

**Plant Propagation Protocol for *Helianthus annuus L.***  
ESRM 412 – Native Plant Production



Images of *Helianthus annuus L.*[7]

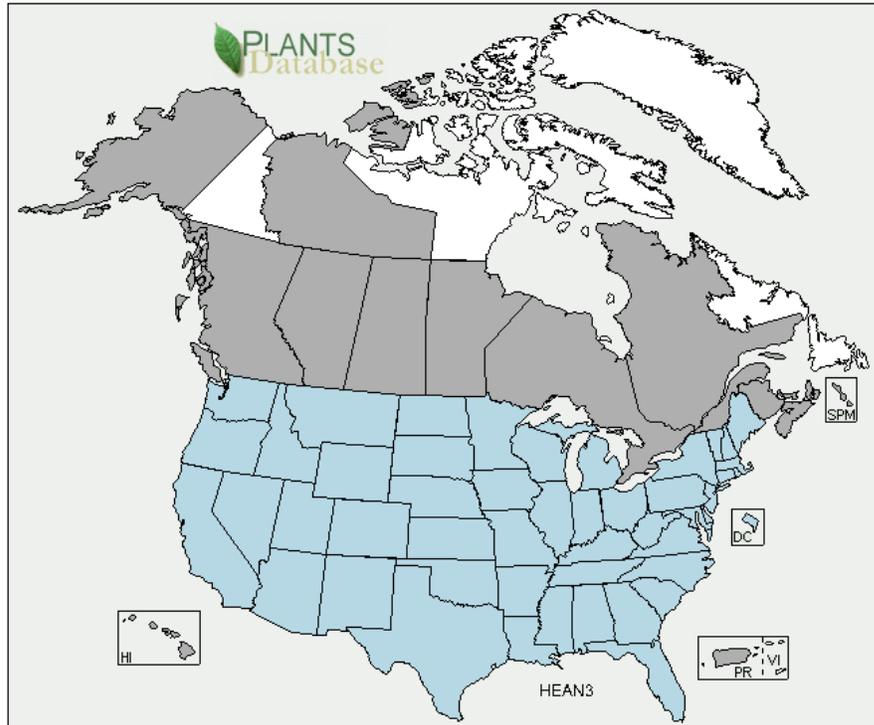
## TAXONOMY

Family Names	
Family Scientific Name:	Asteraceae (Compositae)
Family Common Name:	Aster, daisy, sunflower
Scientific Names	
Genus:	<i>Helianthus L.</i>
Species:	<i>annuus</i>
Species Authority:	Carl Linnaeus
Variety:	<i>Helianthus annuus</i> var. <i>lenticularis</i> (Dougl. ex Lindl.) Steyermark <i>Helianthus annuus</i> var. <i>macrocarpus</i> (DC.) Cockerell <i>Helianthus annuus</i> var. <i>texanus</i> (Heiser) Shinnars [3]
Sub-species:	<i>Helianthus annuus</i> ssp. <i>jaegeri</i> (Heiser) Heiser <i>Helianthus annuus</i> ssp. <i>lenticularis</i> (Dougl. ex Lindl.) Cockerell <i>Helianthus annuus</i> ssp. <i>texanus</i> Heiser [3]
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s)	
Common Name(s):	common sunflower, annual sunflower, sunflower, wild sunflower, mirasol, Kansas sunflower
Species Code (as per USDA Plants database):	HEAN3

## GENERAL INFORMATION

Geographical  
range:

**Native Status:**  
*Helianthus annuus L.*



Map of native distribution of *H. annuus L.* within N. America [6]

*Helianthus annuus L.* - common sunflower  
HEAN3  
in the state of Washington



Map of distribution of *H. annuus L.* within Washington state [6]

