USDA-ARS Sunflower Germplasm Collections

Gerald J. Seiler[1] and Laura Fredrick Marek[2]

[1]USDA-ARS, Northern Crop Science Lab., Fargo, ND

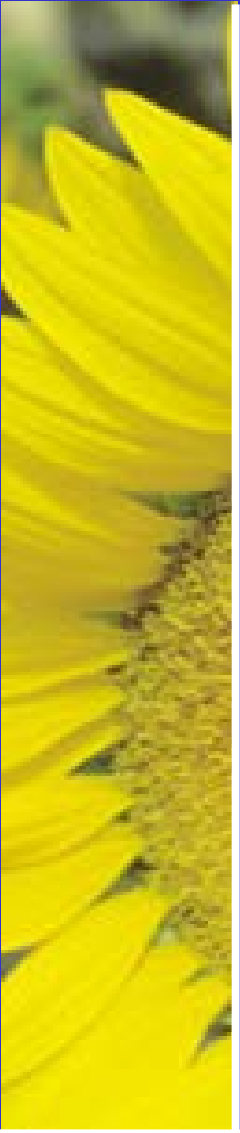
[2] Iowa State University and USDA-ARS, Ames, IA

Cañon City, CO

Sunflower Diversity

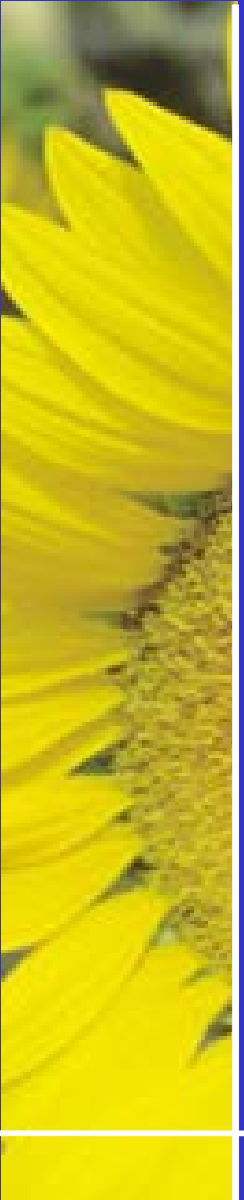
Genetic resources are the biological basis of global food security. Preservation of cultivars, landraces, and wild relatives of important plant species provides the basic foundation to promote and sustain agriculture.

Campbell et al., 2010



Outline

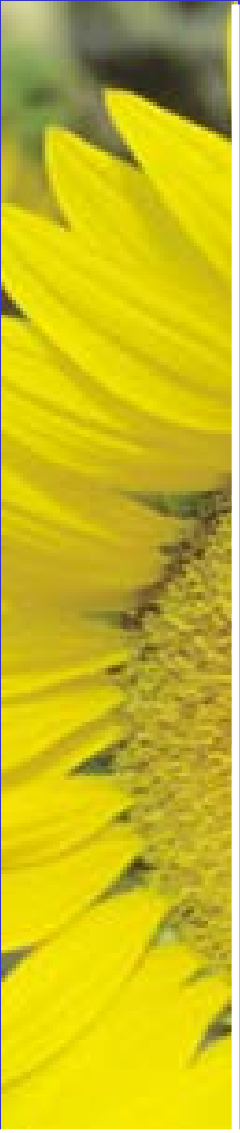
- Sunflower importance
- Collections
- Utilization
- Value
- Future challenges and opportunities



Global Sunflower Production

- 22.5 million hectares
- Production in 60 countries
- Fifth largest edible oilseed crop
- Second largest hybrid seed crop
- 40 billion USD value
- 10% of the world's edible oil

