

# The National Plant Germplasm System's Sunflower Collection: Genetic Diversity for Developing Countries

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The United States' National Plant Germplasm System (NPGS) is a network of organizations and people dedicated to the preservation of crop genetic diversity. Coordinating the system is the Agricultural Research Service (ARS), principal research agency of the United States Department of Agriculture (USDA). Four regional stations within the NPGS maintain working collections from which germplasm samples are distributed. The USDA-ARS National Center for Genetic Resources Preservation (formerly the National Seed Storage Laboratory) in Fort Collins, Colorado is a long-term preservation facility for back-up germplasm samples of lines or 'accessions' in our collections. In total, there are over 450,000 accessions representing more than 1500 genera within the NPGS.

The NPGS' sunflower collection is maintained at the North Central Regional Plant Introduction Station (NCRPIS) in Ames, Iowa. Over 47,000 accessions of 337 different genera are maintained at the NCRPIS. Some of the larger collections include Maize, Cucurbits, Crucifers, Amaranth, and Sunflowers, which comprise about 8% of our holdings.

The NPGS sunflower collection is a diverse assemblage of 3787 accessions from 57 countries: 1624 cultivated *Helianthus annuus* accessions, 1006 wild *Helianthus annuus* accessions, 411 accessions representing 11 other wild annual *Helianthus* species, and 746 accessions representing 37 perennial *Helianthus* species. This collection is one of the largest and most genetically diverse *ex situ* sunflower collections in the world and it is vital to the conservation of *Helianthus* germplasm. The mission of the NCRPIS is to conserve genetically-diverse crop germplasm and associated information, to conduct germplasm-related research, and to encourage the use of germplasm and associated information for research, crop improvement and product development. The NCRPIS website can be accessed at: <http://www.ars-grin.gov/ars/MidWest/Ames/index.html>

When we acquire new accessions of sunflower, many do not have sufficient seed quantities to distribute germplasm to requestors, so the materials must first be regenerated. Our controlled-pollination and maintenance procedures are designed to preserve the genetic integrity of the accessions. Hand-pollinated field regenerations are conducted for cultivated *Helianthus* accessions with a target population of 100 plants, whereas wild annual and perennial *Helianthus* species have a target population of 50 plants that are caged and pollinated with honey bees. According to an isozyme survey of sunflower germplasm, the populations sizes used for both our wild and cultivated regenerations should be sufficiently high to conserve the fidelity of the accessions' original genetic profiles (Cronn et al. 1997). Germplasm for distribution is stored at 4° C and 25% relative humidity and viability is monitored at five-year intervals. When seed quantities reach a minimum amount or when viability drops below 75%, regeneration is necessary.

Data have been compiled for many traits for accessions within the *Helianthus* collection. This data is recorded during regeneration of accessions and evaluation for various traits. Some of the traits include flowering, plant and seed characteristics, disease and insect resistances, percentage oil content, and fatty acid profile. These data are valuable in identifying appropriate accessions for specific environmental

conditions or research objectives. The data are publicly available on the Germplasm Resources Information Network (GRIN) database at: <http://www.ars-grin.gov/npgs/>

There is also a DOS based diskette version of the database called PCGRIN. Either GRIN or PCGRIN can be used to query the database and select germplasm accessions from the entire collection.

Frequently, researchers are uncertain about the criteria or information needed to help them select germplasm materials needed for their research objectives. To enable researchers to sample the available diversity within the collection without testing excessively large numbers of accessions, a core subset of the cultivated sunflower collection was established in 1999 (Brothers and Miller, 1999). The sunflower core subset consists of 112 accessions grouped into ten clusters (Table 1). Accessions within the same cluster should be more genetically similar than accessions between clusters. Accessions in the core subset represent 38 of the 57 countries of origin for the total cultivated sunflower collection (Table 2). The core subset contains two ornamental accessions, seven breeding lines, 12 landraces, and 91 cultivars. Cluster averages for traits such as plant height, percent single-headed plants, days to flower, oil percentage, percent linoleic acid, and *Albugo* resistance are presented in Table 3. Researchers may initially use the core collection to determine traits of interest and, pending the results of their research, request additional accessions from one or more clusters to explore more in-depth at a later date.

Small quantities of germplasm (generally 100 achenes per accession) are distributed world-wide free of charge for *bona fide* research or educational purposes. Seed of the wild sunflower species may have a high degree of dormancy, so a germination technique is included with the seed to facilitate maximum germination. Follow-up information for the distributed germplasm is requested to track its performance and to better curate the sunflower collection. It should also be noted that accessions of some wild species must be watched closely because they have the potential of becoming pernicious weeds. Import requirements vary from country to country so it is necessary for the requestor to secure any required permits from the agricultural department of the importing country.

