Anemone Cut Flower Production in Utah

Shannon Rauter and Melanie Stock

Anemone (*Anemone coronaria*) is grown as a cool-season annual for cut flower production in Utah. Tubers can be planted as early as November in a high tunnel for blooms beginning in March. For field production, plant in fall with insulation or as early as possible in spring (i.e., the soil is workable, approximately early March) for blooms beginning in May. Flower production ceases when temperatures reach approximately 80°F, usually by early July in northern Utah. In North Logan, UT, high tunnels produced an average of 2 to 7 marketable stems per plant, compared to 1 to 4 stems per plant when field grown. Anemone is popular with florists for use in spring arrangements. Its wholesale profit potential is moderately high compared to other Utah-grown cut flowers.

Tuber Preparation

Order tubers (also often called corms) in spring to summer for fall delivery. Purchase the largest tuber size available (typically 5-6 cm) as size is directly linked to yield. If not immediately planting, store the tubers in cool (35-50°F), dry conditions to reduce the risk of rot.

Site Preparation

For anemone (Figure 1) grown in high tunnels, planning and preparation begin the previous fall by installing the plastic high tunnel covering before heavy rain or snowfall. This ensures the soil will have the right moisture content for workability early the following spring and decreases the risk of disease.

Soil testing is highly recommended and careful use of soil amendments (i.e., fertilizer, compost, manure) is necessary because anemone is sensitive to soil salinity, with stress occurring by 2.5 dS per m. Till the soil to incorporate fertilizer or compost based on routine soil test recommendations. Incorporating one inch of low-salt compost into the soil before planting increases organic matter and fertility, with minimal pH or salinity risk. See USU's Compost and Manure Guidelines for options. A soil test is recommended in new planting areas or where soil testing has not occurred in two years. USU's analytical laboratory performs soil tests with pricing available on their website and instructions for sampling here. Rake the tilled soil smooth and form beds that are 3 to 4 feet wide. Wider beds make it difficult to reach the center rows. Install drip irrigation and landscape fabric, if desired, before planting.

Figure 1. Range of anemone bloom colors.

Soaking and Pre-sprouting

Before planting, tubers benefit from soaking in room temperature water (60-77°F) for 3 hours. Leave the water running slightly while soaking to provide aeration. Drain the tubers and then soak for an additional hour in a commercial fungicide, such as a solution of 0.3%

Captan-50% W.P (0.8 oz Captan per 1 gallon of water). By the end of soaking, the tubers should swell to about double their original size (Figure 2A).

After soaking, tubers can be directly planted or pre-sprouted. In USU Trials, pre-sprouting for 2 weeks advanced bloom by 1 week and improved marketable yield compared to direct planting. Pre-sprouting for more than 2 weeks has potential to further advance bloom but may be limited by cold temperatures in the early season. To pre-sprout, fill a flat-bottom seed tray with drainage holes half full of moist potting mix. Place the soaked tubers about ½-inch apart in the tray (this fits 40 in a standard tray) and completely cover them with potting mix. Store the trays in a cool (35-50°F) location for 2 to 3 weeks. Check the trays occasionally and add water if needed to maintain moist media but avoid saturated conditions that increase the risk of rot. Tubers are ready to plant once they have rootlets that are 1/8- to 1/2-inch long (Figure 2B).

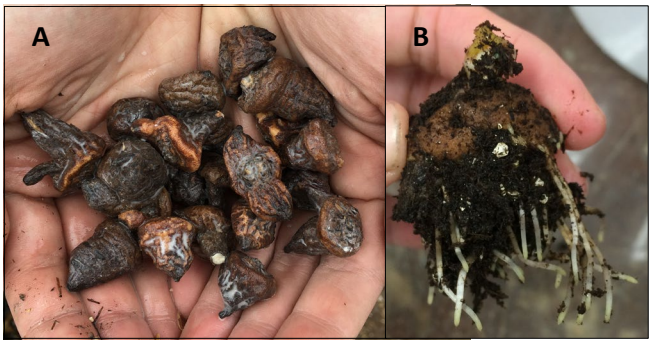

Figure 2. Anemone tubers after soaking (A) and pre-sprouting (B).

