A Wyoming Growers' Reference Guide to Cut Sunflowers

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Greenhouse-produced cut sunflowers growing in 4-inch pots in Laramie.

LOCAL CUT FLOWER PRODUCTION

Imports currently dominate the cut flower industry. The United States Department of Agriculture (USDA) estimates that as many as two-thirds of the domestic consumption of cut flowers is satisfied by growers outside of the U.S. However, as consumer demand shifts toward "non-traditional" cut flower crops, domestic production of so-called "specialty" cut flowers is emerging.

Specialty cut flowers are those other than roses, carnations, or chrysanthemums. Most traditional cut flowers are produced outside the United States due to inexpensive international production costs and their abilities to withstand long-distance shipping. On the other hand, specialty cut flowers are often more fragile and difficult to package and ship. Because of this challenge, specialty cut flowers make up a small percentage of imported cut flower crops. The lack of competition from foreign producers make specialty cut flowers a good candidate for local growers interested in producing cut flowers.

Specialty cut flowers have been some of the most profitable crops a grower can produce. Specialty cut flowers can yield $25,000 to $30,000 per acre. A large part of this profit potential comes from the ability of producers to get a premium for their locally grown product. As a result, flowers produced within the U.S. are generally destined for local markets such as florists, farmers markets, and community supported agriculture (CSA) outlets.

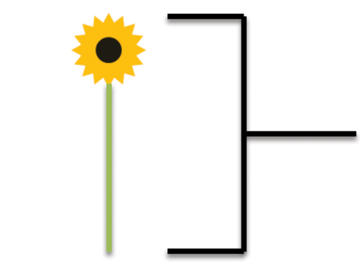
The horticulture industry in Wyoming has shown tremendous growth as interest in local production has increased. The proliferation of farmers' markets, CSAs, and food cooperatives around the state carrying locally produced goods are indicative of this trend. Farmers markets in the state are becoming especially prevalent and significantly contribute to the Wyoming economy. In 2011, farmers' markets contributed more than $800,000 in direct sales.

Despite the popularity of locally grown horticultural goods and the existing infrastructure to support cut flower production, domestically grown cut flowers mostly come from states other than Wyoming. The greenhouses and high tunnels in Wyoming are used for growing edible crops and herbaceous annuals and perennials; few of these structures are used for cut flower production.

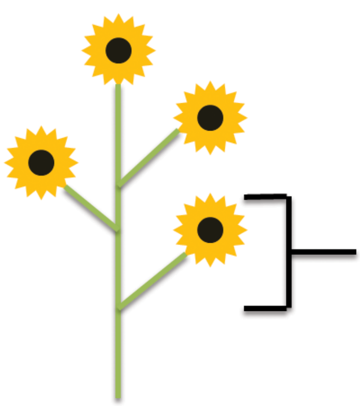
CUT SUNFLOWER POPULARITY

Sunflowers have risen in popularity among growers in the United States and worldwide. The increase in sunflower production is partly due to their high marketability but also their simple and inexpensive cultivation, wide cultivar selection, and long vase life. While sunflowers do not make the list of the top 13 most popular cut flower species, they are usually available year-round with peaks in sales in summer and fall.

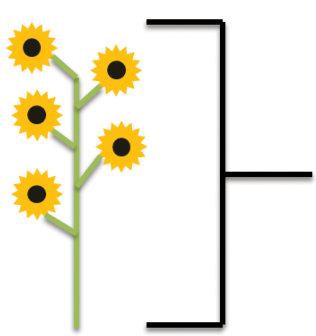
Sunflowers have the potential to be popular year-round in Wyoming due to their colors' strong association with the state's popular culture and the University of Wyoming. The traditional brown and gold inflorescence makes this crop a perfect addition to university functions and Wyoming cultural events. The study described later was conducted following a request from the University of Wyoming for brown and gold flowers for a banquet. We provided locally grown cut sunflowers from our study for numerous other University of Wyoming functions from 2011 through 2013 including an agriculture dean's banquet, experiment station banquets, and a distinguished guest speech.



An unbranched sunflower produces a single flower head on a central stalk.



Some branched cultivars produce multiple large flowers that can be harvested individually from the central stalk.



Other branched cultivars produce multiple smaller flowers that can be harvested all together as a "spray type."

