# Semi-annual Report

July 1, 2025 – December 31, 2025

## Viticulture and Enology programs for the Colorado Wine Industry


## Principal Investigators

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## Collaborating Institutions

- Colorado Department of Agriculture
- The Colorado Wine Industry Development Board
- Colorado State University


## Summary

The majority of the work performed during the reporting period included seasonal vineyard tasks such as vine training, canopy management, crop thinning, harvest, preparing vineyards for dormant season, bud cold hardiness evaluations, data entry and analysis, and the annual Colorado Grape Grower Survey. The vineyard work was performed by CSU staff from the Western Colorado Research Center (WCRC).

Weather conditions in the Grand Valley were warmer than average from July to December. In total, we recorded 12 daily high temperature records at WCRC (4 in August, 8 in December). November 2025 was the warmest November and December 2025 the second warmest December since record-keeping began at the Western Colorado Research Center – Orchard Mesa in 1964. Record daily maximum temperatures were recorded during a 7-day period from 20 to 26 December. The average daily maximum temperature was 59.3 °F which was 21.3 °F above average.

While bud break was near normal subsequent phenological stages were early in 2025. First bloom was observed in the second week of May. On 6 June a severe hailstorm caused 100 % crop loss at WCRC-OM. As we were unable to track vine phenology at the research center the following information is based on observations in commercial vineyards. Harvest started with Itasca in the first week of August. We completed harvest of research plots in grower collaborator's vineyard on 6 October. The latest harvest date reported in the annual grape grower survey was 25 October. A killing frost occured on 28 October.

Preliminary data from the 2025 Colorado Grape Grower Survey indicate an average yield of 3.6 ton/acre. However, those results come from only 321 acre, most of which are in Mesa County. The average state-wide yield is likely to decline when more returns are received. Nevertheless, the data indicate a small increase of 0.2 ton/acre (6 %) compared to the 2024 season. Winery demand for grapes was very weak in 2025 resulting in a grape surplus of 32 %. In response, we continue to see removals of mature vineyards especially in the Grand Valley and a change in the land use to other high value crops.



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There have been no extreme low temperature events during fall 2025 and early winter of 2025/26. Monthly mean temperatures for November and December 2025 and January 2026 have been weel above average. The lowest dormant season temperature observed so far was 11.7 °F on 26 January 2026. By early February 2026, no bud cold damage has been observed on any of the cultivars we monitor.

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**Growing conditions, 2025 season**

Timing of bud break in the Grand Valley was near average. Warmer than average temperatures were recorded for every month of the year, making 2025 the warmest year in our records (1964-2025). Cumulative Growing Degree Day (GDD) accumulation was above average the entire season. By the time of the killing frost on 28 October GDD accumulation had reached 4,097, which is 407 GDD higher than the long-term average.

Precipitation records from the Western Colorado Research Center – Orchard Mesa (WCRC-OM) show below average values for 2025. Nearly one third (1.98”) of the seasonal precipitation was received in October. Total seasonal precipitation was 6.53” compared to the long-term (1981-2010) average of 9.25”.

## Research Update

A severe hailstorm struck WCRC-OM in the afternoon of 6 June 2026. The hail caused massive damage to leaf area and developing clusters. Depending on cultivar, training system, and vine position in the block, we estimated defoliation >80 % and fruit damage near 90 %. To aid vine recovery the decision was made to remove all remaining fruit. All clusters were cut off and dropped to the ground within a week of the storm.

Photo showing Chambourcin vines on 9 June 20205, three days after a severe hailstorm in the afternoon of 6 June 2025.

DUE TO THE DAMAGE FROM A SEVERE HAILSTORM ON 6 JUNE 2025 THERE WAS NO CROP IN 2025 FROM ANY OF THE TRIALS LOCATED AT WCRC-OM.

## I. Cropping reliability

### 1. *Grape cultivars and clones suited to Colorado temperature conditions*

Since 2004 we have greatly expanded the number of cultivars under testing. The first-ever replicated cultivar trial in Delta County was planted at the Western Colorado Research Center - Rogers Mesa (WCRC-RM) site in 2004. This trial was expanded with new entries in 2008-2009 as part of the USDA Multistate NE-1020 project (see below). Also in 2008 and as a part of NE-1020, 26 "new" cultivars were planted at the WCRC-OM site. An additional replicated trial focused on cold-hardy, resistant cultivars was established on a grower cooperator site in Fort Collins in 2013 to identify grape cultivars that can be grown successfully along the Front Range. And in 2014, a fourth trial focused on cold-hardy, resistant cultivars was established with a grower-cooperator in the Grand Valley. A new cultivar trial block was started at WCRC-OM in April 2022 with the planting of Cabernet Volos, Fleurtai, and Soreli. This block was extended in April 2024 to include four additional cultivars: Clarion, Merlot Kanthus, Sauvignon Kretos, and Sauvignon Rytos. A duplicate trial of the seven cultivars planted at WCRC-OM between 2022 and 2024 was established at WRCR-RM in May 2024. The block at WCRC-OM was further extended with the addition of five advanced breeding lines from the University of Minnesota (MN 1311, MN 1347, MN 1394, MN 1419, MN 1421) and the interspecific cultivar Solaris from the breeding program of the Staatliches Weinbauinstitut Freiburg, Germany.

