

GRIN-Taxonomy Crop Wild Relative (CWR) Inventory



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<http://www.ars-grin.gov/~sbmljw/cgi-bin/taxcwr.pl>

GRIN-Taxonomy Crop Wild Relative (CWR) Inventory



- 1. PEO Project initiated in 2008 to assess CWR germplasm needs for NPGS**
- 2. Identify CWR by “gene pool” status**
- 3. Initial work prioritized by economic value of crops**
- 4. Supporting data gleaned from multiple sources**
- 5. Sought external review of treatment**



Defining Classification Criteria for CWR

Gene Pool Concept – Harlan & de Wet. 1971. Toward a rational classification of cultivated plants. *Taxon* 20: 509–517.

Taxon Group Concept – Maxted & al. 2006. Towards a definition of a crop wild relative. *Biodiversity & Conservation* 15: 2673–2685.

Genetic Relative Classification Criteria



Primary – Taxa that cross readily with the crop (or can be predicted to do so based on their taxonomic relationships), yielding (or being expected to yield) fertile hybrids with good chromosome pairing, making gene transfer through hybridization simple.

Secondary – Taxa that will successfully cross with the crop (or can be predicted to do so based on their taxonomic relationships), but yield (or would be expected to yield) partially or mostly sterile hybrids with poor chromosome pairing, making gene transfer through hybridization difficult.

Tertiary – Taxa that can be crossed with the crop (or can be predicted to do so based on their taxonomic relationships), but hybrids are (or are expected to be) lethal or completely sterile. Special breeding techniques, some yet to be developed, are required for gene transfer.

Genetic Relative Classification Criteria



Graftstock – Taxa used as rootstocks for grafting scions of a crop, or used as genetic resources in the breeding of such rootstocks.

Data Elements Collected



- 1. Taxonomic or phylogenetic relationship of crop and CWR**
- 2. Genetic relative status of CWR**
- 3. Geographical distribution of CWR**
- 4. Passport data of crop and CWR accessions**

Crop Genera Already Treated



Cereal: *Avena, Hordeum, Oryza, Sorghum, Triticum, Zea*

Fiber: *Gossypium, Linum*

Forage: *Medicago*

Fruit/Nut: *Actinidia, Ananas, Carica, Carya, Castanea, Citrus, Citrullus, Corylus, Eriobotrya, Fragaria, Juglans, Malus, Olea, Persea, Phoenix, Pistacia, Prunus, Pyrus, Ribes, Solanum, Theobroma, Vaccinium, Vitis*

Oilseed: *Brassica, Carthamus, Crambe, Helianthus, Olea*

Pseudocereal: *Chenopodium*

Pulse: *Arachis, Cicer, Glycine, Lens, Lupinus*

Vegetable: *Allium, Asparagus, Beta, Brassica, Capsicum, Cichorium, Cucumis, Cucurbita, Cynara, Daucus, Eruca, Ipomoea, Lactuca, Pastinaca, Phaseolus, Rheum, Pisum, Raphanus, Sechium, Solanum, Spinacia, Vicia, Vigna*

Other: *Coffea, Humulus, Manihot, Nicotiana, Saccharum, Sinapis*



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[Rhizobial Nodulation Data in GRIN](#)

Cite as:
USDA, ARS, National Genetic Resources Program.
Germplasm Resources Information Network - (GRIN) [Online Database].
National Germplasm Resources Laboratory, Beltsville, Maryland.
URL: <http://www.ars-grin.gov/cgi-bin/npgs/html/queries.pl?language=en> (11 June 2014)

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GRIN Taxonomy for Plants

Query Crop Relatives in GRIN

Enter search criteria below.
 Any or all fields can be searched. Wild cards (*) are accepted.

Crop:

ALL
AJI – Capsicum baccatum var. pendulum
ALFALFA – Medicago sativa subsp. sativa
ALMOND – Prunus dulcis
APPLE – Malus domestica
APRICOT – Prunus armeniaca
ARTICHOKE – Cynara cardunculus
ARUGULA – Eruca vesicaria subsp. sativa
ASPARAGUS – Asparagus officinalis
AVOCADO – Persea americana

(Use shift or control key to make multiple selections.)

Genus name: (e.g. *Oryza* [without author])

Note: Only returns CWR in that genus. Select by crop to return all CWR of its crops.