SUNFLOWER DIVERSITY

The common sunflower, *Helianthus annuus*, is a flowering annual from the Asteraceae family. Native to the Great Plains, it was originally used by humans as a food source. Currently, sunflowers are utilized as one of the world's most important oil crops. Sunflowers are also grown for human and animal consumption and as ornamentals. In addition, sunflowers are a ubiquitous weed throughout North America. Numerous breeding efforts have resulted in enormous diversity within the species.

The majority of sunflowers used as cut flowers are hybrids that demonstrate excellent growth, uniformity, and vigor. In addition, most sunflowers used as cuts contain a genetic trait that prevents pollen production. So-called "pollenless" sunflowers provide for a cleaner, more hypoallergenic arrangement and also demonstrate a longer vase life.

Cut sunflower cultivars can be unbranched, producing a single flower head, or branched, on which multiple flower heads are produced. Flowers from the branched cultivars are either removed individually from the central stalk or harvested all together as a spray type (many small flowers on one stem).

Cut sunflower cultivars vary in stem length, but the most desirable length for a stem is between 24 and 35 inches. Most cultivars are developed to grow within this height range. Stem length is a major factor contributing to the value of a cut flower. It is commonly accepted in the floral industry a stem shorter than 15 inches is considered unsaleable due to its inability to be easily incorporated into a bouquet.

From a production standpoint, the most desirable cut sunflower cultivar is one that takes the least amount of time from sowing to harvest and yields a marketable flower. Time from sowing to harvest for cut sunflowers is reported to be anywhere from 6 to 13 weeks depending on time of year, cultivar, and production method.

A sunflower is known as a "composite flower" and is composed of many smaller flowers resembling a large flower.

Cut sunflower cultivars are available in a wide range of ray flower (petal) colors including: pale and bright yellow, gold, orange, white or cream, apricot, red or burgundy, mahogany, and bicolor (having two colors). The disk (center) flowers are most commonly dark brown or black, but some cultivars have yellow or green centers. Sunflowers can also be successfully dyed to create colors not offered by genetics.

CUT SUNFLOWER PRODUCTION NOTES

The Growing Environment

Many growth characteristics of cut sunflowers are not only dictated by genetic diversity but environmental conditions including temperature, light quantity and quality, soil quality, water availability, and fertilization regimes. Since many of these factors are determined by geographic location, utilizing region-specific information when available is important.

Cut sunflowers have been successfully cultivated in fields, greenhouses, and high tunnels. In a greenhouse, cut sunflowers can be grown in special benches made for cut flower production or in pots. In high tunnels and in field production, sunflowers can be grown in pots, raised beds, or planted directly into the ground.

Sunflowers grow differently depending on the production environment. Research shows that days from sowing to harvest, stem length, stem diameter, and flower diameter can vary among greenhouses, fields, and high tunnels. For example, greenhouse production can either reduce or increase time from sowing to harvest depending on cultivar as compared to high tunnel or field production. Sunflower stems produced in high tunnels can be shorter

Sunflower cultivar 'Sunrich Gold' has a yellow-green disk instead of the more traditional brown center.

Many types of fresh cut flowers can be grown in raised beds. These are newly planted carnations.

but have larger flowers and stem diameters compared to those produced in a greenhouse. Sunflowers grown in high tunnels have been reported to mature faster than those grown in fields. Unfortunately, consistent data on the effects of different growing environments are unavailable due to differences in cultivar response.

Various other advantages and disadvantages exist between growing environments. Sunflowers produced in a protected environment, such as a greenhouse or high tunnel, are less likely to be damaged by adverse weather; however, building and maintaining these structures can be costly. Sunflowers grown in high tunnels can be damaged by high temperatures in the absence of adequate ventilation. On the other hand, high tunnels, if managed properly, provide the advantage of minimized disease and insect problems as compared with field-produced cut sunflowers.

Since the success of cut sunflower production in each of these environments depends on careful cultivar selection, consult seed company descriptions and the literature cited at the end of this bulletin to help choose the best cultivars. Grow a test batch of the chosen cultivar before integrating it into a full production cycle.

Sowing and Transplant

Sunflower seeds are generally sown directly into pots or the ground. Seeds can also be sown in seed flats or plug trays and transplanted two to four weeks after sowing. This transplanting method can help maximize production area if space is limited.