The vines in the new cultivar at WCRC-RM were only in their second year and produced no fruit.

- Multi-state evaluation of wine grape cultivars and clones (Caspari, Bertin, Braddy, Gardner, and Gautam)

This long-term (2004-2027), USDA multi-state research project (originally NE-1020, then NE-1720, now NE-2220) tests the performance of clones of the major global cultivars and new or previously neglected wine grape cultivars in the different wine grape-growing regions within the U.S. and is a collaboration of more than 20 states. All participating states follow the same experimental protocol. In Colorado, 10 cultivars were established in 2008 and 2009 at WCRC-RM, and 25 cultivars at WCRC-OM between 2008 and 2012. At WCRC-OM, we have continued to remove poor performing cultivars and replant with new entries. For example, in 2016 we added MN 1285, a white cultivar from the breeding program at the University of Minnesota. MN 1285 was released in 2017 under the cultivar name 'Itasca'. Following the extreme low temperature event in late October 2020 another five cultivars were removed that had sustained near 100 % bud damage and had shown poor performance in the long term. In late April 2021, five new entries were planted (Agria, Arinto, Corvina Veronese, Sagrantino, Teroldego).

- New disease tolerant and cold-hardy cultivars (Caspari, Bertin, Braddy, Gardner, and Gautam)

Three recent new cultivar releases from the breeding programs at the University of Udine and Institute of Applied Genetics, Udine, Italy, were planted in late April 2022 at WCRC-OM. The three new entries are interspecific cultivars having good to very high tolerance to powdery mildew. The cultivars are Cabernet Volos (Cabernet Sauvignon x Kozma 20-3) grafted to SO4, and Fleurtai (Tocai Friulano x Kozma 20-3) and Soreli (Tocai

Friulano x Kozma 20-3), both grafted to 101-14. Although these cultivars were not planted within the same block where the NE-2220 trial is located, the same experimental protocols are being followed.

In April 2024, this trial was expanded by the addition of four cultivars. The cultivar Clarion is a recent release from the University of Minnesota. The other three cultivars are recent releases from the University of Udine and Institute of Applied Genetics, Udine, Italy. The cultivars are Merlot Kanthus (Merlot x Kozma 20-3), Sauvignon Kretos (Sauvignon blanc x Kozma 20-3), and Sauvignon Rytos (Sauvignon blanc x Bianca), all grafted to 101-14.

In May 2024, the seven cultivars mentioned above were planted at the WCRC-RM site, providing a duplicate planting in a cooler growing region.

In May 2025, the block at WCRC-OM was further extended with the addition of five advanced breeding lines from the University of Minnesota (MN 1311, MN 1347, MN 1394, MN 1419, MN 1421) and the interspecific cultivar Solaris from the breeding program of the Staatliches Weinbauinstitut Freiburg, Germany.

### *2. Mitigating damage from grape phylloxera*

Grape phylloxera (*Daktulospheira vitifoliae*) is an aphid-like insect that feeds on grape roots. Phylloxera is native to the northeastern United States and many American grape species are tolerant to phylloxera. However, the European grape (*Vitis vinifera*) has no tolerance and phylloxera feeding on roots will eventually kill the vines. The first recording of phylloxera in a commercial vineyard in Colorado occurred in August 2015. During a routine Grape Commodity Survey, personnel working for the Cooperative Agricultural Pest Survey (CAPS) found phylloxera on leaves of inter-specific vines in Larimer county. In November 2016, CSU personnel assisting a grower in Mesa County discovered phylloxera on the roots of young Vitis vinifera vines. In subsequent surveys by CSU, phylloxera was discovered in six further vineyards in Mesa County, and one vineyard in Delta County. Phylloxera was found in vineyards planted with inter-specific as well as *Vitis vinifera* cultivars. More vineyards infested with phylloxera were found in further surveys in 2017, 2018, and 2019. At the end of the survey perios there were 18 positive vineyards in Mesa County, 3 in Delta County, 1 in Montrose County, and 2 on the Front Range. It is very likely that in some vineyards phylloxera has been present for more than 10 years.

Phylloxera represents a major threat to the Colorado grape and wine industry. Vineyards in Mesa and Delta County produce >90 % of Colorado's grape crop. At the time phylloxera was discovered more than 90 % of these vineyards were planted with own-rooted vines of European cultivars, making them susceptible to phylloxera damage. Since then the percentage of vineyards with own-rooted V. vinifera vines has declined but still exceeds 50 %. Initially, feeding of phylloxera on roots of susceptible grape vines leads to reduced vine vigor and lower yields. However, phylloxera feeding, in combination with fungal and bacterial infections of the damaged root system, will eventually kill the vines. While phyto-sanitary practices and insecticide applications can slow the spread of phylloxera, the long-term solution is the removal of own-rooted vines of cultivars that are not phylloxera tolerant (all *Vitis vinifera* and some interspecific cultivars) and then replanting with susceptible cultivars grafted to tolerant rootstocks or with tolerant interspecific cultivars.