FAO, 2010



Wild Species- Center of Origin

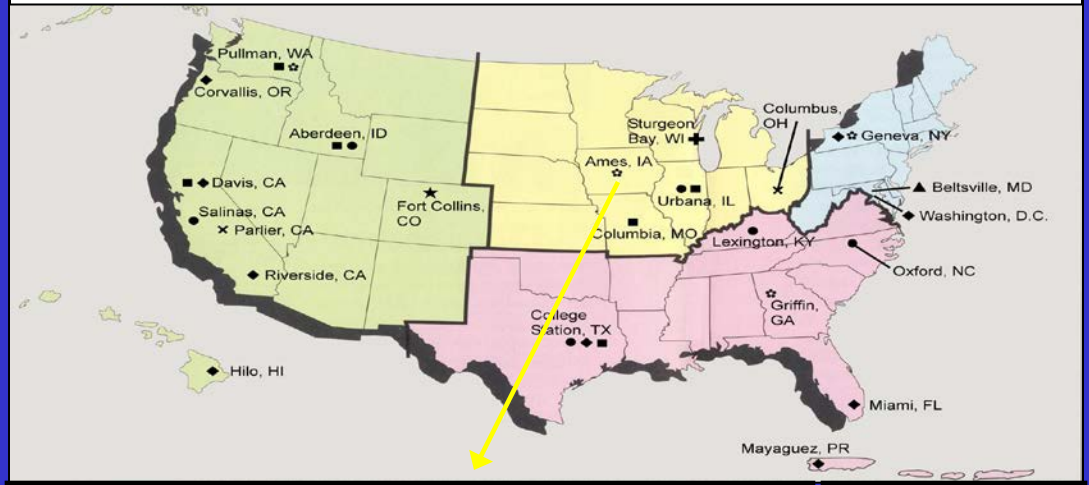
- Co-evolution of crop, ancestors, and pests
- Genetic diversity--52 different species

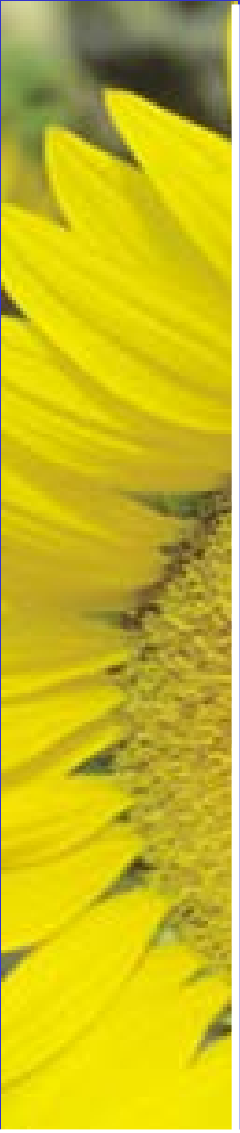
GENETIC DIVERSITY

52 *Helianthus* species

14	Diploid annuals (2n=2x=34)
25	Diploid perennials (2n=2x=34)
3	Tetraploid perennials (2n=4x=68)
7	Hexaploid perennials (2n=6x=102)
1	Mixaploid perennials (2n=2x=34, 4x=68)
2	Mixaploid perennials (2n=4x=68, 6x=102)

SUNFLOWER GENE BANK, USDA, ARS, North Central Regional Plant Introduction Station and Iowa State University, Ames, IA





USDA Sunflower Collections

- Cultivated sunflower collection established in 1948 at Ames, Iowa
- Wild species collection established in 1976 at Bushland, Texas and transferred to Ames, Iowa in 1985

Accessions in the USDA-ARS Sunflower Collections

H. debilis, Florida

Seed increase, Ames, IA

H. niveus, California

Type	Number	Available %
Cultivated	1886	92
Wild species	2201	87
Annual	1359	95
Perennial	842	70
Total	4087	88