Seeds should be sown into a clean, lightweight germination medium approximately one-half inch deep and covered with soil. Temperatures above 50˚F are required for germination, but 70-75˚F is ideal. During germination, the medium should be kept moist, and drying out should be avoided. Seeds for transplant can be kept indoors in a greenhouse or high tunnel.

Spacing

Plant spacing is dependent on whether or not the cultivar is single-stemmed or branching. As a general rule, plants should be spaced as close as 6 inches for small-flowered, single-stemmed varieties (such as ‘Sunrich Lemon’ or ‘Sunrich Gold’) and as wide as 24 inches for large-flowered, single-stemmed or branching varieties (such as ‘Lemon Aura’ or ‘The Joker’). Refer to seed packets for recommended spacing for specific cultivars. Closer plant spacing can be used as a management tool to grow plants

Sunflower seedlings have substantial root systems about two weeks after sowing and can be transplanted into their final growing location.

with longer stems, smaller flowers, and smaller stem diameters. In addition, close plant spacing can decrease branching in branched sunflower varieties.

Growing Temperature

Sunflowers can tolerate a wide range of temperatures, but growers should avoid excessive heat or cold. After germination, temperatures below 50˚F delay flowering, but sunflowers can survive temperatures down to 25˚F. We believe that temperatures exceeding 100˚F can cause damage to sunflowers, as indicated during experiments conducted in Laramie. Ideal temperatures for sunflower growth are 65 to 75˚F days and 65 to 68˚F nights. Warmer temperatures accelerate flowering whereas cooler temperatures slow maturation.

Water Requirements

Sunflowers require consistent irrigation. The growing medium should be kept moist, but oversaturation should be avoided to prevent stem or root decay. Frequent and extensive drying out of the growing medium can lead to delayed flowering and decreased stem length or, in extreme cases, flower deformities.

Fertilization Requirements

Sunflowers grow best with fertilization at 100 to 150 ppm N at each irrigation or 300 ppm N once a week. Trials in Laramie successfully cultivated sunflowers in a greenhouse and high tunnels using 0.02 ounces (about ½ teaspoon) of 15-9-12 slow-release fertilizer per plant.

Light Intensity and Photoperiod

Light intensity and photoperiod (duration of daylength) are some of the most important factors in cut sunflower production. Sunflowers prefer high light levels. Low light intensities can lead to disfigured or over-elongated stems and small, unmarketable flowers.

Photoperiod is hugely influential in determining the days from sowing to flowering and stem length in most sunflower cultivars. While some truly day-neutral (not sensitive to photoperiod) sunflower cultivars exist, the majority of sunflower cultivars will respond to changes in photoperiod. "Short-day" cultivars will respond to days shorter than 12 hours by producing fast-maturing flowers on short stems. "Long-day" cultivars will respond to days longer than 14 hours by initiating flowering more quickly than if the days were short (photoperiod doesn't seem to affect stem length for long-day cultivars). Growing some sunflower cultivars during certain photoperiods results in unmarketable stems. Because most sunflowers will ultimately bloom regardless of photoperiod, cultivars are often falsely advertised as day-neutral. For information on short- and long-day cultivars, consult the references listed throughout this paper.

Sunflower cultivars have been categorized as "day-neutral," "long-day," or "short-day" depending on response to changes in daylength.

	Long-day conditions (≥ 14 hour daylength)	Short-day conditions (≤ 12 hours daylength)
Day-neutral cultivar	Days from sowing to harvest unaffected, stem length unaffected	Days from sowing to harvest unaffected, stem length unaffected
Long-day cultivar	Days from sowing to harvest decreased, stem length unaffected	Days from sowing to harvest increased, stem length unaffected
Short-day cultivar	Days from sowing to harvest increased, increased stem length	Days from sowing to harvest decreased, decreased stem length

Cultivar	Growth habit	Daylength response*
'Frilly'	Branched	Long-day
'ProCut Orange'	Single-stemmed	Short-day
'Sunrich Gold'	Single-stemmed	Short-day
'Soraya'	Branched	Day-neutral
'The Joker'	Branched	Day-neutral
'Zohar'	Single-stemmed	Short-day

**Daylength response as reported by Wien, C.H. 2013. Sunflower seedling daylength response. Cornell Univ. Ithaca, NY. http://hort.cals.cornell.edu/cals/hort/research/loader.cfm?csModule=security/getfile&PageID=702432.*

Scheduling
Scheduling planting, growth, and harvest of sunflowers depends on cultivar and growing conditions, especially photoperiod. To ensure meeting important production dates, sunflowers can be sown on a weekly or bi-weekly rotation.