While there is a large body of research on the performance of rootstocks in many grape growing areas around the world, there is very limited information for Colorado. Only two replicated rootstock studies have been conducted in Colorado prior to the discovery of phylloxera. The first, using Chardonnay grafted to four different rootstocks, was planted at WCRC-OM in 1992/93. The second, planted in 2009 also at WCRC-OM, used Viognier grafted to five different rootstocks. Rootstock research is now a high priority area and three further trials, all located on commercial vineyards in the Grand Valley, have been initiated since 2017.

Low temperatures can kill vine trunks down to the soil or snow line. When using own-rooted vines suckers originating from below or at soil level can be used to retrain damaged vines. When using grafted vines new shoots used for retraining need to come from the scion part, i.e. from the part above the graft union. If low temperatures kill the graft union the whole vine needs to be replaced. In regions where the graft union might get damaged by low temperatures the graft union has to be protected. The standard method for protecting the graft union is to hill up soil in fall. In spring, after the risk of cold temperature damage has passed, the graft union needs to be uncovered to avoid self-rooting from the scion. In a second phylloxera-related study we are investigating alternative methods to the annual hilling and uncovering to protect the graft union from cold temperature injury.

- 2017 Rootstock trial with Cabernet Sauvignon (Caspari, Bertin, Gardner, Gautam, and grower cooperator)

A new rootstock trial with Cabernet Sauvignon (clone 33) grafted to 11 different rootstocks was established in early June 2017 on a grower cooperator's vineyard in the western part of Orchard Mesa using green potted vines. The site is located about 1.6 miles East of WCRC-OM. The following rootstocks are included: 110 Richter (110R), 140 Ruggeri (140Ru), 1103 Paulsen (1103P), 1616C, 101-14 Mgt (101-14), 3309 Couderc (3309), Riparia Gloire (RG), Salt Creek (SC), Schwarzmann (Schw), Selektion Oppenheim #4 (SO4), and Teleki 5C (5C). The trial is set up as a randomized complete block design with 5 replications, and 5 vines per replication. The vineyard is irrigated by micro-sprinklers. Graft unions are protected by hilling over with soil in fall and uncovering the following spring.

Vine establishment in year 1 was very good (255 out of 258 vines planted). In late spring of 2018, vines were pruned back to no more than two spurs per vine, and two buds per spur. On 20 April 2018, two missing entries were replanted using leftover vines from the original planting that had been grown in pots at WCRC-OM. Shoot growth during 2018 was very vigorous. Five vines were lost during 2018.

Vine assessment in spring 2019 showed 250 out of 258 vines originally planted were still alive. There was 100 % vine survival with eight rootstocks but some vine mortality with rootstocks 5C (2), 1616C (1), and 140Ru (5). Although most vines carried a crop in 2019 no harvest data is available as the vines mere mistakenly harvested by a picking crew after the early freeze event on 10 October 2019.

Seven more vines were lost during the 2019/20 dormant season. Some missing vines were replaced in late June 2021. At the end of the 2021 growing season only three out of eleven rootstocks had no missing vines: 1616C, 3309, and 101-14. The highest percentage of missing vines was 17 % with 140Ru.

There was no yield in 2021 due to 100 % bud damage from the October 2020 cold event. All vines needed retraining from the ground.

Suckers / canes were retrained and retied to the fruiting wire in spring 2022. Surplus suckers were removed. There were some missing vines but overall vine survival was much better than in the 2018 companion study (see below). No yield data was available for 2022 as the fruit in the research plot was mistakenly harvested by a picking crew.

There was no bud damage and no vine losses during the 2022/23 dormant season. Yields in 2023 averaged 2.16 ton/acre, ranging from 1.44 ton/acre with 140Ru to 2.90 ton/acre with SO4.

While there was again no bud damage eleven vines were lost during the 2023/24 dormant season. Yields were reduced through a combination of late spring frost and hail. Yields in 2024 averaged 1.4 ton/acre, ranging from 0.63 ton/acre with 140Ru to 2.21 ton/acre with Riparia Gloire.

Vines were dormant pruned in late December to mid January 2025. Except for some shoot and fruit thinning most of the seasonal vineyard work was performed by the cooperating grower. Fruit was harvested on 3 and 6 Oct 2025. (Table 1). Vines grafted to Riparia Gloire and Saltcreek had the highest yield per cropping vine and yield per acre. (Table 1). Vines on 5C and 140Ru had the lowest yield per cropping vine and per acre. Vines on rootstock 140 Ru have the lowest survival rate of 61 %. All other rootstocks have survival rates above 80 %.

Fruit composition of Cabernet Sauvignon at harvest was very similar irrespective of the rootstock used (Table 2). The *V. riparia* x *V. berlandieri* rootstocks (5C, SO4) had the lowest soluble solids levels and the highest concentration of titratable acids and malic acid. Juice nitrogen concentrations (α amino nitrogen and ammonia) were much lower than in the 2024 season, resulting in Yeast Assimilable Nitrogen (YAN) levels of 273 to 369 mg $l^{-1}$.