Planting

Anemone is especially sensitive to warm temperatures, and therefore, planting as early as possible is important to maximize bloom time before temperatures are too hot. Their optimal temperature range for growth and flowering is 54 to 64°F during the day and 41 to 50°F at night, with a minimum survival temperature of 26°F. Above 80°F, flower production declines as the plants go dormant and the foliage dies back. Visit the Utah Climate Center website to find historical temperature data and freeze dates at a weather station near you.

For high tunnel production, plant between November and February. In the field, plant in November or as soon as the ground is workable in the spring (usually early March). To reduce the risk of cold injury and increase marketable yield, use fabric low tunnels within high tunnels and low tunnels or straw mulch in the field. When planting, tubers should be spaced 6 inches apart, with 6 inches between rows, at a depth of 2 inches. It is important to plant the tubers with the eyes on top and the pointed end facing down, as oriented in Figure 2B. Anemone bloom approximately 3 to 5 months later, depending on the planting date.

Irrigation, Pests, and Disease

A freeze-protected culinary water source may be needed for high tunnel plantings, as most secondary irrigation is not available until later in the spring. Drip irrigation is ideal, as it keeps moisture off the foliage and blossoms, and conserves water. Field plantings typically do not require irrigation until the spring unless the soil is extremely dry during fall planting; in this case, water the soil immediately after planting to be moist but not saturated. For optimal growth, anemone need moist soil that is allowed to drain between waterings. Apply 0.5 to 2 inches of water per week (¼ to 1 gallon of water per square foot), depending on temperature, growth stage, and soil texture. The frequency of irrigation events is low in the early season (about once every 2 weeks from November to February) and increases as the season progresses (1 to 3 times per week after February). See Tables 1 and 2 for common production challenges from pests and disease.

Fertilizer

Anemone has moderate nutrient requirements. In general, add 0.34 pounds of nitrogen (N) per 100 square feet each year. For example, 0.75 pounds (about 1 cup) of conventional urea fertilizer (46-0-0), or 2.1 pounds (about 6.5 cups) of organic 16-0-0 fertilizer equals 0.34 pounds of N. Use a slow-release source or apply half of the nitrogen at planting and side dress the other half once the first buds are visible. Phosphorous and potassium should be added before or at planting but should only be applied based on a soil test, as these nutrients can build up in the soil. USU's Calculating Fertilizer for Small Areas is a useful tool for calculating applications with test results.

Shade and Trellising

During early summer production, shade is used to cool the environment, encourage stem elongation, and reduce flower scorch. Shade should cover an entire high tunnel after the plastic has been removed or individual rows in the field (Figure 3). Reference USU's Low Tunnels for Field Cut Flower Production fact sheet for tips on shading small growing areas. Some growers trellis with plastic mesh (6 x 6 inches) to encourage

long, straight anemone stem growth, while others find it unnecessary considering the relatively short plant height compared to other cut flower crops, such as snapdragons, dahlias, or lisianthus.

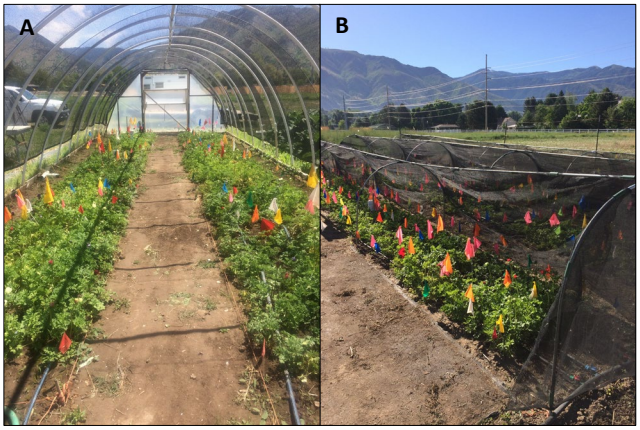

Figure 3. Shaded anemones in a high tunnel (A) and field (B).