Support
Floral caging and/or staking of sunflowers is necessary for greenhouse-produced cut sunflowers. At least two layers of floral caging, set at approximately 6 and 18 inches above the soil level, should be used to support growing stems. Sunflowers grown in the field or in high tunnels may not require support. This is true even in high wind areas as sunflowers will develop a thicker stem to compensate for fast air currents. Overall flower quality, however, can be compromised due to high winds.

Growth Regulators
Gibberellic acid can be used to hasten flowering of sunflowers. Growth regulators that inhibit gibberellin synthesis (such as ancymidol or paclobutrazol) can help reduce sunflower stem length. Always use growth regulators according to label directions and test their effects on other growth characteristics before wide-scale implementation.

Harvest and Postharvest
Sunflowers can be harvested as early as the first signs of color in the ray flowers or after one or two ray flowers lift from the center disk. For best postharvest quality, harvest sunflowers when all of the ray flowers have opened but before the disk flowers have begun to open. Cut stems at soil level and strip off lower foliage. Re-cut stems at an angle before placing in plain water or water mixed with a floral preservative. Cut sunflowers should be stored in a cool (down to 33˚F), dark environment for maximum postharvest life.

Sunflowers grown in the greenhouse should be staked and/or supported with floral caging to ensure stem straightness.

Example of the ideal harvest stage of 'ProCut Bicolor' where petals, or ray flowers, are open, but disk flowers are still tight.

Pests and Diseases
Sunflowers are susceptible to many common greenhouse and outdoor pests and diseases. Thrips damage flower petals but are difficult to manage as the small insects can

Powdery mildew damage to cut sunflower foliage is unsightly and can affect marketability.

burrow within the many flowers composing the sunflower head. In the early stages of sunflower growth, aphids are especially damaging and cause irreversible flower disfigurement. Sunflowers are also susceptible to root-rotting infections (like *Pythium*) and foliar diseases (such as powdery mildew) that can destroy a harvest or make flowers unsightly and unmarketable.

SUMMARY OF CULTIVAR TRIALS IN LARAMIE

Purpose and Objectives

From 2011 to 2012, cultivars 'Dafna,' 'ProCut Bicolor,' and 'Sunbright Supreme' were assessed for their production potential in the Wyoming High Plains. The purpose was to produce information for Wyoming growers, like the recommendations reported in this bulletin. All three cultivars were grown year-round in a greenhouse and during the summer in two high tunnels oriented perpendicular to one another. The objectives were to determine any differences between cultivars, times of year, season-extending growing environments, high tunnel orientation, and growing location within high tunnels. Experiments were conducted at the University of Wyoming Laramie Research and Extension Center in Laramie.

What We Did

Three sets of experiments were conducted: a year-round greenhouse study, a high tunnel orientation study, and a greenhouse versus high tunnel study. Sunflowers produced in all growing locations were sown and germinated in plug trays in a greenhouse environment. After 15 days, sunflowers for greenhouse production were transplanted into 4-inch plastic pots, and sunflowers for high tunnel production were transplanted directly into amended soil. Plants in both the greenhouse and in the high tunnels were spaced 6 inches apart. Each plant was fertilized with 0.02 ounces (about ½ teaspoon) of controlled-release fertilizer (Osmocote Plus, 15-9-12, Scotts Miracle-Gro Company, Marysville, OH) and watered twice daily in the greenhouse and once daily in the high tunnels. Sunflowers were grown in natural light and daylength. Sunflowers in the greenhouse were grown at 70˚F days and 60˚F nights.

At harvest, data were taken on saleable yield, days from sowing to harvest, stem length, stem diameter, and flower head diameter. These measurements were chosen for their importance to growers and the floral industry.