Genetic relative status:
 primary
 secondary
 tertiary
 graftstock

Family(ies):

ALL FAMILIES
all pteridophytes
all gymnosperms
all angiosperms
Abietaceae
Abolbodaceae
Abrophyllaceae

(Use shift or control key to make multiple selections.)

Native distribution:

Continent: ALL CONTINENTS ▼

Region: ALL REGIONS ▼

Country(ies):

ALL COUNTRIES
Afghanistan
Albania
Algeria
American Samoa
Andorra
Angola

(Use shift or control key to make multiple selections.)

State/Province: (e.g. Alabama)

Include non-native distribution

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Crop: ALFALFA

(compiled by Dr. Blanca León; reviewed by Dr. Stephanie L. Greene, Geneticist/Curator, USDA/ARS, National Temperate Forage Legume Genetic Resources Unit, Prosser, Washington on 7 November 2012)

Crop taxa:

1. [Medicago sativa L. subsp. sativa](#) – alfalfa
2. [Medicago sativa L. nothosubsp. varia \(Martyn\) Arcang.](#) – variegated alfalfa
3. [Medicago sativa L. subsp. falcata \(L.\) Arcang.](#) – sickle alfalfa

Crop wild relatives:

Primary

1. [Medicago sativa L. subsp. falcata \(L.\) Arcang. var. falcata \(L.\) Döll](#) [tetraploids] — [References]
2. [Medicago sativa L. subsp. glomerata \(Balb.\) Rouy](#) [tetraploids] — [References]
3. [Medicago sativa L. subsp. sativa](#) [wild types] — [References]
4. [Medicago sativa L. nothosubsp. tunetana Murb.](#) [tetraploids] — [References]
5. [Medicago sativa L. nothosubsp. varia \(Martyn\) Arcang.](#) [tetraploids] — [References]
6. [Medicago sativa L. subsp. falcata \(L.\) Arcang. var. viscosa \(Rchb.\) Posp.](#) [tetraploids] — [References]

Secondary

1. [Medicago prostrata Jacq.](#) — [References]
2. [Medicago sativa L. subsp. caerulea \(Less. ex Ledeb.\) Schmalh.](#) — [References]
3. [Medicago sativa L. subsp. falcata \(L.\) Arcang. var. falcata \(L.\) Döll](#) [diploids] — [References]
4. [Medicago sativa L. subsp. glomerata \(Balb.\) Rouy](#) [diploids] — [References]
5. [Medicago sativa L. nothosubsp. tunetana Murb.](#) [diploids] — [References]
6. [Medicago sativa L. nothosubsp. varia \(Martyn\) Arcang.](#) [diploids] — [References]
7. [Medicago sativa L. subsp. falcata \(L.\) Arcang. var. viscosa \(Rchb.\) Posp.](#) [diploids] — [References]

Tertiary

1. [Medicago arborea L.](#) — [References]
2. [Medicago cancellata M. Bieb.](#) — [References]
3. [Medicago daghestanica Rupr. ex Boiss.](#) — [References]
4. [Medicago hybrida \(Pourr.\) Trautv.](#) — [References]
5. [Medicago marina L.](#) — [References]
6. [Medicago papillosa Boiss.](#) — [References]
7. [Medicago papillosa Boiss. subsp. macrocarpa \(Boiss.\) Urb.](#) — [References]
8. [Medicago papillosa Boiss. subsp. papillosa](#) — [References]
9. [Medicago pironae Vis.](#) — [References]
10. [Medicago rhodopea Velen.](#) — [References]
11. [Medicago rupestris M. Bieb.](#) — [References]
12. [Medicago ruthenica \(L.\) Trautv.](#) — [References]
13. [Medicago saxatilis M. Bieb.](#) — [References]

Crop Relatives in GRIN Taxonomy

(for the query: family = 'all families' & native country = 'all countries' & crops = 'chickpea' & genetic relative status = 'GR1, GR2, GR3, & GS' & repositories = 'all')

Follow links for a) **GRIN** taxon reports or b) to view literature supporting this items for explanation.)