Harvest and Storage

Bloom typically begins once the average daily temperatures are warm enough for growth (approximately 50°F) and lasts up to 14 weeks in the high tunnel and 10 weeks in the field. Pre-sprouting hastens the onset of harvest by approximately 1 week. Blooms are typically shortest for the first few weeks of harvest and lengthen as the season progresses. Harvest during the cool parts of the day after the flower has opened and closed once and no gray fuzz remains. Since this harvest stage can be difficult to determine, an alternative is to harvest once the stem between the collar and the bloom (the pedicel) is ¼- to ½-inch long (Figure 4).

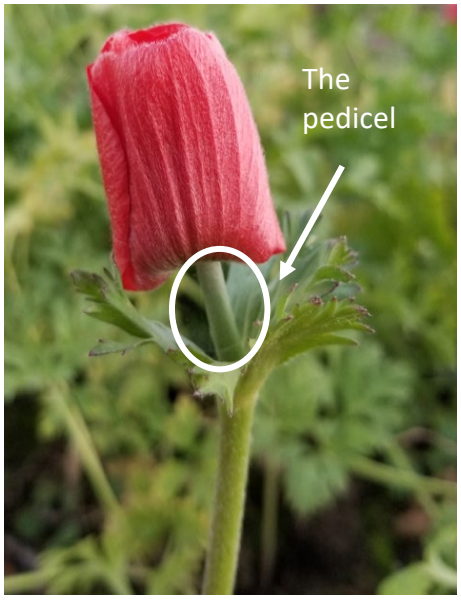

Figure 4. Aim to harvest at this bloom stage. The bud should be fully colored with minimal gray fuzz and a pedicel length of ¼- to ½-inch.

Place the cut stems directly into water while harvesting to avoid wilting. After harvest, place stems in fresh water with floral preservative. Move the cut stems into cool storage (40°F) and store upright to prevent stem curvature. Cool storage is effective for up to five days, and quality decreases with longer storage. Vase life can be up to 10 days with the use of floral preservatives, frequent water changes, and fresh stem cuts. Anemone pedicels will continue to elongate in the vase, by up to roughly 2 inches. Sort stems by length and color and use rubber bands to assemble bunches of ten stems. Wrap bunches in sleeves before marketing wholesale to florists to prevent damage during transport and increase visual appeal (Figure 5).


Figure 5. Sleeved anemone bunches ready for sale on florist wholesale markets

Economics

In Utah, total yields of 3 to 10 stems per plant are common, while yields up to 25 stems per plant have been recorded with ideal management and weather. Often only 50 to 75% of total stems are long enough to market, with florists preferring a minimum of 10-inch-long stems and sometimes purchasing 8- to 10-inch-long stems at a reduced price. In 2021, the wholesale import price ranged from $1.00 to $2.00 per stem (AMS, 2022). From 2020-22, USU-grown anemone sold in bunches of 10 for $12.50 to $15.00 ($1.25 to $1.50 per stem) in Cache Valley and Wasatch Front markets. Anemones also present a strong choice for farmer-florists to use in arrangements as plants bloom as early as March in a high tunnel, continue blooming up to 14 weeks, produce high total yields, and are early enough to follow with a second crop. Reference USU's Anemone High Tunnel Budget and Field Budget for detailed cost and return estimates of production.

Table 1. Common diseases of anemone.