What We Found

The data collected for the year-round greenhouse study indicate that time of year affects stem length, days to harvest, and saleable yield. The cultivars exhibited different responses to seasons. 'Dafna' and 'Sunbright Supreme' bloomed more quickly on short stems during the short-day, winter months, whereas 'ProCut Bicolor' bloomed more quickly in the long-day, summer months. Stem length of 'ProCut Bicolor' was not affected by season.

Saleable yield also varied throughout the year. Stems were considered saleable if they were more than 16 inches tall, reached flowering maturity, and were not deformed or disfigured. When sunflowers bloomed quickly, stems were often short and spindly and deemed unmarketable. This happened most frequently for 'Dafna' and 'Sunbright Supreme' during the winter months. On the other hand, sunflowers that grew overly tall would bend and create crooked stems or break. 'Dafna' and 'Sunbright Supreme' experienced these problems in the summer months. 'ProCut Bicolor' had the tendency to grow too tall in the winter and summer as stem length was not shown to be affected by time of year.

The data collected in the high tunnel orientation study show that the effect of high tunnel orientation on stem length is cultivar-specific. 'Sunbright Supreme' grew taller in the north-south-oriented tunnel than the east-west-oriented tunnel, whereas the other two cultivars did not have different stem lengths among the two high tunnels. Days from sowing to harvest was not affected by high tunnel orientation for any of the cultivars. The north-south tunnel produced a higher percentage of saleable cut sunflowers than the east-west tunnel. Overall saleable yield was low at 57 percent and 35 percent in the north-south and east-west tunnels, respectively. 'ProCut Bicolor' was produced at the highest saleable yield.

The high tunnel orientation study also allowed for comparisons among growing locations within the high tunnels. Each high tunnel was considered to have two growing locations across the long ends of the structure. Sunflowers in the northern planting location (in the east-west tunnel) grew taller than those in the southern planting location. Sunflowers in the eastern planting location (in the north-south tunnel) grew taller than those in the western planting location. This growth variation is potentially due to differences in light intensity across growing locations. Days from sowing to harvest was not affected by growing location.

The greenhouse versus high tunnel experiment showed differences and similarities among the two growing locations. Stem lengths between the two growing locations were the same for all cultivars; however, days to harvest were different depending on cultivar. 'ProCut Bicolor' bloomed more quickly in the high tunnels, but 'Dafna'

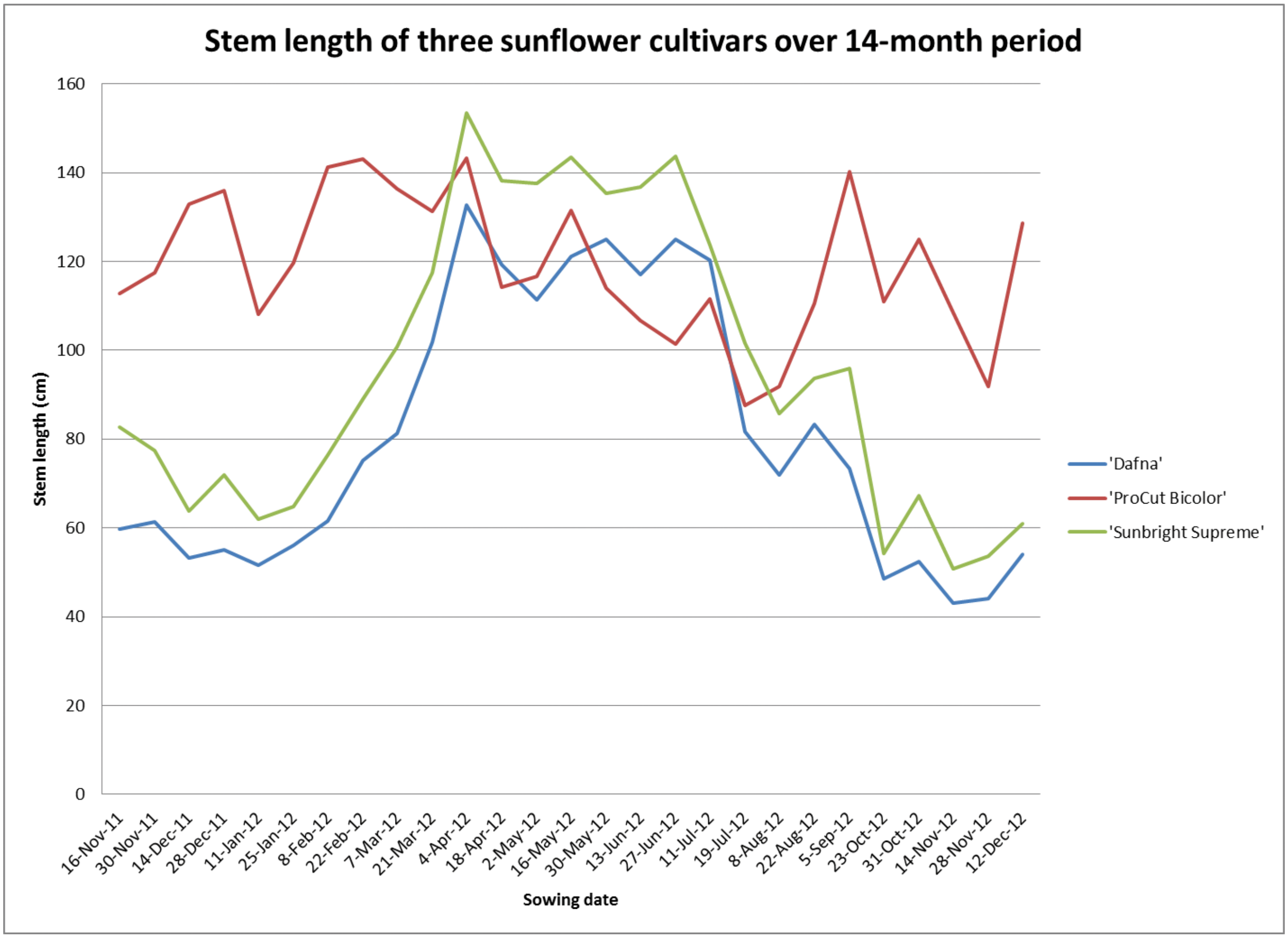
Days from sowing to harvest is affected by cultivar and time of year.