	<p><i>H. annuus L.</i> is native throughout North America: the western and central United States, Canada, and northern Mexico. [3]</p> <p>The species is thought to have various geographic variants over its native range:</p> <p><i>H. annuus var. jaegeri</i> from the southwest.</p> <p><i>H. annuus var. lenticularis</i> widely distributed across the west.</p> <p><i>H. annuus var. annuus</i> from the central and eastern United States.</p> <p>Studies have found that the wild <i>H. annuus</i> variants from the Great Plains are more closely allied with the domesticated <i>H. annuus L.</i>, while the southwestern and Californian wild <i>H. annuus L.s</i> were more distantly related. There were also findings that the midwestern variants had the highest genetic diversity. [1]</p>
Ecological distribution:	<i>H. annuus L.</i> is very common and widely distributed across ecosystems. It thrives in sunny locations found in grasslands and prairies.
Climate and elevation range:	<i>H. annuus L.</i> plants are intolerant of shade, tolerate a mean temperature range of 6-28 °C, and a mean precipitation range of 20-400 cm. On the North American continent, <i>H. annuus L.</i> is common on open sites in many different habitats at elevations below around 2,200 meters. [3]
Local habitat and abundance:	<i>H. annuus L.</i> typically likes to inhabit disturbed sites, roadsides, fields, and shrublands. [3]
Plant strategy type / successional stage:	<p><i>H. annuus L.</i> is a stress tolerating early colonizer, thriving in areas that have been disturbed by humans, such as roadsides, waste places, empty city lots and edges of fields. <i>H. annuus L.</i> can hybridize spontaneously with several wild relatives. Cultivars before 1960 were open-pollinated, cross-pollinated by insects and were highly self-incompatible, like the wild form. Current commercial <i>H. annuus L.</i> varieties are self-compatible, although environmental conditions can influence the level of self-fertility expressed.</p> <p>Pollen transfer is via insect pollinators, principally bees. The pollen is spiny, adapted to be transported by insects, and may be viable for several days. Little is cross-pollinated by wind because the pollen is rather heavy. Although the anthers containing the pollen and the stigma are on the same floret, the two lobes of the stigma are initially not exposed to their own pollen. However, they are susceptible to pollination from other florets of the same head by insects, wind or gravity. [2]</p>
Plant characteristics:	<i>H. annuus L.</i> is a tall herbaceous annual, with varieties ranging in height from 50 to 500 cm. The seedling roots are initially taprooted, with maturing plants developing a large fibrous, later root spread. [3] The stems are typically unbranched and along with most other parts of the plant vary from glabrous to very densely pubescent. Stem length is determined by the number of internodes. The first leaves are always opposite but in some varieties become alternate. The leaves are usually petiolate and three nerved, vary in shape from linear to ovate and are usually entire or serrated. The color intensity could vary

	<p>from light to dark green.</p> <p>The inflorescence is a capitulum or head, characteristic of the Asteraceae (Compositae) family. The heads are radiate and the ray flowers are neutral or pistillate. They are usually large and yellow but the color can range from lemon-yellow, orange to reddish. It consists of 300 to 1,000 flowers but could be higher in non-oil cultivars, up to 1,000 to 2,000 individual flowers. [11] The outer whorl of disk flowers open first, at about the time that ray flowers spread out from their folded position against the buds of disk flowers. Successive whorls of one to four rows of disk flowers open daily for 5 or more days. [2] The ray flowers are sterile 1.5-4 cm long, with yellow ligules. The disc flowers are perfect with 5 corolla lobes 5-8 mm long forming a tubular purple-brown to yellow floret subtended by a small firm, bract attached to the receptacle. [3] The attitude of the head is variable. The head shape varies, being concave, convex or flat.</p> <p>The achene, or fruit of the <i>H. annuus L.</i> consists of a seed, often called the kernel, and adhering pericarp, usually called the hull. In the absence of fertilization, the achenes will be empty, with no kernel. Achenes vary from 7 to 25 mm in length and 4 to 13 mm in width. They may be linear, oval or almost round. [2]</p> <p>Because the cultivated <i>H. annuus L.</i> was originally a cross pollinating crop and rather self-incompatible, it crosses readily with other annual <i>Helianthus</i> species. These include <i>H. argophyllus</i>, <i>H. bolanderi</i>, <i>H. dibilis</i>, <i>H. neglectus</i>, <i>H. paradox</i> and <i>H. praecox</i>. Artificial methods are required to cross <i>H. annuus L.</i> with perennial species. [2]</p> <p><i>H. annuus L.</i> is a native domesticated crop. During the last 3,000 years, Native Americans increased the seed size and genetics by repeatedly selecting the largest seeds. [6]</p>
<b>PROPAGATION DETAILS</b>	
Ecotype:	
Propagation Goal:	Seeds are the best way to propagate <i>H. annuus L.</i> Plants can be grown in containers from seed and transplanted to a site if done carefully.
Propagation Method:	Seed
Product Type:	Seeds, containers (plugs)
Stock Type:	
Time to Grow:	In temperate regions, <i>H. annuus L.</i> requires approximately 11 days from planting to emergence, 33 days from emergence to head visible, 27 days from head visible to first anther, 8 days from first to last anther, and 30 days from last anther to maturity. Cultivar differences in maturity are usually associated with changes in vegetative period before the head is visible. If starting seedlings indoors, it will take 20 - 30 days from seeding to when they can be outplanted. This timing is dependent on growing conditions and also the size of the container they are planted in. <i>H. annuus L.</i> has deep roots that require a