Table 1: Effect of rootstock on vine survival after nine years and yield in 2025 of Cabernet Sauvignon growing in a commercial vineyard in the western part of Orchard Mesa near Grand Junction, CO.

| Rootstock | Vine survival (%) | Yield per cropping vine (lb) | Yield (ton/acre)[1] |
|---|---|---|---|
| 110R | 96 | 6.47 | 2.80 |
| 140Ru | 61 | 5.89 | 1.51 |
| 1103P | 88 | 6.44 | 2.46 |
| 1616C | 88 | 8.08 | 2.90 |
| 101-14 | 91 | 6.81 | 2.35 |
| 3309 | 100 | 8.19 | 3.26 |
| 5C | 83 | 5.37 | 1.74 |
| Riparia Gloire | 91 | 9.74 | 3.32 |
| Salt Creek | 96 | 8.64 | 3.78 |
| Schwarzmann | 83 | 7.01 | 2.61 |
| SO4 | 83 | 8.62 | 2.48 |

[1]Yield calculation based on number of vines initially planted.

Table 2: Effect of rootstock on fruit composition at harvest in 2025 of Cabernet Sauvignon growing in a commercial vineyard in the western part of Orchard Mesa near Grand Junction, CO.

| Rootstock | Soluble solids (Brix) | pH | Titratable acidity (g $l^{-1}$) | Tartaric acid (g $l^{-1}$) | Malic acid (g $l^{-1}$) | Alpha amino nitrogen (mg $l^{-1}$) | Ammonia (mg $l^{-1}$) |
|---|---|---|---|---|---|---|---|
| 110R | 26.6 | 3.52 | 5.4 | 7.9 | 1.6 | 153 | 167 |
| 140Ru | 26.5 | 3.53 | 5.7 | 8.4 | 2.1 | 164 | 163 |
| 1103P | 26.0 | 3.59 | 5.4 | 7.4 | 2.2 | 185 | 164 |
| 1616C | 26.1 | 3.54 | 5.5 | 7.7 | 2.1 | 167 | 165 |
| 101-14 | 26.7 | 3.63 | 5.1 | 7.6 | 1.7 | 148 | 144 |
| 3309 | 26.8 | 3.52 | 5.5 | 8.3 | 1.7 | 156 | 173 |
| 5C | 25.5 | 3.53 | 6.1 | 7.5 | 2.5 | 200 | 176 |
| Riparia Gloire | 26.0 | 3.53 | 5.3 | 7.8 | 1.3 | 171 | 158 |
| Salt Creek | 26.4 | 3.60 | 5.0 | 8.0 | 1.5 | 158 | 161 |
| Schwarzmann | 26.0 | 3.63 | 5.1 | 7.6 | 1.4 | 190 | 174 |
| SO4 | 24.9 | 3.50 | 6.1 | 7.4 | 2.6 | 186 | 184 |

- 2018 Rootstock trial with Cabernet Sauvignon (Caspari, Bertin, Gardner, Gautam, and grower cooperator)

This trial was a duplicate of the 2017 new rootstock trial with Cabernet Sauvignon (clone 33). Vines were planted in May/June 2018 on a grower cooperator's vineyard in the central part of Orchard Mesa. Due to very low yields and very low vine survival the grower made the decision to remove the vineyard and replant with peaches.

- 2019 Rootstock trial with Souzao in a challenging soil. (Caspari, Bertin, Gardner, Gautam, and grower cooperator)

A new rootstock trial with Souzao (clone 1) grafted to 7 different rootstocks was established in late June 2019 on a grower cooperator's vineyard in the western part of Orchard Mesa. The site is located about 1.6 miles Northeast of WCRC-OM. The location for this trial is a former hay field that had not been irrigated for 10 years. Although the soil is classified as Gyprockmesa clay loam, the soil in this specific location is more sandy with a high percentage of large gravel, and at the time of planting highly alkaline. Gravelly areas within vineyards with predominantly Gyprockmesa clay loam are common on Orchard Mesa. Also, in the past many vineyards have been established on sites that had not been irrigated for many years, and this trend is likely to continue. Therefore, this site presents an opportunity to investigate the performance of a smaller set of rootstocks when grown in challenging soil conditions. One or two rootstocks from the main genetic groups used in rootstock breeding (*V. berlandieri* x *V. rupestris*; *V. berlandieri* x *V. riparia*; *V. riparia* x *V. rupestris*, *V. solonis* x *V. riparia*) are being evaluated.

The trial is set up as a randomized complete block design with 6 replications, and 4 vines per replication. Vines are irrigated by micro-sprinklers. The following rootstocks were planted on 28 June 2019 using green potted vines: 110 Richter, 1103 Paulsen, Teleki 5C, SO4, 101-14 Mgt, 3309 Couderc, and 1616C.

As vine vigor was low in 2019 all vines were pruned back to one or two canes leaving no more than 4 nodes per cane in April 2020. Fifteen out of the 168 vines originally planted failed to grow. Shoot growth in 2020 was severely affected by deer browsing. An extreme low temperature event in late October 2020 resulted in near 100 % bud mortality. Consequently, surviving vines needed retraining from the ground in 2021. Twelve vines failed to grow in 2021. Five replacement vines, leftovers from the 2019 planting that were grown in pots at WCRC-OM for two years, were planted in June 2021. At the end of the 2021 growing season there were 22 missing vines (out of a total of 164), with half the missing vines grafted to 1103P.

Four more vines were dead following the 2021/22 dormant season. Three vines grafted to 5C were planted in spring 2023. In the summer of 2023, overall vine survival of the original 2019 planting was 80 %, ranging from 50 % with 1103P to 96 % with 101-14. More replacement vines were ordered in April 2023 and planted in May 2024.