Sunflowers in the northern planting location grew taller than those in the southern planting location.

and 'Sunbright Supreme' bloomed more quickly in the greenhouse. Sunflowers grown in the high tunnels across all cultivars had larger flower head and stem diameters than those grown in the greenhouse. The small flowers in the greenhouse were likely a result of constricted root growth from the 4-inch pots. Stem diameters of sunflowers produced in the high tunnels likely increased due to windy conditions but never exceeded the ¾-inch floral standard.

Impacts and Recommendations

The differences among cultivars, times of year, and growing locations mean that growers must carefully pick cultivars to ensure successful crops. While some seasons may yield a quick crop, saleable yield can be significantly compromised by small, disfigured stems. On the other hand, a slow, tall crop may take up too much time in the greenhouse for profitable production and result in stem breakage issues. Growers should explore the results of this study and others to determine the best times of year for certain sunflower cultivars.



Stem length is affected by cultivar and time of year.

If growers have the resources available, lighting to extend the daylength (photoperiodic lighting), shading (to shorten the daylength), and supplemental lighting (to increase light intensity during the day) could be utilized to maximize production potential for the three cultivars tested in the year-round greenhouse study. The data collected here suggest that shading would be beneficial for 'Dafna' and 'Sunbright Supreme' during the summer months, and photoperiodic lighting would be beneficial for 'ProCut Bicolor' during the winter months. Furthermore, photoperiodic lighting, and possibly supplemental lighting, could be used for 'Dafna' and 'Sunbright Supreme' during the winter months to achieve higher quality flowers and higher saleable yield. The plant growth regulators discussed earlier in this bulletin could also be explored as potential ways to improve year-round cut sunflower production.

Although there were differences in stem length among high tunnel orientations and high tunnel locations, the practical impact of this variation is minimal. Among all the high tunnel orientations and locations, stems consistently met or exceeded floral standards. Since days from sowing to

Sunflowers in the eastern planting location grew taller than those in the western planting location.

harvest were the same between high tunnel orientations and locations, it can be concluded that all growing orientations and locations should be considered equally suitable for cut sunflower production.