	<p>large container for proper growth. Smaller sized containers would need to be outplanted earlier than larger ones. [11]</p>
Target Specifications:	<p>Seeds preferable, or seedling when it has established a few sets of leaves and a thickened stem.</p>
Propagule Collection:	<p><i>H. annuus L.</i> is considered mature when backs of heads are yellow and the bracts are turning brown.</p> <p><i>H. annuus L.</i> are ready to store or eat when the disk at the back of the flower has turned dark brown. You can easily remove the seeds by rubbing two heads together, or just rubbing your palm over the seeds. Store raw seeds in a cloth bag in a place with good air circulation. Airtight containers such as jars or tins encourage mold development.[8]</p> <p>It usually takes 2 or more weeks from when the flower has stopped growing before the moisture is low enough for the seeds to be harvested. Frost or chemical desiccation speeds up the drying. <i>H. annuus L.</i> threshes easily and harvesting is done in October when the moisture content is below 12%. [2]</p>
Propagule Processing/ Characteristics :	<p>Around 60,000 seeds per lb.</p> <p><i>Helianthus</i> seeds can stay viable in the soil for many years and can be stored for several years if seeds are harvested and stored properly. Seeds should be below 12% moisture for temporary storage and below 10% for long term storage. Seed up to 15% moisture is satisfactory for temporary storage in freezing weather, but spoilage is likely after a few days of warm weather. [11]</p> <p>The lower moisture content limit in hermetic storage at 18 degrees C is a very low 2%. [4]</p> <p>The mean number of years recorded for germinability to drop below 50% for agronomic species kept in 8 different storage facilities worldwide has been estimated at 2-5 years. [3]</p>
Pre-Planting Propagule Treatments:	<p><i>H. annuus L.</i> seeds have dormancy. The seeds have a chemical inhibitor, which is broken down by cool temperatures and adequate moisture. Seed dormancy is influenced by depth of burial in the soil, soil moisture, minimum winter temperatures, and the seed's resin content. [3]</p> <p>Seeds need to be stratified before planting. [7] This can be done by soaking them for 18 hours or lightly scarring them.</p> <p>Germination of the seeds can be influenced by environment, ripeness, density and size. Seed size is impacted by environmental conditions, plant density, cultivar differences and position on the head. Seeds with a higher density have shown to have higher rates of germination. [10]</p>
Growing Area Preparation:	<p>A moist, firm seedbed free of weeds is desirable.</p> <p><i>H. annuus L.</i> is intolerant of acid or waterlogged soils. It prefers growing in well-drained, fertile, neutral to slightly alkaline soils and tolerates a pH range of 4.5 to 8.7. [3]</p> <p>If growing in containers for outplanting, a “peat pot” or other biodegradable</p>