Disease	Identification	Control
Botrytis (gray mold)	A fungal disease that appears as brown dead areas and may have a gray fuzzy appearance. Affected areas are buds, flowers, leaves, and stems.	Adequately space and vent plants and surroundings. Prune and destroy infected plant material. Regularly disinfect pruners to prevent spread. Spray with fungicide effective against botrytis blights, such as potassium bicarbonate.
Tomato spotted wilt virus (TSWV)	Viral disease with wide host range. Causes yellow ringspots on leaves that can turn brown/black. Can be spread by thrips and introduced on infected plant stock.	Prevent introduction by purchasing clean plant material, eliminating weeds (hosts) from the area, and immediately removing infected plants. Chemical control of thrips (Table 2) early in the season can help minimize disease spread.
Powdery Mildew	Fungus growing on leaves, stems, and occasionally flowers. The leaves appear covered in white flour (the fungal spores).	Use a fungicide registered for anemone with myclobutanil and sulfur active ingredients (do not apply sulfur above 90°F). If late in the season, chemical control may not be warranted. Remove and destroy plant stems at the end of the season.
Root, stem, and crown rots	Fungi that infect roots and crowns of plants. Dull-colored foliage or wilting followed by yellowing of plants. Plants may be stunted and then die. Roots are dark, soft, or decayed.	Avoid excessive irrigation/moisture, especially before the tubers sprout. Plant in well-drained soil. Dig out and destroy infected plants. Clean and disinfect tools with 70% ethanol or disinfecting wipes.

Table 2. Insect pests of anemone.

Insect	Identification	Control
Aphids	Green, yellow, or black soft-bodied, very small insect (Figure 3) that can transmit virus (Table 1). Feeds on buds, stems, and leaves, leaving a sticky "honeydew" that can accumulate on the plant.	Populations grow rapidly. Encourage natural predators, such as ladybeetles, by providing habitat and avoiding broad-spectrum insecticides. Spraying a strong stream of water directly on aphids can remove them. If populations reach a threshold, consider organic insecticidal soaps and horticultural oils.
Mice/Voles	Chew stems at base; can fully kill plants.	Control rodents with rodenticide bait or traps under the low tunnels and within the high tunnels.
Spider Mites	Microscopic insects that feed primarily on the underside of leaves and cause stippling (light dots) on the leaves that can turn bronze then brown and fall off. This is sometimes confused for leaf burn. They also form thin webbing on leaves.	Avoid drought stress with adequate irrigation. Remove nearby weeds and minimize dust (avoid rototilling nearby). Encourage natural predators (e.g., predatory mites, minute pirate bugs) by avoiding broad-spectrum insecticides. Spraying a strong stream of water directly on spider mites can remove them. Consider organic insecticidal soaps or horticultural oils.
European Earwigs	Elongated, brown bodies with a prominent pair of rear "pinchers" (cerci). Hide in tight and dark spaces on the plant. Feed on plant stems, leaves, and blooms, and other arthropods. Damage can be severe if populations are high.	Populations tend to be greatest in mid-summer, but monitor throughout the season. Hand removal is often most effective. Scout in the morning, where they are often in leaf crevices or blooms. Earwig traps can be made using a container with bait (soy sauce, smell oil, grease, etc.) and a perforated lid. Bury the container up to the lid and empty periodically.
Ants	Soil mounded around stems. Insect girdling and tunneling through stems near the soil surface.	Apply insect bait stations around affected plants. Ant bait stations are easy to apply and can be moved to other locations. Typically resolves problems in a few days.
Thrips	Brown-yellow, very small, with fringed wings. Causes stippling or irregular white blotches on foliage and flowers. More notably, they transmit viruses and often hide in blooms, making them undesirable for use. Monitor with blue or yellow sticky traps.	Remove nearby weeds and eliminate plant debris that provides overwintering sites. Encourage natural predators by providing habitat and avoiding broad-spectrum insecticides. Thrips build resistance to many insecticides; chemical control is difficult and not recommended. Spraying a strong stream of water directly on thrips can remove them. If populations are at threshold, consider organic insecticidal soaps or horticultural oils.