To request PCGRIN or sunflower accessions or to receive additional information contact:

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#### References:

- Brothers, M.E. and J.F. Miller. 1999. Core subset for the cultivated sunflower collection. Proc. of the 21<sup>st</sup> Sunflower Research Workshop, pp. 124-127.
- Cronn, R.C., M.E. Brothers, K.M. Klier, P.K. Bretting, and J.F. Wendel. 1997. Isozyme genetic markers and *Helianthus* germplasm management. Proc. of the 19<sup>th</sup> Sunflower Research Workshop, pp. 89-96.

Table 1. Cluster assignment, accession number, pedigree, and country of origin for accessions in the cultivated sunflower core subset.

Cluster No.	Accession No.	Pedigree	Country of Origin
1	Ames 15660	Sannace	USA
1	PI 265099	VNIIMK 1646; 4 Moth Res.	FSU
1	PI 331176	Manfredi INTA	Argentina
1	PI 340790	VNIIMK 8931 '66	FSU
1	PI 377530	Kenya White	Kenya
1	PI 408726	Relax	France
1	PI 430539	Cakinskij 321; VIR 2669	FSU
1	PI 430541	Progress; VIR 2699	FSU
1	PI 431516	Romsun N-2-2004	Romania
1	PI 431558	NS-B-16-63/1	Yugoslavia
2	Ames 3314	Yawne	Zimbabwe
2	Ames 4114	Sundak	USA
2	Ames 10099	Chang Lin	China
2	Ames 20080	Kosin	Bulgaria
2	PI 170412	Turkey, No. 2770	Turkey
2	PI 171655	Acyiceci, No. 6706	Turkey
2	PI 175723	Gonondu, No. 5472	Turkey
2	PI 184048	Novosadski	Yugoslavia
2	PI 232904	Lovaszpatonai	Hungary
2	PI 251901	Jdanovsky 6432	FSU
2	PI 256334		Pakistan
2	PI 289626	France, No. 5	France
2	PI 343798	Tchernianka Select W-17	Iran
2	PI 377528	Dark Stripe	Kenya
2	PI 380576	Pehuen	Argentina
2	PI 496265	Liao 2	China
2	PI 497247	K-2311; VIR 019	FSU
2	PI 500688		Zambia
2	PI 507899	3100402	Hungary
2	PI 535890	Krzynowloski Miejscowy	Poland
3	Ames 3285	Ames 3285	Uncertain
3	Ames 3301	Gigant 549	Germany
3	Ames 7573	Arrowhead	USA
3	Ames 18900	Stepniak, WIR 1686	FSU
3	PI 162454	Sunrise, No. 143	Uruguay
3	PI 221693	No. 2	Indonesia
3	PI 251990	No. K1879	Turkey
3	PI 372173	Peredovik 304 USSR 60%OIL	FSU
3	PI 372258	Smena	FSU
3	PI 386096	Hatzor Ayala	Israel
3	PI 483077	Pervenets	FSU
3	PI 490281	Ames 101	Turkey
3	PI 496263	Damaya	China
3	PI 497250	VIR 160; K-3220	FSU
3	PI 497937	Start	FSU

Table 1 (continued).

Cluster No.	Accession No.	Pedigree	Country of Origin
4	Ames 3221	L-2625-1	Ukraine
4	Ames 3234	6 SC U6 L6; 780721	France
4	Ames 3307	Kruglik A-41	Germany
4	Ames 3391	Romsun V3355; 803420	Romania
4	Ames 3430	VIR 107	UNCERTAIN
4	Ames 18911	Skorospelyj, WIR 3114	FSU
4	PI 386230	VIR 847	Kazakhstan
4	PI 431542	D-75-10	Yugoslavia
5	PI 369359	Hopi	USA
5	PI 507901	3100404	Hungary
5	PI 600705	CO-PB 68	Spain
5	PI 600721	Hidatsa No. 2	USA
6	Ames 3264	Oleisty Borowski; 814309	Germany
6	Ames 3332	Advance; 814277	Germany
6	Ames 3361	VK-47; 803449	FSU
6	Ames 3366	HS 61; 803454	Romania
6	Ames 3454	Karlik	Spain
6	PI 287230	Enisej	FSU
6	PI 307934	Armavirski; Col. No. 943	FSU
6	PI 307942	VNIIMK 8883; Col. No. 951	FSU
6	PI 371936	Voshod; 2180	FSU
6	PI 432519	Landrace	USA
6	PI 487194	Egnazia	Italy
6	PI 497939	VK-12	FSU
6	PI 505839	Odesskij 113; VIR-3321	FSU
6	PI 531351	Georgia	India
7	Ames 3309	B-7422; 803484	Poland
7	Ames 7574	Mennonite	UNCERTAIN
7	Ames 18904	Zaria, WIR 2179	FSU
7	PI 291404	Szaratovszkij Ranni	Hungary
7	PI 296289	Jupiter	South Africa
7	PI 480472	CCA82-2	Zambia
7	PI 531350	Francia "E"; 691; VI-2-366	France
7	PI 307831	Aguapei	Brazil
7	PI 369360	Seneca	USA
7	PI 424926	Kortus	FSU
8	Ames 3426	371-35; 803378	Canada
8	PI 431529	43-48 VK-32	FSU
8	PI 431538	D-75-4	Yugoslavia
8	PI 535894	Wielkopolski	Poland
8	PI 600717	Mandan No. 1	USA

Table 1 (continued).