	<p>container is ideal to allow direct planting without root disturbance, otherwise a 6-12" pot is appropriate. At least a 5 gallon container is necessary for <i>H. annuus L.</i> to grow to maturity.</p>
<p>Establishment Phase (from seeding to germination) :</p>	<p><i>H. annuus L.</i> seed should be planted into moist soil about 2 inches deep, but never more than 3 inches. Seed must be placed into moist soil for rapid germination to occur. <i>H. annuus L.</i> has trouble emerging through crusted soil.[5]</p> <p>Plant seed directly outdoors in spring once temperatures are high enough or indoors if transplanting. <i>H. annuus L.</i> seeds will germinate at 4° C, but temperatures of at least 8 to 10°C are required for satisfactory germination. Seeds are not affected by vernalization (cold) in the early germination stages. Seedlings in the cotyledon stage have survived temperatures down to -5°C.</p>
<p>Length of Establishment Phase:</p>	<p>5-10 days [8]</p>
<p>Active Growth Phase (from germination until plants are no longer actively growing):</p>	<p>Optimum temperatures for growth are 21 to 26°C, but a wider range of temperatures, 18 to 33°C, show little effect on productivity. Extremely high temperatures have been shown to lower and germination and growth. [11]</p> <p>To prevent overcrowding, the seedlings usually need to be thinned. To minimize disturbance to a seedling being retained, press the soil around it after thinning the adjacent seedlings. Water the newly establishing seedlings fairly frequently until the roots have developed. Support is required for the <i>H. annuus L.</i> stems. Stakes help support the stem and protect the seedlings from rodent or bird damage. Birds and small mammals love both the <i>H. annuus L.</i> seeds and the tender young seedlings. A scarecrow or netting may be necessary to protect the plants from herbivores. [6]</p>
<p>Length of Active Growth Phase:</p>	<p>For seed production at least 100 days from germination to full maturity. For growing container plants, 20-30 days before outplanting. [11]</p>
<p>Hardening Phase:</p>	<p>Plants should be gradually hardened off by placing them outside, in a sheltered location during the day. A cold frame with the lid open is ideal for this. Bring them in at night to avoid severe frosts. When they are ready for planting out, make sure it is after the last frosts.</p>
<p>Length of Hardening Phase:</p>	<p>After growing indoors for 20-30 days, harden off outside for 7 days.</p>
<p>Harvesting, Storage and Shipping (of seedlings):</p>	

Length of Storage:	This depends on the container size and variety.
Guidelines for Outplanting / Performance Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	<p><i>H. annuus L.</i> does not usually outplant with high success. Handle the seedlings very gently and only by their leaves when outplanting disturbing the roots as little as possible.</p> <p>Full sun is necessary for best growth and bloom, and plants should receive an inch of water per week, either from rain or irrigation. [8]</p> <p><i>H. annuus L.</i> is considered to be somewhat of a drought tolerant plant and will grow in a variety of soil types from sands to clays, and a wide range of soil pHs. <i>H. annuus L.</i> has a low salt tolerance and requires well drained soil. Fertility nutrients required by <i>H. annuus L.</i> are nitrogen, phosphorus and occasionally potassium. Because of its deep roots, it can utilize the nutrients that have been leached into the deeper zones from previous applications. Weed control is essential in the early stages of growth, as the crop does not compete well. This is can be done by weeding or inter-row cultivation. Later on when the canopy becomes heavy, competition from weeds is considerably reduced. [2]</p>
Other Comments (including collection restrictions or guidelines, if available):	<p><i>Helianthus petiolaris</i> (prairie sunflower) can often be confused with <i>H. annuus</i>, being similar in habit and appearance although, <i>Helianthus petiolaris</i> is a smaller plant with smaller leaves, smaller composite heads, shorter rays, and generally shorter in height. It also is mostly confined to sandy soils. Characteristics which differ, and help with identification, are the central pales of the composite disk, which are densely white-bearded at the apex on <i>Helianthus petiolaris</i> but are not with <i>Helianthus annuus</i> [9]. The phyllaries of <i>Helianthus annuus</i> are generally wider than 4 mm, variously ciliate, and have an abruptly attenuate apex, versus <i>Helianthus petiolaris</i> having phyllaries less than 4 mm wide, not conspicuously ciliate, yet variable, and gradually attenuate (generally tapering from base to tip) Generally, <i>Helianthus petiolaris</i> leaves are more lance shaped with the margins not usually toothed or obscurely so. To complicate their discrete identification even more, the two species hybridize, with the resulting offspring having intermediate characteristics. [3]</p>