USU Anemone Trials

In 2020-2022, trials were conducted at the Greenville Research Farm in North Logan, UT (USDA Hardiness Zone 5, last frost date: May 15) to evaluate bloom timing, yield, and quality. We tested cultivars ('Carmel' and 'Galilee'), pre-sprouting, the use of low tunnels within high tunnels, and combinations of low tunnels, mulch, and bare soil in the field. We also trialed mid-month planting dates in November, January, February, and March in a high tunnel and November, March, and April in a field. These planting dates were selected for Cache Valley, UT. For the Wasatch Front, plant up to two weeks earlier than Cache Valley. Locations with a higher elevation or cooler climate should plant later.

High Tunnel vs. Field Production

High tunnels allow for earlier growth and production during more optimal, cool temperatures, as well as more control. High tunnel production began in March, 5 weeks earlier than the field, and resulted in an average of 2 to 7 marketable (longer than 8 inches) stems per plant (Figure 6), compared to 1 to 4 marketable stems per plant when field grown (Figure 7). Extremely wet or cold spring conditions can postpone field plantings and further delay production compared to high tunnels.

Planting Dates and Insulation

Marketable yield was greatest (4 to 7 stems per plant) for plantings from November to February when low tunnels were used within a high tunnel (Figure 6). Meanwhile, marketable yield was 3 stems per plant for November to February plantings without low tunnels and 2 stems per plant for March plantings. Low tunnels within high tunnels advanced peak harvest by up to 2 weeks and approximately doubled the production of long stems (longer than 10 inches) for November through February plantings. Planting dates after mid-February in the high tunnel is not recommended for Utah production as high temperatures during bloom reduce marketable yield by up to 49%.

For field production, planting in November and March with insulation is recommended, but April is too late. Any type of insulation (straw mulch, a fabric low tunnel, or straw mulch under a fabric low tunnel) improved total and marketable yield by maintaining warmer soils compared to uninsulated plantings (Figures 7 and 8). Emergence of insulated November field plantings was 95%, compared to 55% without insulation. From mid-November to mid-March, the soil temperature at a 2-inch depth was an average of 3.9°F warmer with insulation compared to bare soil. Insulation also advanced harvest by up to 4 weeks for November plantings and up to 2 weeks for March plantings compared to uninsulated plantings.

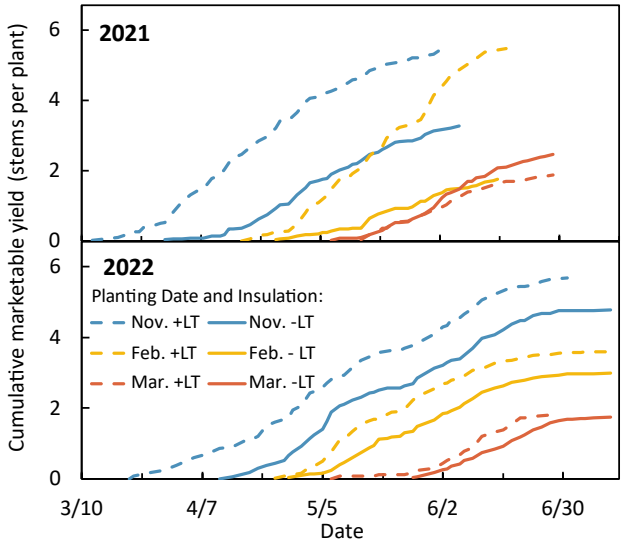

Figure 6. A high tunnel's cumulative marketable yield (stems per plant) of 'Galilee' by planting date: Nov. (blue lines), Feb. (yellow lines), and Mar. (red lines) and insulation: with low tunnels (+LT, dashed lines) and no low tunnels (-LT, solid lines) in 2021 (top panel) and 2022 (bottom panel).

