Tackling the three challenges of dahlia production: bloom timing, nutrient management, and disease

This report is funded by the ASCFG Research Foundation.

[1,2]Melanie Stock and [1]Claudia Nischwitz | [1]Utah State University (USU), [2]PI

Summary of Need

Dahlias (*Dahlia pinnata*) are widely grown, premium cut flowers in the U.S. Intermountain West, where dinnerplate varieties typically sell wholesale to florists for $3.00 to $5.00 per stem. Once flowering begins, dahlias bloom continuously until frost, thus can provide a long window for harvest and generate significant farm income. In a survey by M. Stock, 87% of cut flower farms listed dahlia as a key summer or fall crop (Utah Urban and Small Farms Conference, 4 Mar. 2020). However, meeting market demand can be challenging, as yields can be low. Dinnerplate varieties begin blooming late, often just weeks before frost, and plant growth can be inconsistent: from stunting to loss in vigor, heavy vegetative growth, or unpredictable flowering.

Moderating Utah temperatures with protected cultivation methods may be key for early and sustained production, as dahlias are a warm-season crop that experience injury below 41°F and above 88°F (Brøndum and Heins, 1993). High tunnels have been used in the U.S. Midwest and northern Great Plains to advance the season (Ortiz et al., 2012; Kluza, 2019), which showed planting nearly one month before last frost increased yield and quality (Kluza, 2019). In addition to high tunnels, low tunnel, and shade may improve production, particularly for microfarms that lack adequate space for high tunnels. Early literature on dahlia indicated shielding plants from intense sun and wind also improved bloom (Johnson and Turner, 1847).

Unpredictable plant growth is a challenge with production that can be caused by soil fertility status or virus infection. The American Dahlia Society (2001) recommends 175 lb nitrogen (N) per acre and found growers tend apply more nutrients than needed, potentially reducing yield up to 25%, while international research suggests 90 to 450 lb N per acre (Sheergojri et al., 2013; Prasad et al., 2018). Therefore, creating regional guidelines is important for long-term soil health and productivity, particularly in the U.S. West, where soils are sensitive to fertilizer application and present challenges for production with elevated pH and salinity, limited organic matter, and excessive nutrient retention (Stock et al., 2020).

Virus infection also reduces plant vigor and production, but sourcing clean stock and identifying infection is challenging. Dahlia mosaic virus (DMV) has been exceptionally prevalent in Utah since testing began in late 2019 (USU, 2021). Plants ranged from asymptomatic, to stunted, to exhibiting mosaics or necrotic lesions. More research is needed to research links to nutrient management, the association of specific symptoms with strains, transmission, and cultivar susceptibility. Making virus testing more available to farms and promoting best practices are needed to improve statewide production.

Goals for Utah dahlias in 2021:

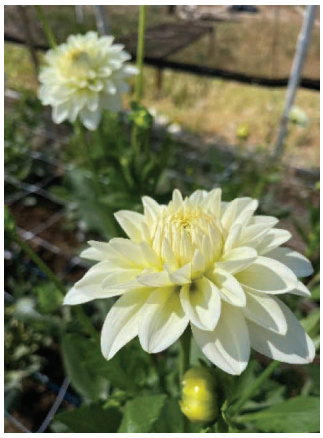
- Trial protected cultivation methods with the use of high tunnels, low tunnels, shade, and mulch.
- Test yield, bloom timing, and soil and plant tissue N levels with five N rates for optimal production.
- Provide free virus testing to Utah farmers and document symptoms.

Procedures and Early Results: A collaboration between the ASCFG, USU Extension, and Western SARE

Protected Cultivation

Protective cultivation methods were trialed at both the USU Agricultural Experiment Station in North Logan, Utah (USDA Hardiness Zone 5, average last and first frosts: 21 May and 25 Sep., 4610 ft elevation), and Wheeler Historic Farm in Murray, Utah (USDA Hardiness Zone 7, average first and last frosts: 08 May and 05 Oct, 4393 ft). In North Logan, high tunnel production was compared to open field conditions with 'Serena' and 'White Pearl' by the dedicated work of undergraduate researcher, Anna Collins, of Dr. Stock's USU Small Farms Lab. The high tunnel was planted on April 27, and the field on May 24. Plastic film covered the high tunnel until late June, at which time it was removed and replaced with 30 % shade cloth.

The high tunnel advanced harvest by 35 days, with first harvest occurring on July 9 in the high tunnel, and August 13 in the field (Figure 1). As of August 27, the high tunnel produced an average of ten stems per plant while the field has averaged six (Figure 1). Quality has also been greater with high tunnel production. The minimum standard for marketability with Utah florists is six inches and undamaged blooms. The high tunnel has averaged five marketable stems per plant as of August 27, the average stem length was 11 inches, with stems lengths ranging from 8 to 34 inches. In the field, harvest has occurred on only two dates, with the first marketable stems harvested on August 27. On average, the field has produced one marketable stem per plant (Figure 1), indicating the benefit of high tunnels in Northern Utah. We expect (hope for!) harvest to continue until the end of September in the field and into October in the high tunnel, when hard frost will end the trial.



