflower are typically associated with disturbed areas. The basic habitat for the annual species was disturbed areas with clay loam soil near agricultural activities and in inhabited areas (Table 1). This species was the most widely spread of any of the species collected. *Helianthus petiolaris* ssp. *petiolaris* is restricted to sandy soils. The perennial species generally inhabit roadside ditches, edges of cultivated fields, waste areas, edges of wooded areas along streams, and swampy areas. The perennial species are usually found in species specific habitats.

Species identification was facilitated by the presence of flowers in most populations. The perennial species collected were quite distinct species and do not readily hybridize and introgress in this area.

In general, the lack of sunflowers along the coastal area of Oregon and Washington was somewhat unexpected. At one time, we drove almost 800 km without seeing a single sunflower. We would have expected to see a few perennial species in and along the edges

Table 1. Wild sunflower species collected from the Northwestern Region of the U.S. during September, 1987

Species	Number of populations	Collection site(s)*	Typical habitat
ANNUAL			
H. annuus	28	OR, WA, ID, MT	Disturbed roadside ditches
H. petiolaris ssp. petiolaris	3	MT	Sandy roadside ditches
PERENNIAL			
H. cusickii	4	OR, WA	Steep rocky clay slopes
H. maximiliani	2	MT	Moist roadside ditches
H. nuttallii ssp. *nuttallii*	12	OR, ID, WY, MT	Moist roadside ditches
H. pumilus	1	WY	Rocky soil, roadside ditches
TOTAL	50		

* OR = Oregon, WA = Washington, ID = Idaho, WY = Wyoming and MT = Montana

of wooded areas, but none were found. There may be several reasons for lack of wild sunflowers in this area. First, we were there at the wrong time of the year; second, due to forests and climatic conditions, the species have not become established; and third, due to the lack of adequate habitat to become established. The absence of wild sunflower is probably a combination of many things.

Most species which are known to inhabit the region were collected. *Helianthus bolanderi*, an annual species, was not collected because of serious forest fires in southwestern Oregon and northern California. Collection in this area was prohibited. We do not feel that the forest fires threatened the species in general, while it certainly may have destroyed some localized populations. The other species not collected was the perennial *H. ciliaris*. This species had been previously reported as a weed in an orchard. It was probably locally restricted to a limited area and was not located. This species becomes a noxious weed in agricultural areas of the southwest U.S.

Seed set appeared to be good, especially in the annual species. Seed set in the perennial accessions was variable. Past experience has shown that perennials do not set many seeds, probably due to their perennial nature, and do not need to set seed to survive. The size of the population also influences the availability of pollen and pollinators, and thus seed set. Attempts were made to collect from large populations, but the perennial *H. cusickii* populations were never large. Another problem was that some of the perennial populations were past flowering and the good seed had already shattered. One population of *H. pumilus* had good seed set. Most accessions of *H. nuttallii* ssp. *nuttallii* were large populations and had good seed set. The other perennial species, *H. maximiliani*, occurred in small scattered populations.

Most of the populations from which seeds were collected did not have any evidence of diseases, except for the presence of rust (*Puccinia helianthi* Schw.). Rust was observed on eight accessions, seven of which were annual, six *H. annuus* and one population of *H. petiolaris* ssp. *petiolaris*. *Helianthus maximiliani* was the only perennial to have rust

present on it, and it was only a light infection. The severest rust was found in Idaho, near Idaho Falls, where most plants in one population of *H. annuus* were severely infected and plants were apparently dead from the disease. There were several potato and wheat fields in the immediate area. The other area where severe rust was found was near Billings, Montana, in a population of *H. petiolaris* ssp. *petiolaris*. Caution should be noted because these are field observations from a small number of populations at one time of the year. Some populations may have been escapes and the presence of rust may not be related to genetic resistance.

The most frequent insect damage observed was caused by the seed weevil (*Smicronyx* spp.). Two populations had leaf damage due to leaf–feeding insects, probably grasshoppers and aphids. The most evident damage observed in the field was to the head and stems. Stem borer damage was present in several of the perennial and annual species, with damage to the heads by *Suleima* bud moth. Damage to heads and bracts was observed, which was assumed to be caused by grasshopper feeding.

The germplasm collected has several potential uses for the improvement of cultivated sunflower. The most significant contribution of the exploration was the collection of accessions of perennial *H. cusickii* and *H. pumilus*. Both of these species were inadequately represented in the sunflower germplasm collection. These species are potential sources of genes for water stress tolerance based on their arid habitats. The utilization of these germplasm accessions will require considerable enhancement to overcome the strong perennial nature of the species. Interspecific crossing will be difficult and will necessitate the use of some of the newer techniques, such as embryo rescue and chromosome doubling and technologies of plant genetics and breeding.

CONCLUSIONS

Fifty accessions representing six different wild sunflower species were collected from the northwestern U.S. in August to September 1987. *Helianthus annuus* was represented by 28 accessions, while 19 perennial accessions were collected. The most significant contribution was the collection of *H. cusickii* and *H. pumilus*. These diploid perennial species are potential sources of genes for drought tolerance. There is a continued need to collect and preserve valuable sunflower germplasm. Detailed information concerning the exploration and a copy of the official report can be obtained form the senior author.