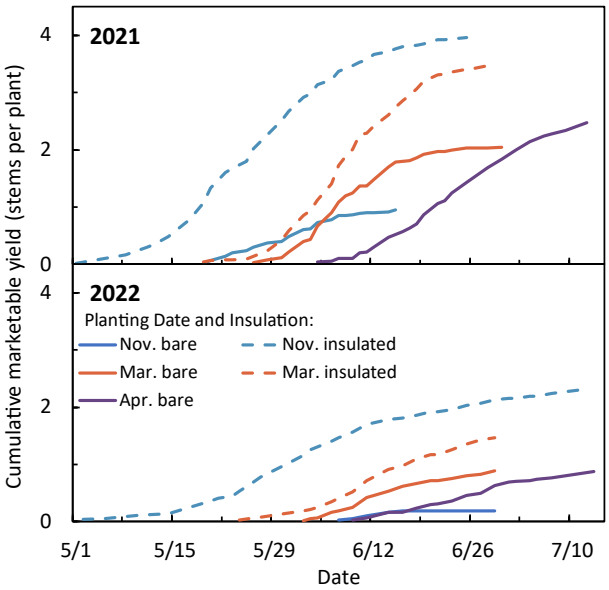

Figure 7. A field's cumulative marketable yield (stems per plant) of 'Galilee' by planting date: Nov. (blue lines), Mar. (red lines), and Apr. (purple lines) and insulation: bare (solid lines) and insulated (dashed lines) in 2021 (top panel) and 2022 (bottom panel).

Cultivars and Pre-sprouting

While 'Galilee' is marketed as producing many blooms that are smaller in diameter and 'Carmel' is marketed as producing fewer blooms that are larger in diameter, we did not observe any differences in bloom size or appearance. Across the high tunnel and field, 'Galilee'

had greater average marketable yield (2.9 stems per plant) than 'Carmel' (2.3 stems per plant). 'Carmel' and 'Galilee' represent strong choices for Utah cut flower production, but 'Galilee' is preferred when available. Pre-sprouting advanced harvest by up to 1 week and increased yield for high tunnel and spring field plantings by 0.6 stems per plant.

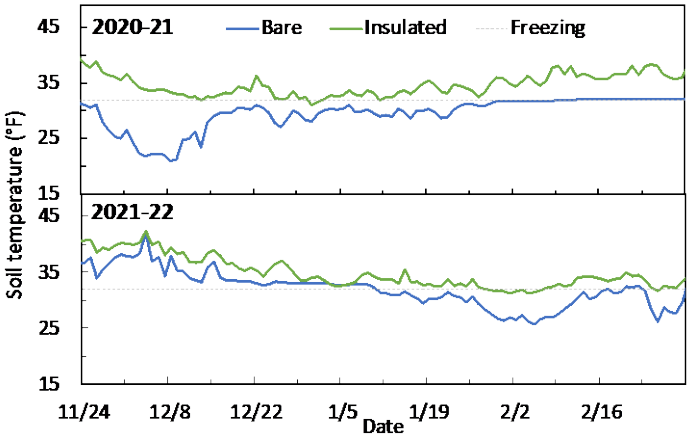

Figure 8. Daily average field soil temperature (2-inch depth) left bare (blue lines) or insulated (green lines) during winter 2020-21 (top panel) and 2021-22 (bottom panel).

Conclusions

Anemone is a popular spring crop that can benefit local farms with its high and early yields. Management practices that advance bloom during optimal temperatures (40-64°F) are critical for high-quality stems and maximizing yield. Pre-sprout tubers to advance harvest by 1 week and increase yield by 0.6 stems per plant. Succession plant in high tunnels with low tunnels from November through February to produce a consistent harvest from the beginning of April to the end of May. For anemone grown in the field, plant in November or March with insulation to prevent cold injury. Smaller yields are expected from the field and begin in May, lasting until the end of June.

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