In contrast to 2024, there were large differences in yield per cropping vine between the rootstocks in 2025 (Table 3). The yield of vines on 1103P was 80 % than that of vines on 5C. However, due to low vine survival, vines on rootstock 1103P produced the lowest yield per acre. Only two rootstocks produced more than 2 ton/acre (Table 3). The yields on this site were reduced due to spring frost damage in spring 2024 causing lower trunk damage and the need to retrain during the 2024 season. Only twothirds of the surviving vines produced a crop in 2025. Averaged across all rootstocks the yield in 2025 was 1.79 ton/acre, similar to 2024.

Rootstock effects on fruit composition at harvest were generally small (Table 4). Yeast Assimilable Nitrogen concentrations were down compared to the 2024 season with an average value of 307 mg $l^{-1}$.

Table 3: Effect of rootstock on vine survival after 7 years and yield in 2025 of Souzao growing in a commercial vineyard on Orchard Mesa near Grand Junction, CO.

| Rootstock | Vine survival of 2019 planting (%) | Yield per cropping vine (lb) | Yield (ton/acre)[1] |
|---|---|---|---|
| 110R | 83 | 6.43 | 2.81 |
| 1103P | 50 | 6.63 | 0.99 |
| 1616C | 71 | 4.16 | 1.91 |
| 101-14 | 96 | 4.13 | 1.68 |
| 3309 | 92 | 5.31 | 2.10 |
| 5C | 83 | 3.69 | 1.73 |
| SO4 | 88 | 4.28 | 1.56 |

[1]Yield calculation based on number of vines initially planted.

Table 4: Effect of rootstock on the 2025 fruit composition of Souzao growing in a commercial vineyard on Orchard Mesa near Grand Junction, CO.

| Cultivar | Soluble solids (Brix) | pH | Titratable acidity (g $l^{-1}$) | Tartaric acid (g $l^{-1}$) | Malic acid (g $l^{-1}$) | Alpha amino nitrogen (mg $l^{-1}$) | Ammonia (mg $l^{-1}$) |
|---|---|---|---|---|---|---|---|
| 110R | 24.5 | 3.17 | 7.7 | 10.2 | 1.8 | 132 | 141 |
| 1103P | 24.6 | 3.23 | 7.1 | 10.0 | 1.7 | 139 | 146 |
| 1616C | 24.7 | 3.23 | 7.6 | 10.0 | 2.2 | 159 | 163 |
| 101-14 | 24.6 | 3.26 | 7.3 | 10.0 | 2.0 | 195 | 180 |
| 3309 | 24.1 | 3.12 | 8.0 | 10.5 | 1.9 | 169 | 177 |
| 5C | 24.5 | 3.25 | 7.6 | 10.3 | 2.2 | 186 | 184 |
| SO4 | 24.4 | 3.21 | 7.8 | 10.6 | 2.3 | 179 | 193 |

- Inter-planting with grafted vines (Caspari, Bertin, and Gardner)

Once vineyards planted with own-rooted *Vitis vinifera* cultivars become infested with phylloxera, vine vigor and productivity will start declining. It may take several years from the initial infection for symptoms to appear. Currently it is not known how fast phylloxera spreads throughout a vineyard following initial infestation under Colorado conditions. Based on experiences in other areas of the world it is reasonable to assume that it will take at least 5-10 years from initial infestation before vine productivity has declined to such a low level that it requires replanting. Generally at this point, vines are pulled in fall shortly after harvest, then the vineyard is prepared for replanting with grafted or phylloxera-tolerant cultivars the next spring. With this approach, similar to a newly planted vineyard, the first crop is expected in year 3. Another option, however, is to interplant with vines of the new cultivar 2 to 3 years before the anticipated removal. While at that time the vineyard productivity is already declining, vines are still productive enough to not yet warrant removal. With good management, the inter-planted vines can be grown so that at the end of the second or third season, when own-rooted vines need to be removed, canes can be tied to the cordon wire, and a crop can be produced in the following season. The advantage of the interplant approach is that there is no 2-year break in crop production. However, it requires good management of the inter-planted vines.

A new trial to evaluate the inter-planting approach was established in early May 2017 at WCRC-OM. A total of 120 dormant Chardonnay (clone 99) vines grafted to SO4 rootstock were inter-planted in a block of Chardonnay planted with own-rooted vines in 1991. Phylloxera was discovered in this block in December 2016. For several years prior to the discovery of phylloxera, vine vigor and yield had been severely depressed at the northern end of the block while the southern part was not affected. Original vine spacing is 5 feet, and interplants were planted midway between the existing vines. As this block is also used for the cover crop / irrigation study (see below), some areas of the block are drip irrigated while other areas are irrigated by micro-sprinklers.

Vine establishment in year 1 was very good. All vines established, and many vines had >0.5 m shoot growth. Graft unions were covered with soil in late fall, and uncovered again in May 2018. Vines were pruned in late spring 2018, leaving no more than two spurs per vine, and two nodes per spur. No more than two shoots per vine were trained up during the 2018 growing season. Graft unions were protected again with soil in late fall 2018.