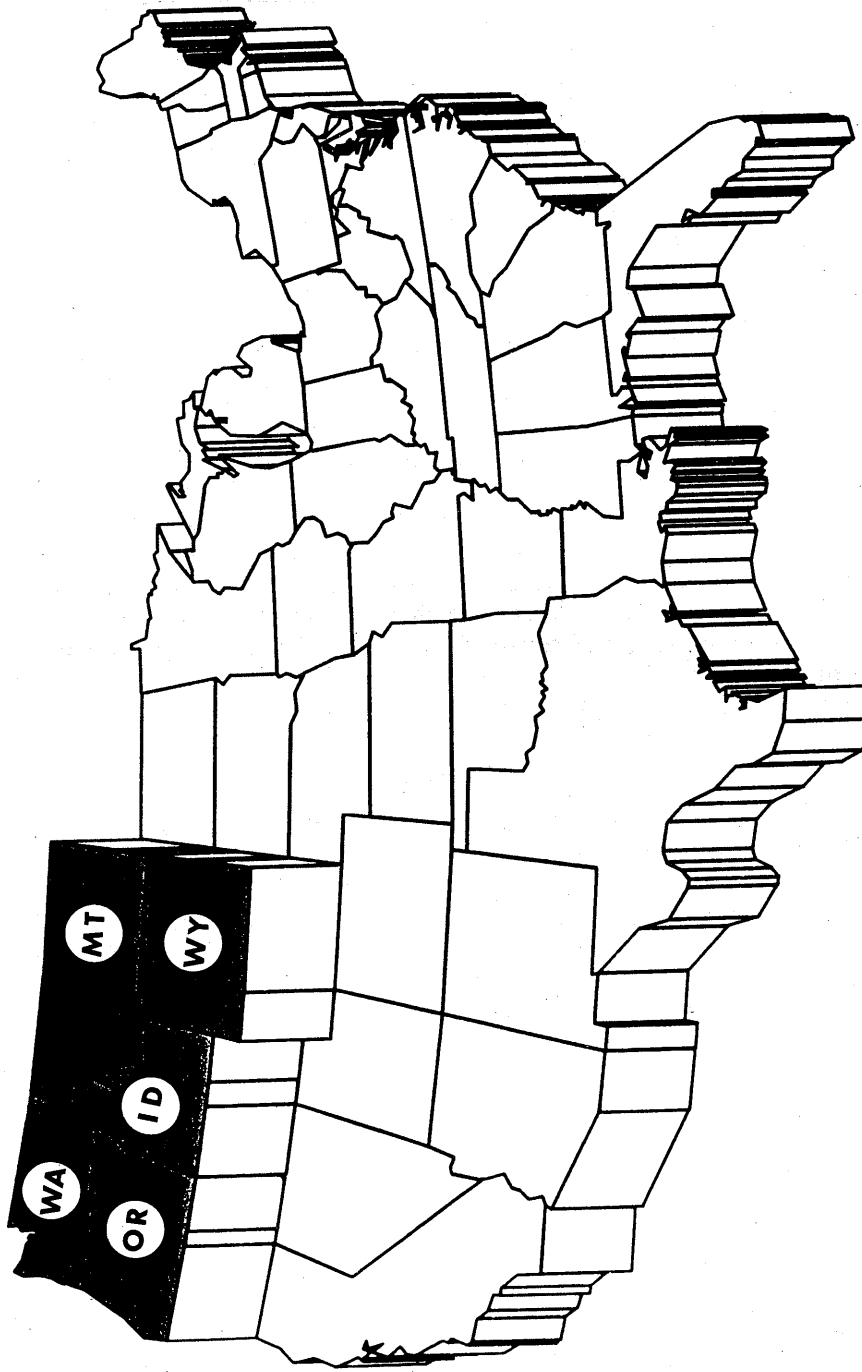

Figure 1. Wild sunflower germplasm exploration to the Northwestern U.S., 1987.

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UN VALIOSO GERMOPLASMA DE GIRASOL RECOLECTADO EN EL NOROESTE DE LOS ESTADOS UNIDOS

RESUMEN

Cincuenta poblaciones de girasol silvestre anual y perennee fueron colecionados en la región del noroeste de los Estados Unidos. Seis especies diferentes fueron representados con 28 poblaciones de *H. annuus* anual, tres *H. petiolaris* ssp. petiolaris cuatro *H. cusickii* dos *H. maximiliani* doce *H. nuttallii* spp. *iuttallii* y una *H. pumilus*. La contribución mas significativa fueron las accesiones de la colección de *H. Cusickii* y *H. pumilus* que tienen potencial para resistencia a sequía. Exploraciones futuras son nccesarias para preservar la diversidad natural de especies silvestres.

COLLECTE DE GERMPLASM DE TOURNESOL AU NORD–OUEST DES ETATS–UNIS

RESUMÉ

Cinquante populations de tournesol sauvage annuel ou perenne ont été collectées dans la région nord-ouest des Etats-Unis. Six espèces différentes sont représentées avec 28 populations de *H. annuus* annuelles, trois de *H. ssp. petiolaris*, quatre de *H. cusickii*, deux de *H. maximiliani*, douze de *H. nuttallii* ssp. *nuttallii*, et une de *H. pumilus*. La contribution la plus significative fut la collection des accessions de *H. cusickii* et *H. pumilus*, qui a un potentiel pour la tolérance à la sècheresse. De futures explorations sont rendues nécessaires dans le but de preserver la diversité naturelle des tournesols sauvages.