Wild Species Traits of Value

Downy mildew resistance

Rust resistance

Powdery mildew resistance

Phomopsis tolerance

Verticillium wilt resistance

Sclerotinia resistance

Broomrape resistance

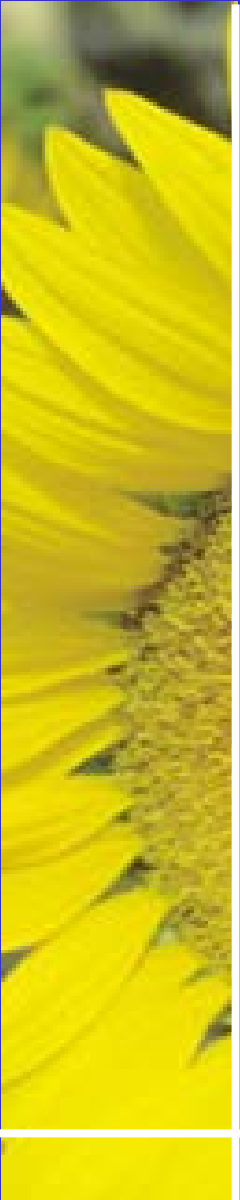
Alternaria leaf spot resistance

Cytoplasmic male sterility

Insect resistance

Herbicide resistance

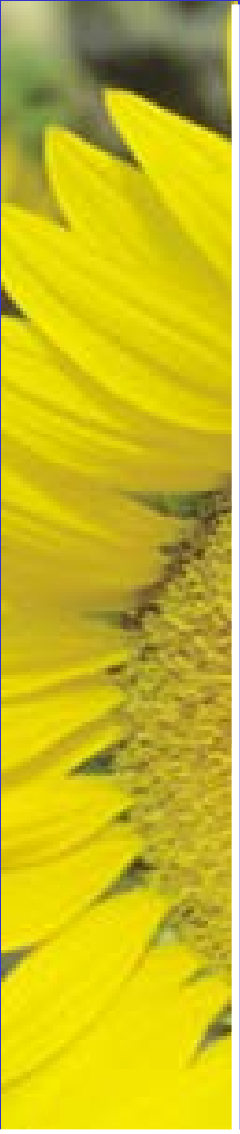
Salt tolerance



Use of Crop Wild Relatives in the Past 20 Years for 13 Important International Food Crops

Crop	Diseases/ insects	Abiotic stress	Male sterility	Total traits contributed
	Number of species			
Tomato	10	2	0	55
Rice	7	3	1	12
Potato	6	0	0	12
Wheat	11	0	0	9
Sunflower	5	1	1	7

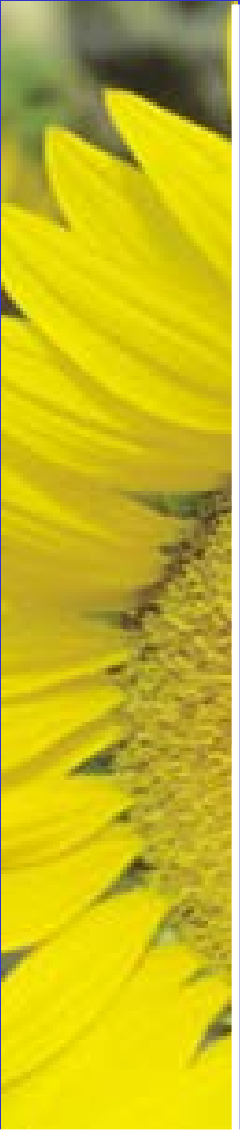
Hajjar and Hodgkin, 2007



Wild Species Economic Impact $$$

- **393.4 million dollars in USA**
  (Prescott-Allen and Prescott-Allen, 1986)

- **269.5 million dollars in USA**
  (Phillips and Meilleur, 1998)