After the leaves had dropped in the fall of 2018 an assessment was made of the potential to retain canes for cropping in 2019. Only about 7 % of the vines had sufficiently strong shoot growth that two canes could be tied to the cordon wire and fill the allocated space (5 feet). Another 32 % had enough growth to tie down one cane. About 51 % had insufficient growth to tie down a cane, and thus produce a crop in 2019. Vine mortality of 10 % by the end of the second season was rather high.

Inter-planted vines produced the equivalent of 0.16 ton per acre in 2019 compared to 1.6 ton per acre from the mature vines. Even the combined yield of 1.76 ton per acre is way too low to meet annual operating costs. It is reasonable to expect a yield of 1 to 2 ton per acre in year 3 so inter-planted vines produced less than 20 % of what is expected.

Combined yields of inter-planted and mature own-rooted vines in 2020 were again much below expectations at 1.16 ton/acre. Mature grafted vines growing in the North half of this block produced 5.42 ton/acre. In light of both very high primary bud damage from the October 2020 extreme cold event and declining vine vigor and yield the decision was made to remove the mature own-rooted vines. Vines were pulled out in early December 2020. Nineteen missing inter-plants were replaced in spring 2021.

Inter-planted vines produced a small crop of 0.56 ton/acre in 2021. This is a very low yield for 5-year old vines. However, while missing vines and a slow establishment contribute towards the low yield the main cause was bud damage from the October 2020 cold event. The mature Chardonnay vines grafted to four different rootstocks growing in the same block produced only 0.49 ton/acre. Survey data for 2021 show that all but one other Chardonnay block in Mesa County produced no crop at all, and a county average of 0.14 ton per acre.

The 2022 season was the second growing season after the removal of the old own-rooted vines, and the sixth growing season overall for the inter-planted vines. Without bud cold damage the yield increased to 4.03 ton/acre. The 30-year old grafted vines growing in the same block produced 4.92 ton/acre. This difference is almost entirely due to the missing inter-plants that needed replacement in spring 2021 as the replacement vines had no or minimal yields in 2022.

In 2023 there was a small reduction in yield to 3.76 ton/acre.The 31-year old grafted vines growing in the same block produced 3.02 ton/acre. This is in contrast to 2022 when the previously interplanted vines produced less than the mature grafted vines. However, in 2024 the mature grafted vines again produced more than the inter-planted vines (3.23 versus 2.62 ton/acre).

There was no yield in 2025 due to the damage from the June hailstorm.

- Develop planting and maintenance practices for grafted vines that reduce management costs and vine losses due to cold temperature damage to the graft union – 2017 study (Caspari, Bertin, Gardner, and Gautam)

In Colorado, where low temperatures can cause trunk injuries, the graft union needs to be protected during the coldest part of the year to avoid lethal damage to the cultivar. Common methods of graft union protection are hilling up soil around the graft union or covering the graft union with mulch materials. In spring, after the risk of cold temperature damage has passed, the graft union needs to be uncovered to avoid self-rooting from the scion. Due to the semi-arid climate of western Colorado, the top part of the soil is very dry and hot during the growing season. Dry and hot soil conditions are generally not conducive for root growth. Hence, a study was initiated in 2017 to evaluate if planting grafted vines with the graft union just below the soil surface would result in no or minimal root development from the scion.

A field study to test the effect of planting depths, in combination with irrigation method, on the propensity of self-rooting was established at WCRC-OM in early May 2017. Chardonnay (clone 99) grafted to SO4 rootstock was planted with the graft union 2” above ground (Control = standard practice), or with the graft union 2”, 4”, or 6” below the soil surface. Half the vines are irrigated by drip, the other half by micro-sprinkler. There are 10 single-vine replications per treatment. Drip emitters are positioned so that the trunks are not wetted during irrigation events, while micro-sprinklers wet 100 % of the vineyard floor area.

In the planting year, for treatments with the graft union below the soil surface, the planting holes were only partially filled so that the graft unions did not get covered by soil. In late fall, more soil was added to those holes right up to the level of the soil surface. Graft unions will remain covered for the remainder of the experiment. Graft unions of Control vines with graft unions placed 2” above the soil were covered every fall and uncovered again the following spring.

Root development from the scion and the rootstock was evaluated from 2018 to 2021 on five to ten vines per treatment. Soil was carefully removed down to the graft union and slightly beyond. While scion rooting in year two was minor significant root development out of the scion was observed in subsequent years. By the end of year 5 many strong roots originating from above the graft union were found on all the vines that were evaluated (see photos below). Such high level of scion rooting is undesirable as a) these roots are susceptible to phylloxera feeding and damage, and b) it carries the risk that over time the scion roots develop into the dominant part of the root system and that the rootstock roots diminish. In contrast, no scion roots were observed on Control vines where the graft union located 2” above soil level were hilled up in fall and uncovered the following spring.

While initial results of this study were promising, the number and size of scion roots observed in years four and five indicate that planting vines with the graft union just below the ground surface and covering with soil is not a viable technique for the protection of the graft union. Growers should use the standard methods – planting vines with the graft union above ground, hilling up in fall, and uncovering in spring – until other methods to protect the graft union can be tested.