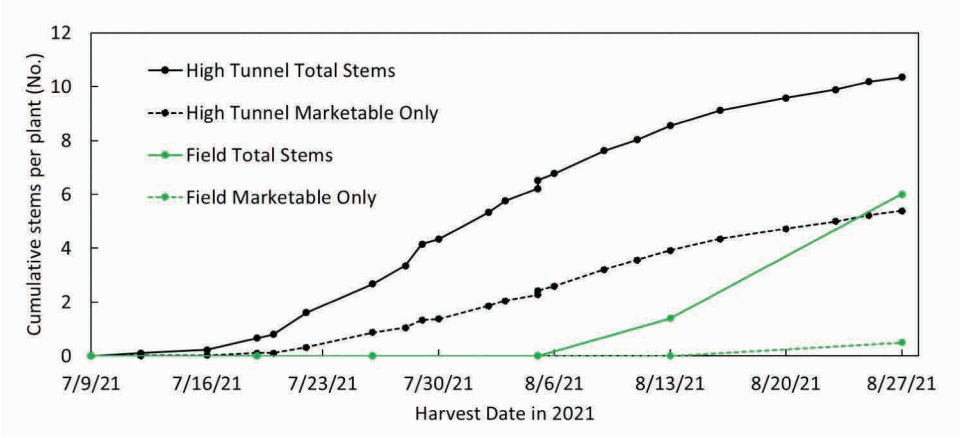


Figure 1. *Left*: 'Serena' grown in a high tunnel in North Logan, UT. *Right:* The cumulative number of stems from 'Serena' and 'White Pearl' harvested from the high tunnel (black lines) and field (green lines). The solid lines represent total stems (marketable quality + cull), while the dashed lines are only marketable stems.

In Murray, the use of low tunnels for shading and mulch was tested. This trial is in Salt Lake County, where the majority of Utah's cut flower farms are located, and represents a much warmer growing area compared to the USU research farm located 100 miles north in North Logan. 'La Luna' tubers were planted on June 1, and 'Café au Lait' cuttings were planted June 9. Planting dates were delayed due to commercial stock and shipping challenges; therefore, low tunnels were tested as shade and wind break structures; not early season advancement. Two practices were then tested: the use of black versus white plastic mulch on the soil, and the use of shade versus no shade on the low tunnel structures. Each combination of mulch and shade was tested, and soil temperature sensors were installed beneath the plastic. The trial has been carefully monitored by Mark Brenneman of Wheeler Historic Farm, and Amanda Pratt, USU Extension Master Gardener and owner of A Lavender Garden.

While we are in the process of collecting and analyzing the data, early visual observations can be shared. Overall, the use of 30 % shade improved plant establishment, which was challenging with the late planting dates and the record heat and drought conditions in Utah during 2021. Black plastic without shade resulted in a loss of 17% of plants, while black plastic with shade resulted in an 11% loss of plants. With the use of white plastic, plant loss was only 6% with or without shade. Harvest of marketable stems began one week earlier with plants grown in white plastic mulch (August 19) compared to black plastic mulch (August 26), regardless of shading treatment (Figure 2). Though harvest has just begun, plants with white plastic mulch and shade have been more productive (Figure 2). We hypothesize the white plastic mulch and shade may have kept conditions cooler and the solar radiation less intense, leading to improved early growth and production. We are eager to continue monitoring production into October and compare total yields with soil temperature data, as well as repeat this study in 2022.

Nutrient Management

A field of 'Café au Lait' was planted on May 24 in North Logan to test five N fertilizer rates (0, 50, 100, 150, and 200 lb N per acre) by research assistant, Eli Oliver, of Dr. Stock's USU Small Farms Lab (Figure 3). To assess N uptake by the plants, the soil was tested prior to planting and will be again after frost-kill for pH, salinity, nutrients, and will be compared to plant tissue samples collected just prior to flowering. Six cut flower farms are also growing 'Café au Lait' with us and have submitted soil samples for testing: we thank Stonehouse Dahlias, Flourish Flower Market, Calluna Flower Farm, Wasatch Blooms, Sego Lily Flower Farm, and Local Roots Flower Farm. For the North Logan field trial, plant growth rates were greater with N application rates of 100 lb N per acre or more. Harvest began on July 27, and the most total and marketable blooms were harvested from plants fertilized at 150 lb N per acre. We expect the field trial to continue through the end of September and look forward to our growers' findings.