Crop: CHICKPEA

(compiled by Dr. Blanca León; reviewed by Dr. Michael A. Grusak, USDA/ARS Dr. Clarice Coyne, USDA/ARS, Western Regional Plant Introduction Station, Pullman, WA)

Crop taxon:

1. [*Cicer arietinum* L.](#) – chickpea

Crop wild relatives:

Primary

1. [*Cicer reticulatum* Ladiz.](#) — [\[References\]](#)

Secondary

1. [*Cicer echinospermum* P. H. Davis](#) — [\[References\]](#)

Tertiary

1. [*Cicer atlanticum* Coss. ex Maire](#) — [\[References\]](#)
2. [*Cicer bijugum* Rech. f.](#) — [\[References\]](#)
3. [*Cicer incisum* \(Willd.\) K. Malý](#) — [\[References\]](#)
4. [*Cicer judaicum* Boiss.](#) — [\[References\]](#)
5. [*Cicer pinnatifidum* Jaub. & Spach](#) — [\[References\]](#)

http://www.ars-grin... Cicer reticulatum info... x

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Taxon: *Cicer reticulatum* Ladiz.

Genus: *Cicer* subgenus: *Cicer* section: *Cicer* series: *Cicer*
 Family: *Fabaceae* (alt. *Leguminosae*) subfamily: *Faboideae* tribe: *Ciceraceae*. Also placed in: *Papilionaceae*
 Nomen number: 301039
 Place of publication: *Notul. Roy. Bot. Gard. Edinburgh* 34(2):201. 1975
 Name verified on: 20-Jan-1987 by ARS Systematic Botanists. Last updated: 19-Jun-2012
 Species priority site in: Western Regional Plant Station ([WRS](#))
 Accessions: 34 in National Plant Germplasm System.

List all available (and unavailable) NPGS accessions. Include images and historical accessions sorted by number
 or names
 List all available (and unavailable) NPGS accessions by country.
 Check [PlantSearch](#) database of [Botanic Gardens Conservation International](#) for possible non-NPGS germplasm.

Economic importance:

- Gene sources: cold tolerance for chickpea ([\[Link\]](#))
- Gene sources: high yield for chickpea ([\[Link\]](#))
- Gene sources: pest resistance for chickpea ([\[Link\]](#))
- Gene sources: primary genetic relative of chickpea ([\[Link\]](#))
- Gene sources: probable progenitor of chickpea ([\[Link\]](#))

Distributional range:

Native:

- ASIA-TEMPERATE
Western Asia: Turkey »

References:

- Abbo, S. et al. 2007. Utilization of wild relatives. 348 In: Yadav, S. S. et al., eds., Chickpea breeding and management. 348.
- Davien, A. M. R. et al. 2007. A natural infrageneric classification for *Cicer* (Leguminosae, Ciceraceae). *Blumea* 52:379-400.
- Euro-Med Editorial Committee. *Euro+Med Plantbase: the information resource for Euro-Mediterranean plant diversity (on-line resource)*.
- Infarinato, A. et al. 1996. Screening wild *Cicer* species for resistance to Fusarium wilt. *Pl. Dis.* 80:42-44.
- Iruela, M. et al. 2002. Phylogenetic analysis in the genus *Cicer* and cultivated chickpea using RAPD and ISSR markers. *Theor. Appl. Genet.* 104:643-651.
- Javadi, F. et al. 2007. Geographical diversification of the genus *Cicer* (Leguminosae: Papilionoideae) inferred from molecular phylogenetic analyses of chloroplast and nuclear DNA sequences. *Bot. J. Linn. Soc.* 154:175-186.
- Leonardi, W. de et al. 1996. Pollen and seed morphology of *Cicer arietinum* L. cultivars and relationships with *C. reticulatum* Ladiz. and *C. echinospermum* P. H. Davis. *Pl. Genet. Resources Newsletter*, 105:29-36.
- Maesen, L. J. G. van der et al. 2007. Taxonomy of the genus *Cicer* revisited. 2:14-43 In: Yadav, S. S. et al., eds., Chickpea breeding and management. 2:14-43. [\[Link\]](#)
- Maesen, L. J. G. van der. 1987. Origin, history and taxonomy of chickpea. 29 In: Saxena, M. C. & K. B. Singh, The chickpea. 29.
- Maxted, N. 2012. Review of *Fabaceae* Ciceraceae, Faboae (Viciae) data for *World Economic Plants*, ed. 2. pers. comm. via e-mail on 24 Jan.
- Porcher, M. H. et al. *Searchable World Wide Web Multilingual Multicrop Plant Names Database (MMPND) (on-line resource)*.
- Redden, R. J. & J. D. Berger. 2007. History and origin of chickpea. 1:1-13 In: Yadav, S. S. et al., eds., Chickpea breeding and management. 1:1-13.
- Shan, F. et al. 2005. Geographical patterns of genetic variation in the world collections of wild annual *Cicer* characterized by amplified fragment length polymorphisms. *Theor. Appl. Genet.* 110:381-391.
- Singh, K. B. & B. Ocampo. 1997. Exploitation of wild *Cicer* species for yield improvement in chickpea. *Theor. Appl. Genet.* 95:191-222.
- Thompson, J. P. et al. 2011. Hybridisation of Australian chickpea cultivars with wild *Cicer* spp. increases resistance to root-