One such alternative method to annual hilling up and uncovering is currently being investigated using five out of ten of the Control vines. There are ten Control vines each with either drip or micro-sprinkler irrigation. The graft unions of half the vines (five with drip, five with micro-sprinkler) are annually covered up in fall and uncovered in spring. The other half of the vines had the graft union continuously covered since fall of 2019 (the CC treatment). Instead of using soil to cover up the graft union we have used wood chip mulch (supplied free of charge by a local tree care service company). In late fall of 2020, the mulch was removed to determine if any scion rooting had occurred in the CC treatment. No roots were found above the graft union. Graft unions were immediately covered up again and remained covered throughout the 2021 season. In the falls of 2021, 2022, 2023, 2024, and 2025 the CC vines were again checked for scion rooting, and the graft union covered up again right after the observations. Again, no scion roots were found in any of the years.


Photos show root development from the scion part (above the graft union) of the same vines at the end of the third (top row) and fifth (bottom row) growing season of drip-irrigated Chardonnay/SO4 vines when the graft union is permanently buried at 2”, 4”, or 6” (left to right) below the soil surface.

So far the results from this second part of the study are promising. No scion rooting has been observed after six years of continuous cover with a wood chip mulch. If no scion rooting can be confirmed in future years then this practice could replace the annual hilling up in fall and uncovering in spring. From a practical perspective it should be noted that the wood chip mound stayed intact around the graft union of drip irrigated vines but there was a need to touch up the mound of micro-sprinkler irrigated vines. As the wood chips decompose there is the risk that scion rooting may occur over time. A few more years of observations are required before a final conclusion about the feasibility of this practice can be made.

- Develop planting and maintenance practices for grafted vines that reduce management costs and vine losses due to cold temperature damage to the graft union – 2021 study (Caspari, Bertin, Gardner, and Gautam).

Based on the promising results with wood chips to protect the graft union from the 2017 study, a new study to evaluate if graft unions can be covered indefinitely without causing scion rooting was initiated in spring of 2021 in three rows of the Chardonnay block at the Orchard Mesa site that was initially planted in 1992. Half the vines in this Chardonnay block were own-rooted with the other half grafted to four different rootstocks. The own-rooted vines were starting to decline due to phylloxera damage. Following the record-breaking cold event in late October 2020 the decision was made to pull out all own-rooted vines rather than to retrain already declining vines during 2021. Instead, 120 dormant Chardonnay vines (clone 37.1) grafted to rootstock SO4 were planted on 21 April 2021.

This experiment is a modification of the 2017 study (see above). Half the vines are planted with the graft union 2” above the soil surface (Control = standard practice) while the other half are planted with the graft union 2” below the soil surface. Like the 2017 study, the planting holes for the treatment 2” below soil surface were not filled up entirely after planting, leaving the graft union exposed. In fall of 2021 those holes were filled up to the soil surface. Half the holes in this treatment were filled with soil, the other half with wood chip mulch. Graft unions will remain covered throughout the experiment. Graft unions of half the Control vines were covered in fall 2021 with soil while graft unions of the other half of the Control vines were covered with wood chip mulch. In early May 2022, for each covering treatment of the Control (soil or wood chip mulch), half the graft unions were uncovered in the spring and recovered again in the fall. These annual covering / uncovering treatments will be applied to the same Control vines for the remainder of the experiment. The other half of the Control treatment will remain covered throughout the experiment (treatment CC), as will the graft unions placed 2” below ground, except for brief moments when soil or mulch is removed to check if scion roots are occurring.

In mid September 2023, all covered graft unions were briefly uncovered to determine if there was any root emergence from the scion part of the vines. As expected, no scion roots were observed on Control vines (annual covering / uncovering of the graft union). There was also no scion rooting on vines planted with the graft union above ground and continously covered with wood chips. However, 3 out of 10 vines with the graft union above ground and continously covered with soil had small roots emerging from the scion. The vast majority of vines planted with the graft union 2” below the soil surface and covered up with either soil or mulch had roots emerging from the scion.

Root observations were repeated in mid October 2024. Once again, no scion roots were found on Control vines and vines where the graft union was continuously covered with wood chips. However, scion rooting was observed on one out of 15 Control vines with continuous soil cover, and nearly all vines with the graft union 2” below soil surface.

Root observations in late September 2025 again confirmed no scion rooting on on Control vines (annual covering / uncovering of the graft union). For vines planted with graft unions above ground, scion rooting was observed on 20 % when covered continuously with soil and 7 % when covered continuously with wood chips. This was the incidence that we observed scion rooting with wood chips when grafts are located above ground. The majority of vines with the graft union 2” below soil surface had roots emerging from the scion, irrespective of the cover material (soil or wood chips).

### *3. Cold temperature injury mitigation and avoidance*

Low yields and large year-to-year yield fluctuations are characteristic of Colorado grape production, even in the Grand Valley AVA, due to cold temperature injury. The research projects outlined below try to identify best methods to either avoid cold injuries altogether, or mitigate cold temperature negative effects on vine survival, yield, quality, and vineyard economics. It should be noted that the identification of cultivars that are best suited to Colorado's climate (see cultivar trials above) is a fundamental component for avoiding cold injury.