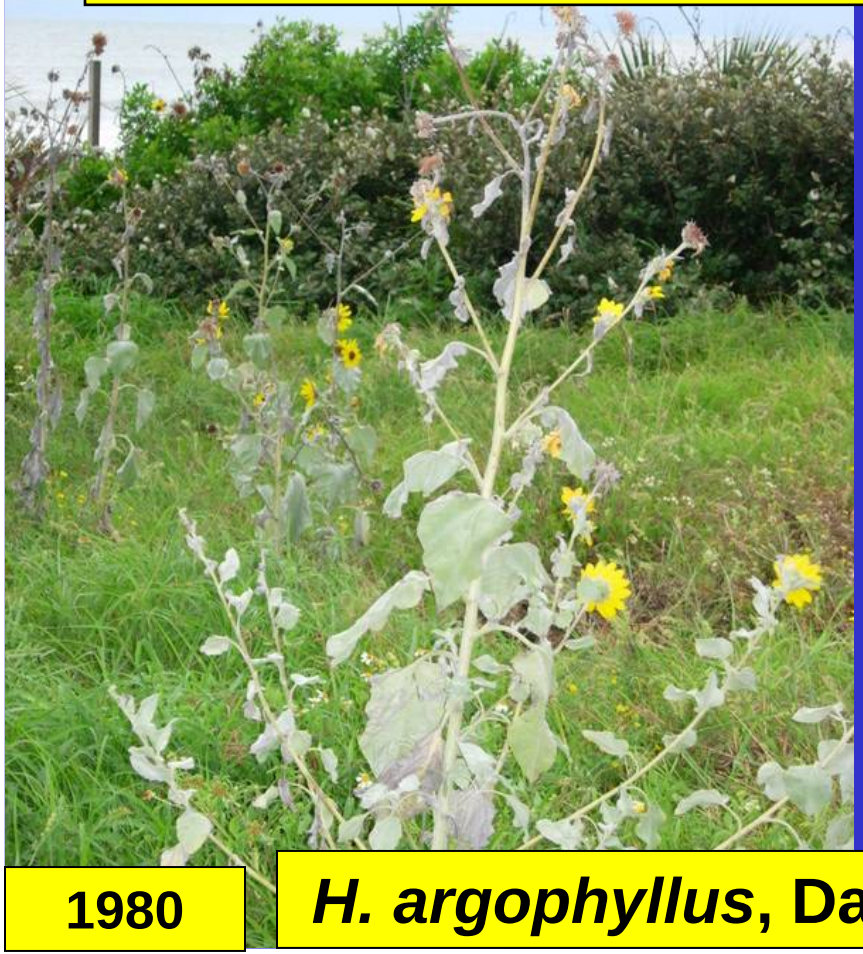
Wild *Helianthus* sources of resistance for sunflower diseases