Crop Relatives in [GRIN T](#)

(for the query: **family** = 'all families' & **native country** = 'all countries' & **crops** = 'chickpea' & **GS** & **repositories** = 'all')

Follow links for a) **GRIN taxon reports** or b) **to view literature supporting this gene** items for explanation.)

Crop: CHICKPEA

(compiled by Dr. Blanca León; reviewed by Dr. Michael A. Grusak, USDA/ARS Childs Dr. Clarice Coyne, USDA/ARS, Western Regional Plant Introduction Station, Pullman,

Crop taxon:

1. [Cicer arietinum L.](#) – chickpea

Crop wild relatives:

Primary

1. [Cicer reticulatum Ladiz.](#) — [\[References\]](#)

Secondary

1. [Cicer echinospermum P. H. Davis](#) — [\[References\]](#)

Tertiary

1. [Cicer atlanticum Coss. ex Maire](#) — [\[References\]](#)
2. [Cicer bijugum Rech. f.](#) — [\[References\]](#)
3. [Cicer incisum \(Willd.\) K. Malý](#) — [\[References\]](#)
4. [Cicer judaicum Boiss.](#) — [\[References\]](#)
5. [Cicer pinnatifidum Jaub. & Spach](#) — [\[References\]](#)

http://www.ars-grin... Literature citations for...

Literature References for [GRIN Taxonomy Crop Relative Gene Pool Assignment](#)

Taxon: *Cicer echinospermum* P. H. Davis

- Davies, A. M. R. et al. 2007. A natural infrageneric classification for *Cicer* (Leguminosae, Cicereae). [Blumea](#) 52:379–400. [This study complements Maesen et al.'s 2007 (Chickpea Breed Mgmt 2:14–45.) proposed taxonomy; *Cicer echinospermum* clustered with *C. reticulatum* and *C. arietinum* as in other previous studies; all these three species were recognized in subgenus *Cicer* section *Cicer* series *Cicer*.]
- Javadi, F. et al. 2007. Geographical diversification of the genus *Cicer* (Leguminosae: Papilionoideae) inferred from molecular phylogenetic analyses of chloroplast and nuclear DNA sequences. [Bot. J. Linn. Soc.](#) 154:154–175. [This study confirmed the monophyly of the genus *Cicer*; *C. arietinum* affinities were strongly supported with *C. echinospermum* and *C. reticulatum* within a monophyletic clade that also included as a sister group *C. bijugum*, *C. judaicum*, *C. pinnatifidum* and *C. incisum*.]
- Ahmad, F. & A. E. Slinkard. 2004. The extent of embryo and endosperm growth following interspecific hybridization between *Cicer arietinum* L. and related annual wild species. [Genet. Resources Crop Evol.](#) 51:765–772. [This study examined conditions of embryogenic development arrest in crosses involving chickpea and its secondary and tertiary gene pool species; it performed crosses between *Cicer arietinum* × *C. echinospermum*, and also its reciprocal; it found differential growth between the former cross and its reciprocal; after 10 days all embryo and endosperm tissue degenerates for the reciprocal hybrid, while for the former cross embryo tissue continues its development.]
- Thompson, J. P. et al. 2011. Hybridisation of Australian chickpea cultivars with wild *Cicer* spp. increases resistance to root-lesion nematodes (*Pratylenchus thornei* and *P. neglectus*). [Austral. Pl. Pathol.](#) 40:601–611. [This study examined hybrids derived from crosses between resistant lines of *Cicer echinospermum* (male parent) and *C. arietinum*; these hybrids showed greater resistance to both nematodes than other tested wild species.]
- Singh, K. B. & B. Ocampo. 1997. Exploitation of wild *Cicer* species for yield improvement in chickpea. [Theor. Appl. Genet.](#) 95:418–423. [This study obtained hybrids between cultivated *Cicer arietinum* as a female parent and *C. echinospermum*.]