## INFORMATION SOURCES

### References:

1. Cronn, R., M Brothers, K. Klier, P.K. Bretting, and J.F. Wendel. 1997. Allozyme variation in domesticated annual sunflower and its wild relatives.
2. Dedio, W. *The Biology of Helianthus annuus L. (Sunflower)*. Plant Biosafety Office. Canadian Food Inspections Agency. 2005. Online at <http://cera-gmc.org/docs/decdocs/05-209-009.pdf>
3. Halvorson, William & Guertin, Patricica. *Factsheet for: Helianthus annuus L.* U.S. Geological Survey. Southwest Desert Field Station. Sonoran Field Station. University of Arizona. 2003. Available at <http://sdrsnet.snr.arizona.edu/data/sdrs/ww/docs/heliannu.pdf>.
4. Hong, T.D. & Ellis, R.H. *A protocol to determine seed storage behavior*. Department of Agriculture, The University of Reading, UK. IPGRI Technical Bulletin. No. 1. Online at <http://69.90.183.227/doc/case-studies/ttcc/SeedStorage.pdf>
5. Johnson, Jerry, Meyer, Ronald, & Krall, J.M. *High Plains Sunflower Production Handbook*, Kansas State University, April 2009. Online at <http://www.ksre.ksu.edu/library/crpls2/MF2384.pdf>
6. Kartesz, John. Biota of North America Program. *PLANTS profile, Helianthus annuus L.* Natural Resources Conservation Service. United States Department of Agriculture. Online at <http://plants.usda.gov/java/profile?symbol=hean3>.
7. Lady Bird Johnson Wildflower Center, Native Plant Database. *Helianthus annuus L.* The University of Texas at Austin. 2011. Online at [http://www.wildflower.org/plants/result.php?id\\_plant=HEAN3](http://www.wildflower.org/plants/result.php?id_plant=HEAN3).
8. MacKenzi, Jill. *Sunflowers*. Yard and Garden Briefs. University of Minnesota, Extension Service. 1999. Online at <http://www.extension.umn.edu/yardandgarden/ygbriefs/h118sunflowers.html>
9. McDougall, W.B. 1973. Seed plants of northern Arizona. The Museum of Northern Arizona. Flagstaff. 594 pp.
10. McKenney, Cynthia & Smith, Crystal. *Enhancing the Germination of Sunflowers (Helianthus annuus L.)*. Texas Tech University. Dept. of Plant and Soil Science. SNA Research Conference. Vol. 52. 2007. Online at <http://www.sna.org/Resources/Documents/07resprocsec08.pdf>

	<p>11. Oplinger, E.S., Doll, J.D. <i>Sunflower</i> Departments of Agronomy and Soil Science, College of Agricultural and Life Sciences and Cooperative Extension Service, University of Wisconsin-Madison. 1990.</p> <p>Putnam, D.H, Hicks, D.R., Durgan, B.R., Noetzel, D.M., Meronuck, R.A. <i>Sunflower</i>. Departments of Agronomy and Plant Genetics, Entomology and Plant Pathology, University of Minnesota. 1990.</p>
Other Sources Consulted:	<p>1. Kamal, Javed &amp; Bano, Asghari. <i>Efficiency of allelopathy of sunflower (Helianthus annuus L.) on physiology of wheat (Triticum aestivum L.)</i>. Department of Plant Sciences, Faculty of Biological Sciences. Quaid-I-Azam University. 2009. Online at <a href="http://www.ajol.info/index.php/ajb/article/viewFile/61853/49925">http://www.ajol.info/index.php/ajb/article/viewFile/61853/49925</a></p>
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