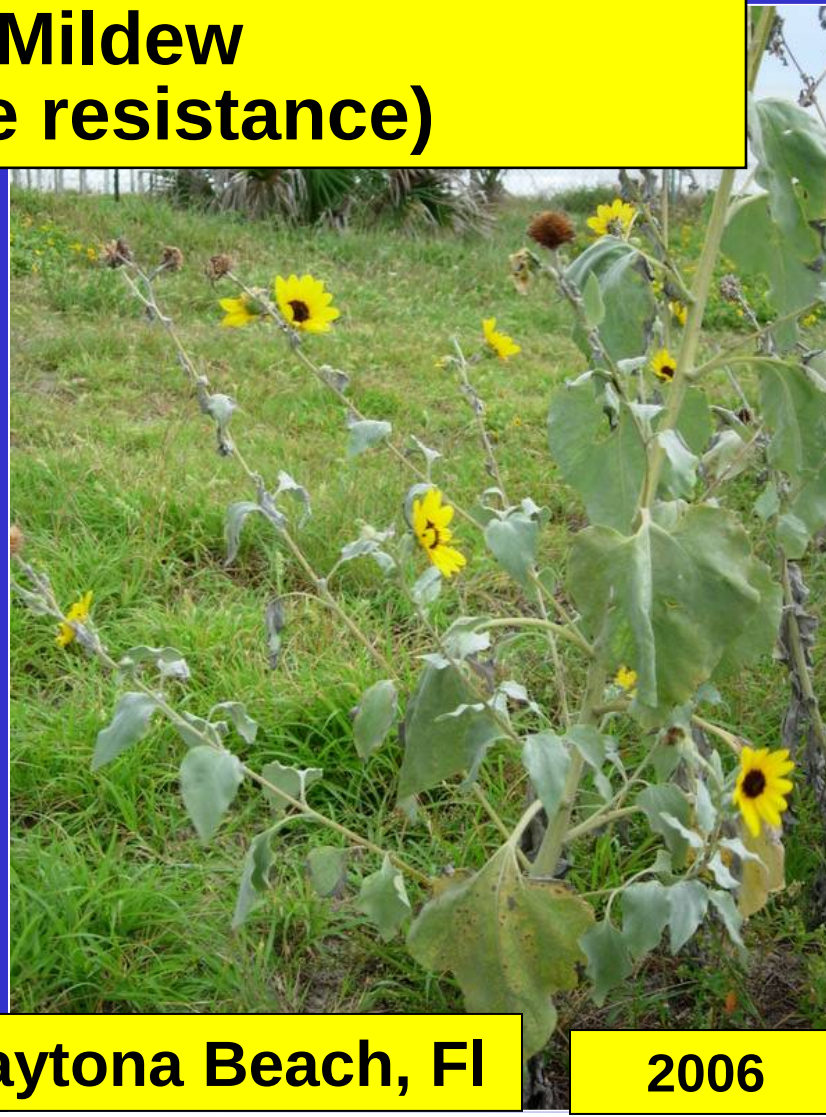
Disease	Wild species	
	Annual	Perennial
Rust	3	5
Downy mildew	10	15
Sclerotinia	7	18
Phomopsis	7	18
Alternaria	3	9
Powdery mildew	3	9
Rhizopus	0	4
Phoma	2	8
Charcoal rot	0	5
Broomrape	5	25
Verticillium	4	3

Downy Mildew (Multiple race resistance)

- Downy mildew--multiple races- 300, 700, 730, 770, & metalaxyl-resistant race
- *H. argophyllus*, ARG-1575 collected 1980
- ARG-1575-2 germplasm registration, 1991
- RHA 419 and RHA 420 registration, PI_{arg} gene, 2002
- RHA 464 registration, PI_{arg} gene, 2010

Downy Mildew
(Multiple race resistance)





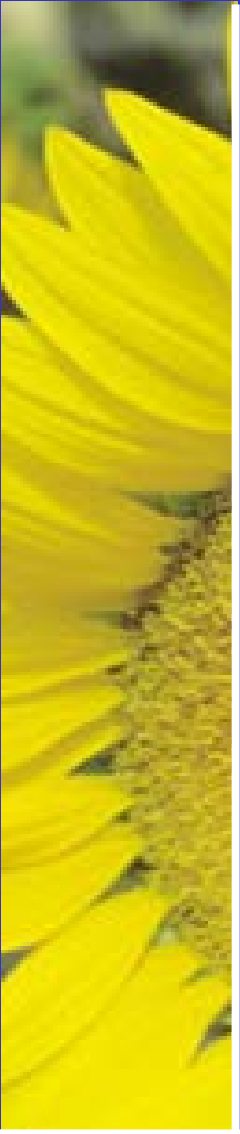
1980

H. argophyllus, Daytona Beach, Fl

2006

Distribution of Accessions in the USDA-ARS Sunflower Collection 2001-2011

Sunflower collection	Cultivated	Wild	Total
Requests	650	520	1,170
Recipients	514	430	944
Accessions sent	7,303	7,707	15,010
Items sent	11,831	10,683	22,514