In this study, high tunnel production yielded fewer saleable stems than the greenhouse. Low saleable yield was likely due to heat damage. Sunflowers that exceeded the height of the roll-up sides of the high tunnels received less ventilation and may have overheated. The taller cultivars, 'Sunbright Supreme' and 'Dafna', were damaged at the highest rate, whereas the shortest cultivar, 'ProCut Bicolor,' performed best among all sunflowers tested in the high tunnels. In light of these results, we recommend shorter cultivars (such as 'Premier Lemon' or 'Sunrich Yellow') be explored for high tunnel cut sunflower production. A list of shorter cultivars can be found in some of the references provided at the end of this bulletin.

Differences among high tunnel and greenhouse production in terms of flower head and stem diameters should be considered when producing for a particular market. While in some instances the larger flowers produced in high tunnels may be desirable, a buyer may prefer a smaller sunflower. Growers should determine their respective markets for cut sunflowers when deciding whether or not to produce cut sunflowers in a high tunnel or greenhouse.

A planting guide for 'Dafna,' 'ProCut Bicolor,' and 'Sunbright Supreme' for Wyoming growers is provided after the references section of this publication. While this study has evaluated three cultivars for their year-round and high tunnel potential, hundreds of cultivars exist, and we highly recommend growers test new cultivars before large-scale introduction into a growing regime.

References for more information on production of cut sunflowers:

Books

Armitage, A. M. and J.M. Laushman. 2008. *Specialty cut flowers: the production of annuals, perennials, bulbs and woody plants for fresh and dry cut flowers.* Varsity Press, Portland, OR.

Byczynski, L. 2008. *The flower farmer: an organic grower's guide to raising and selling cut flowers.* Chelsea Green Publishing, White River Junction, VT.

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Lopez, R.G., and M.A. Ortiz. 2012. "Do high tunnels make the cut?" Greenhouse Grower, Willoughby. 27 Apr. 2012. < http://www.greenhousegrower.com/article/28959/do-high-tunnels-make-the-cut>.

Wien, C.H. 2013. Chris Wien's research page. 16 July 2013. <http://hort.cals.cornell.edu/cals/hort/research/wienresearch.cfm>.

Cut sunflower seed suppliers:

- Burpee Seeds and Plants: www.burpee.com
- Harris Seeds: www.harrisseeds.com
- Johnny's Selected Seeds: www.johnnyseeds.com
- Sunflower Selections: www.sunflowerselections.com

Internet addresses change and pages can disappear over time. If you find problems with any of the listed web sites in this publication, please contact (author name, address, phone number, email address).

Planting guide for cultivars 'Dafna,' 'ProCut Bicolor,' and 'Sunbright Supreme' for greenhouse production in Wyoming.[y,z]

Desired Harvest Month	Cultivar	Recommended Sowing Date
January	'Dafna'	Third week in October
	'ProCut Bicolor'	Third week in September
	'Sunbright Supreme'	Third week in October
February	'Dafna'	Last week in November
	'ProCut Bicolor'	Third week in October
	'Sunbright Supreme'	Last week in November
March	'Dafna'	Last week in December
	'ProCut Bicolor'	Third week in November
	'Sunbright Supreme'	Last week in December
April	'Dafna'	Last week in January
	'ProCut Bicolor'	Third week in December
	'Sunbright Supreme'	Last week in January
May	'Dafna'	Last week in February
	'ProCut Bicolor'	Last week in January
	'Sunbright Supreme'	Last week in February
June	'Dafna'	Third week in March
	'ProCut Bicolor'	Last week in February
	'Sunbright Supreme'	Third week in March
July	'Dafna'	First week in April
	'ProCut Bicolor'	Third week in April
	'Sunbright Supreme'	Last week in March
August	'Dafna'	Second week in May
	'ProCut Bicolor'	Third week in May
	'Sunbright Supreme'	Second week in May
September	'Dafna'	Second week in June
	'ProCut Bicolor'	Last week in June
	'Sunbright Supreme'	Second week in June
October	'Dafna'	Last week of July
	'ProCut Bicolor'	Third week of July
	'Sunbright Supreme'	First week of July
November	'Dafna'	Last week in August
	'ProCut Bicolor'	Last week in July
	'Sunbright Supreme'	Last week in August
December	'Dafna'	Last week in September
	'ProCut Bicolor'	Third week in August
	'Sunbright Supreme'	Last week in September

[y]*Time to harvest may vary due to number of cloudy days, temperature, or other environmental factors.*
[z]*Sowing date recommendations are for the first day of each desired harvest month.*