Cluster No.	Accession No.	Pedigree	Country of Origin
9	Ames 1844	Sepasol	Spain
9	Ames 21671	Ames 21671	Mongolia
9	PI 265499	Cinza 42	Colombia
9	PI 323281	Black Sayar	Pakistan
9	PI 343809	W-31	Iran
9	PI 369358	Havasupai	USA
9	PI 378895	Impira INTA	Argentina
9	PI 432512	Landrace	USA
9	PI 433377	Giza	Egypt
9	PI 531345	Csehszlovakiai "B"; 685	Czechoslovakia
10	Ames 1837	Hemas	Bulgaria
10	Ames 1843	Record	Romania
10	Ames 3300	Funksinka 10; 814288	Germany
10	Ames 10101	JB 4	China
10	PI 170419	No. 3332	Turkey
10	PI 195573	No. 9588	Ethiopia
10	PI 213175		UK/England
10	PI 221441	Aftab-Parast; No. 1031	Afghanistan
10	PI 243074	W.Y. I/7	Jordan
10	PI 263178		Tanzania
10	PI 340784	USSR Mayak '66	FSU
10	PI 372259	VNIIMK 6540	FSU
10	PI 378894	Guayacan INTA	Argentina
10	PI 432504	Hopi dye	USA
10	PI 490324	Ornamental	Poland
10	PI 531339	Bekecsi "B"; 676; VI-2-380	Hungary

Table 2. Countries of origin for accessions in the cultivated sunflower collection and in the cultivated sunflower core subset.

Country	No. of accessions in the collection	No. of accessions in the core subset	Percent selected for the core subset
Afghanistan	2	1	50
Argentina	46	4	9
Australia	5		0
Austria	2		0
Brazil	2	1	50
Bulgaria	13	2	15
Canada	63	1	2
Chile	7		0
China	22	4	18
Colombia	3	1	33
Cuba	1		0
Czechoslovakia	3	1	33
Egypt	4	1	25
Ethiopia	6	1	17
Former Soviet Union	150	25	17
France	25	4	16
Georgia	1		0
Germany	46	5	11
Hungary	83	5	6
India	3	1	33
Indonesia	1	1	100
Iran	61	2	3
Iraq	10		0
Israel	4	1	25
Italy	3	1	33
Jordan	12	1	8
Kazakhstan	1	1	100
Kenya	17	2	12
Korea	1		0
Lebanon	1		0
Lithuania	1		0
Mexico	9		0
Monaco	1		0
Mongolia	2	1	50
Morocco	1		0
Netherlands	3		0
Pakistan	4	2	50
Paraguay	1		0
Peru	1		0
Poland	38	4	11
Portugal	2		0
Rhodesia	3		0
Romania	46	4	9

Table 2 (continued).

Country	No. of accessions in the collection	No. of accessions in the core subset	Percent selected for the core subset
Russian Federation	70		0
South Africa	11	1	9
Spain	107	3	3
Sweden	1		0
Syria	2		0
Tanzania	1	1	100
Turkey	122	6	5
Ukraine	16	1	6
United Kingdom	3	1	33
United States	383	11	3
Uruguay	7	1	14
Yugoslavia	73	4	5
Zambia	28	2	7
Zimbabwe	36	1	3
Uncertain	54	3	6
Total	1624	112	7

Table 3. The core subset cluster means and standard deviations for five cultivated sunflower descriptors.

Cluster	Plant Height (cm)	% Single Heads	Days to Flower	% Oil Content	Percent Linoleic	Albugo <sup>†</sup>
1	229 ± 34	86 ± 18	65 ± 7	36 ± 5	37 ± 7	5 ± 1
2	209 ± 17	90 ± 13	65 ± 11	30 ± 4	43 ± 8	6 ± 1
3	168 ± 35	42 ± 44	64 ± 7	31 ± 7	38 ± 15	5 ± 1
4	112 ± 12	60 ± 35	59 ± 10	35 ± 5	29 ± 8	5 ± 2
5	228 ± 19	43 ± 10	77 ± 12	35 ± 5		6 ± 2
6	165 ± 31	91 ± 9	63 ± 10	34 ± 5	33 ± 13	6 ± 1
7	195 ± 49	89 ± 13	62 ± 8	30 ± 6	36 ± 8	6 ± 1
8	131 ± 13	98 ± 4	62 ± 8	33 ± 9	13 <sup>#</sup>	5 ± 1
9	331 ± 48	58 ± 39	78 ± 6	31 ± 4	47 ± 11	5 ± 1
10	262 ± 39	92 ± 9	76 ± 13	33 ± 6	46 ± 7	6 ± 1

# Only one observation

<sup>†</sup> Where 1=immune, 9=lethal infection