Accession Distribution

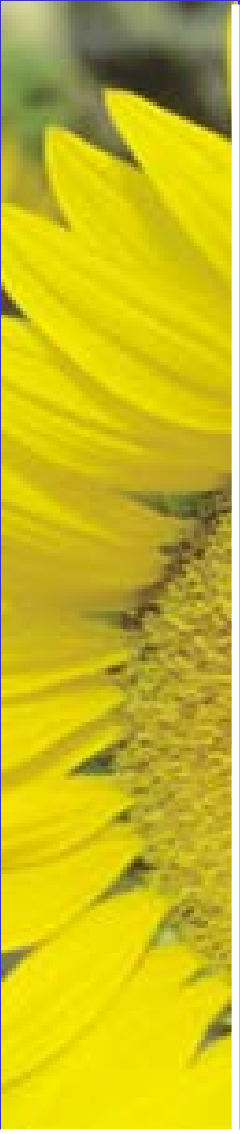
70% Domestic

30% International

60% Breeding and Research

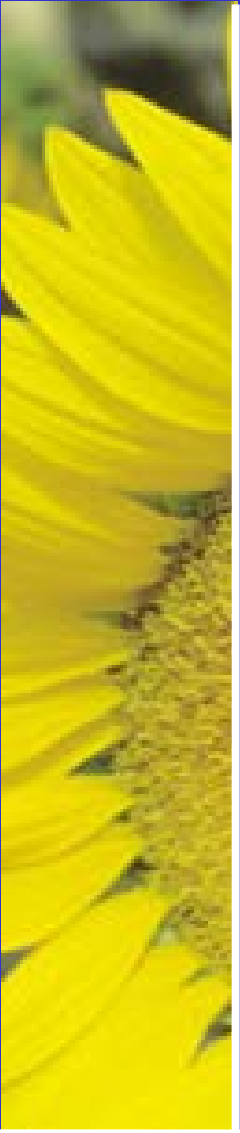
- 32% Diseases
- 14% Molecular
- 14% Oil quality

40% No specific information



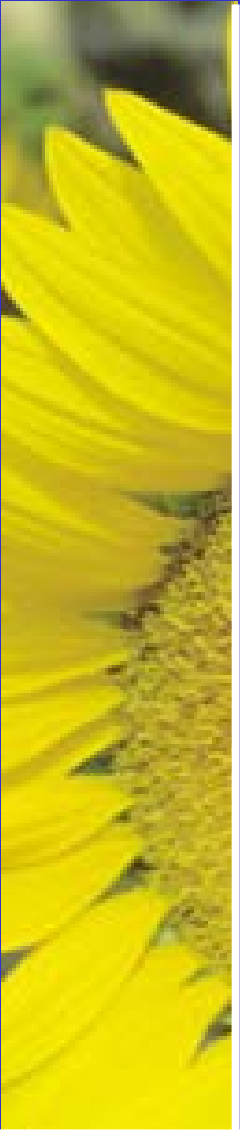
Collection Milestones

- Developed original descriptor list and passport information
- Instrumental in obtaining evaluation money to increase descriptor information—Substantially increased evaluation information in GRIN, especially for diseases
- 30 explorations in USA, Canada, and Australia over 32 years—15 in the last 10 years—Covered over 125,000 miles—2,000 wild species accessions added to the genebank collection
- Obtained funding to hire a permanent full-time curator
- Consolidation of wild and cultivated collections at one location, Ames, IA
- Increased availability of cultivated collection to 92% and wild collection to 87%