Query Crop Relatives in GRIN

Enter search criteria below.

Any or all fields can be searched. Wild cards (*) are accepted.

submit query

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Crop:

- ALL
- AJI – Capsicum baccatum var. pendulum
- ALFALFA – Medicago sativa subsp. sativa
- ALMOND – Prunus dulcis
- APPLE – Malus domestica
- APRICOT – Prunus armeniaca
- ARTICHOKE – Cynara cardunculus
- ARUGULA – Eruca vesicaria subsp. sativa
- ASPARAGUS – Asparagus officinalis
- AVOCADO – Persea americana

(Use shift or control key to make multiple selections.)

Genus name: (e.g. *Oryza* [without author])

Note: Only returns CWR in that genus. Select by crop to return all CWR of its crops.

Genetic relative status: primary secondary tertiary graftstock

Family(ies):

- Aspidistraceae
- Aspleniaceae
- Asteliaceae
- Asteraceae/Compositae
- Asteranthaceae
- Asteropeiaceae
- Astragalaceae

(Use shift or control key to make multiple selections.)

Native distribution:

Continent:

Region:

Country(ies):

- ALL COUNTRIES
- Afghanistan
- Albania
- Algeria
- American Samoa
- Andorra
- Angola

(Use shift or control key to make multiple selections.)

State/Province: (e.g. Alabama)

Include non-native distribution

Selections

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Crop Relatives in [GRIN](#) Taxonomy

(for the query: family/altfamily = [Asteraceae](#) & native country = [Albania](#) & crops = [all](#) & genetic relative status = [GR1 & GR2](#) & repositories = [all](#))

Follow links for a) [GRIN taxon reports](#) or b) [to view literature supporting this gene pool classification](#) (Place cursor over highlighted items for explanation.)

Crop: [ARTICHOKE](#)

(compiled by Dr. Blanca León)

Crop taxon:

1. [Cynara cardunculus](#) [Cardoon and Scolymus Groups](#) – artichoke/cardoon

Crop wild relatives:

Primary

1. [Cynara cardunculus](#) L. subsp. [cardunculus](#) — [\[References\]](#)

Crop: [CHICORY](#)

(compiled by Dr. Blanca León)

Crop taxon:

1. [Cichorium intybus](#) L. – chicory

Crop wild relatives:

Secondary

1. [Cichorium pumilum](#) Jacq. — [\[References\]](#)

Crop: [ENDIVE](#)

(compiled by Dr. Blanca León)

Crop taxon:

1. [Cichorium endivia](#) L. subsp. [endivia](#) – endive

Crop wild relatives:

Primary

1. [Cichorium pumilum](#) Jacq. — [\[References\]](#)

Secondary

1. [Cichorium intybus](#) L. — [\[References\]](#)

Crop: [LETTUCE](#)

(compiled by Dr. John H. Wiersema; reviewed by Dr. Beiquan Mou, USDA/ARS, Salinas, California on 7 June 2013)

Crop taxa:

1. [Lactuca sativa](#) L. – lettuce
2. [Lactuca sativa](#) Cos or Romaine Lettuce Group ([Lactuca sativa](#) L. var. [longifolia](#) Lam.) – romaine lettuce
3. [Lactuca sativa](#) Crisphead (Iceberg or Cabbage) and Butterhead Lettuce Groups ([Lactuca sativa](#) L. var. [capitata](#) L.) – head lettuce
4. [Lactuca sativa](#) Cutting or Curled Lettuce Group ([Lactuca sativa](#) L. var. [crispa](#) L.) – leaf lettuce
5. [Lactuca sativa](#) Stalk (or Asparagus) Lettuce Group ([Lactuca sativa](#) L. var. [angustana](#) L. H. Bailey) – stalk lettuce

Crop wild relatives:

Primary

1. [Lactuca serriola](#) L. — [\[References\]](#)

Secondary

1. [Lactuca saligna](#) L. — [\[References\]](#)



1. Contributions to GRIN CWR data are welcome

2. Specialist reviews of GRIN CWR data are also welcome

<http://www.ars-grin.gov/~sbmljw/cgi-bin/taxcwr.pl>



Thank you for your attention!