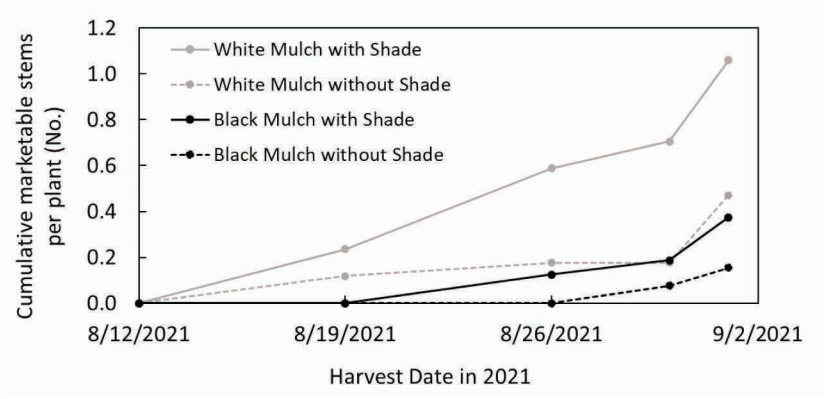


Figure 2. *Top left*: 'La Luna' and 'Café au Lait' at Wheeler Historic Farm in Murray, Utah on August 11, with plastic mulch and shade versus no shade. *Bottom left*: Harvest by Amanda Pratt, USU Extension Master Gardener and owner of A Lavender Garden. *Above*: the cumulative marketable yield with white (gray lines) and black (black lines) plastic mulch, shade (solid lines) and no shade (dashed lines).

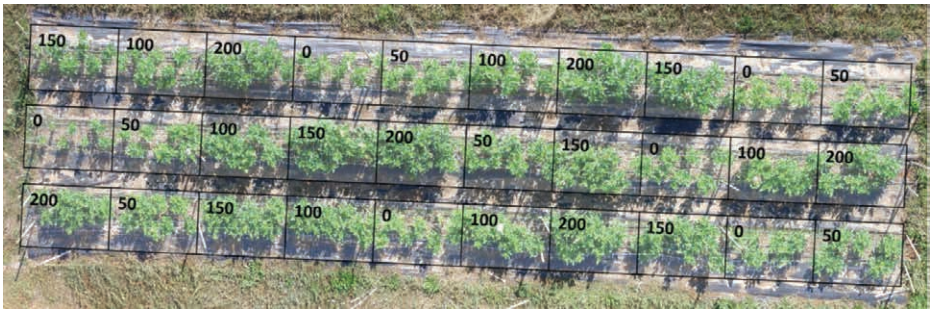


Figure 3. Field of 210 'Café au Lait' plants that are divided into 30 plots that each test one of five N treatments: 0, 50, 100, 150, and 200 lb N per acre.

Figure 4. *Top left:* An example of healthy and productive beds of dahlias grown by Lindsey Waddoups, owner of Three Sprouts Flower Farm in Davis County, Utah, on August 26, 2021. *Top right:* A healthy dahlia leaf with no visual sign of virus infection. *Bottom:* Examples of a stunted plant and mosaic patterns on the leaves of dahlia from across Utah that indicate potential virus presence and warrant laboratory testing.

To determine the prevalence of virus in Utah dahlias, as well as classify plant symptoms by virus and by combination of viruses, we have been obtaining plant tissue samples through collaboration with Utah farmers and dahlia enthusiasts. Samples are tested in the USU Plant Pathology Lab by six committed undergraduate research assistants supervised by Dr. Nischwitz. Please note, our laboratory is restricted to testing samples only from Utah; we do not have permits for out-of-state samples. We continue to be impressed with and very thankful for the strong engagement of Utah growers and their dedication to research in our state.

Collaborating with established farms, and using social media (@usu_smallfarms on IG) to publicize testing to newer farms has been successful in growing our testing program, as well as sharing information on our website (USU, 2021). We posted pictures of what to look for in potentially infected plants, visited farms to collect samples, collaborated with county Extension faculty to scout fields, and have been fortunate to have many growers reach out via email with pictures and mail in samples for testing (Figure 4). Since May 2021, we have obtained 294 samples for virus testing and sample processing is underway. The plant tissue samples represent eight counties across Utah, where cut flower farms are predominantly located. We expect to create a USU Extension fact sheet that details virus incidence and identification for farms and gardens.

We thank the ASCFG for their support of these studies that are in collaboration with USU Extension and Western SARE grants, and the Utah growers who contribute to this research and make us love what we do.

References

American Dahlia Society. 2001. <https://dahlia.org/docsinfo/articles/nutrients-for-dahlias/>.

Brøndum, J.J. and R.D. Heins. 1993. J. Am. Soc. Hortic. Sci. 118(1): 36-42. DOI: 10.21273/JASHS.118.1.36.

Kluza, J. 2019. M.S. Thesis. North Dakota State University. Fargo, North Dakota.

Johnson, G. and J. Turner. 1847. The Gardeners Monthly Volume. Simpkin, Marshall, & Co. London, 111 pp.

Prasad, D. S. H., V.M. Prasad, S.K. Goutham, and S.C. Bose. 2018. Plant Archives, 18(1), 795-798.

Sheergojri, G.A., Z.A. Rather, F.U. Khan, I.T. Nazki, and Z.A. Qadri. 2013. Appl. Biol. Res., 15(2), 121-129.

Stock, M., T. Maughan, and P. Grossl. 2020. <https://digitalcommons.usu.edu/extension_curall/2116/>.

Utah State University (USU). 2021. <https://extension.usu.edu/pests/news/dahlia-mosaic-virus>.