Future Challenges

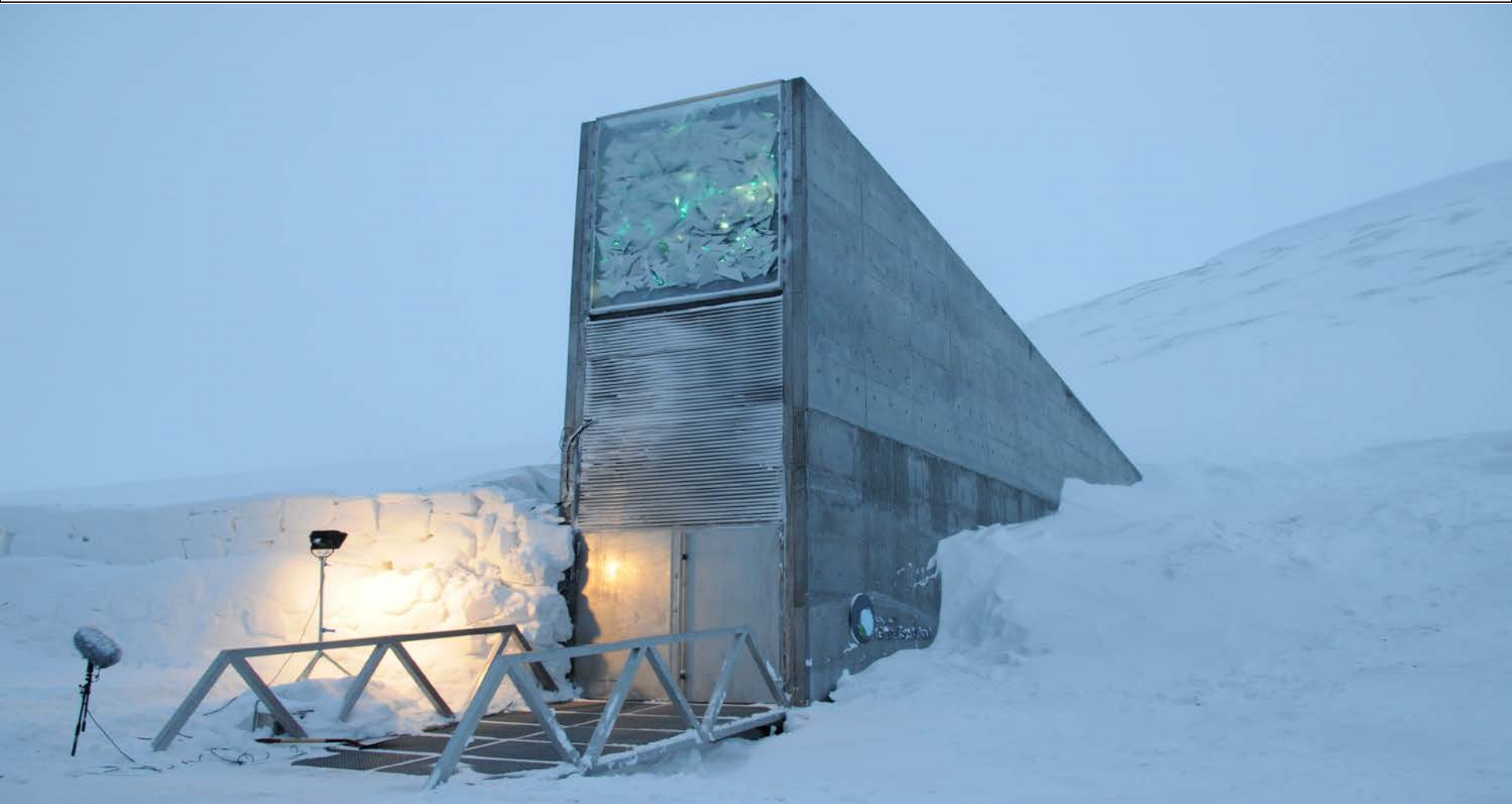
- Genetic resources--Global political restructuring, decreased opportunity for germplasm exchange
- Lack of commitment by countries to support genetic resources
- Phytosanitary permits, import permits, intellectual property, MTAs
- Destruction of native habitats



Future Opportunities

- Addition of molecular tools to mine the available genetic diversity
- Opportunity to move exotic genes with more precision and efficiency
- Currently bioinformatics is the bottleneck for complete exploitation of sunflower genetic resources information

Svalbard Global Seed Vault, Spitsbergen Norway, Global Crop Diversity Trust




A
B
C
D
E

750,000 accessions
Capacity 4.5 millions
-18C storage temperature
70,000 NPGS stored (including sunflower)

Thank You!