- Characterizing cold hardiness (Caspari, Bertin, Gardner, and Gautam)

There are substantial differences in cold hardiness of cultivars. Understanding the patterns of acclimation, maximum hardiness, and deacclimation is a prerequisite to developing strategies that reduce cold injury. Since 2004, we have been testing bud cold hardiness during dormancy of Chardonnay, Syrah, and Chambourcin that differ in rate and timing of acclimation and deacclimation, as well as maximum hardiness. During the 2013/14 and 2014/15 dormant seasons, we have done the first-ever characterization of the seasonal pattern for Aromella. Bud cold hardiness of seven entries in the NE-1720 trial at Orchard Mesa (Albarino, Cabernet Dorsa, Cabernet Sauvignon, Carmenere, Souzao, Verdelho, Zweigelt) as well as all 12 cultivars from the Grand Valley trial evaluating cold-hardy cultivars (Arandell, Aromella, Brianna, Cayuga White, Chambourcin, Corot noir, La Crescent, Marquette, Noiret, St Vincent, Traminette, Vignoles) has been evaluated over multiple years. From the 2020/21 to 2022/23 dormant season we have tested Frontenac and Vidal blanc from a grower cooperator vineyard. Since the 2020/21 dormant season we have included Itasca in regular tests. Results from the cold hardiness tests are made available via our Webpage, and growers are using this information when deciding if freeze/frost protection is needed.

Cold hardiness tests were started on 30 Sep 2025 to ascertain baseline values of bud cold hardiness late in the growing season and prior to a killing frost. Initial cold hardiness values from Washington State University (WSU) (https://wine.wsu.edu/extension/cold-hardiness/) are way too low and differ substantially from recently published values from Cornell University. We consistantly find bud hardiness in fall to be much less than what is indicated by WSU. Determining intial bud cold hardiness and the acclimation pattern of key cultivars is critical information for Colorado grape growers as most damaging cold events of the past 30 years have occurred during the cold aclimation phase.

Bud cold hardiness tests with eleven cultivars are conducted on a two week interval. For further information and updates visit: https://aes.colostate.edu/wcrc/stations/orchard-mesa/viticulture/cold-hardiness/

## II. Development of Integrated Wine Grape Production

### *1. Sustainable resource use*

An Integrated Vineyard Production System requires a sustainable use of all resources, including soil, water, and air. The projects listed below are the continuation of our long-term program.

- Vineyard floor management - soil health, fertility, and water requirements (Caspari, Bertin, Gardner, and Gautam)

Approximately 40% of the vineyards in Colorado are drip irrigated. While drip and sub-surface drip irrigation are the most water efficient methods of irrigation, the question arises how to manage the inter-row area. Precipitation in Colorado's semi-arid climate is generally insufficient to maintain a green cover crop. Many older vineyards were set up with drought tolerant grasses sown in the inter-row area, but over the years those grasses have died out and been replaced by weeds. Some growers opt to clean-cultivate the inter-row, others maintain bare soil using herbicides or mow the resident vegetation. Bare soil or minimal vegetation cover in the inter-row is likely to degrade soil quality that potentially has negative impacts on vine performance. Results from the cultivar trial at Rogers Mesa (see Viticulture Webpage) show a very strong effect of soil condition and irrigation system on yield and fruit quality[2].

To further investigate the effects of different soil and irrigation management on long-term vineyard productivity and vine and soil fertility, an experiment was initiated in the fall of 2013 in the Chardonnay block at the Orchard Mesa site that was planted in 1992. These vines have been drip irrigated since planting, with an initial crested wheatgrass cover crop planted in the inter-row area. Over time the grass has been replaced by weeds and/or bare soil. Vine vigor is low in many areas of the block - a situation not uncommon in older commercial vineyards. After the 2013 harvest, the irrigation system was changed from drip to sprinkler, and four replicated cover crop treatments established: two different grass-only cover crops; one grass-legume mix; and one legume mix. During the 2014 growing season the vineyard was sprinkler irrigated to optimize the establishment of the cover crops. In spring 2015 one of the grass-only treatments ("Hycrest" crested wheatgrass) was returned to drip irrigation (the "standard" situation since planting in 1992).

The results for 2015 to 2020 from this cover crop study have been reported in previous annual reports. Due to the cold injury from the October 2020 event and declining vine vigor due to phylloxera the decision was made to remove all own-rooted vines. Vines were pulled in December 2020. The guard rows for this trial were used for an inter-plant study, and inter-planted vines produced only a small crop in the first four years but are now in full production (see previous reports). There were no inter-planted vines in the three rows used for the cover crop study. Thus, new vines (Chardonnay clone 37.1 on SO4 rootstock) were planted in spring 2021. There have been no vine losses to date (December 2025) All the vines are used for the 2021 study on alternative methods to protect the graft union (see above).

The cover crops were kept short by mowing once near the time of bud break to reduce the risk of damage from late spring frosts. After the risk of frost had passed, the cover crops were allowed to grow tall. Cover crops were mowed four times during the remainder of the 2025 season.

Vine vigor in this replant situation has been low and vines produced only a small crop of 0.5 ton/acre in the third growing season (2023) compared to 3.76 ton/acre for mature vines growing in adjacent rows. While vegetative vigor improved in the 2024 season the yield was still low at 0.81 ton/acre. Mature vines grafted to rootstock 5C that are part of this cover crop study produced 4.08 ton/acre. There was no crop in 2025 due to hail damage.

There are two interesting observations about the impact of cover crops on early yields and fruit composition in this replant situation. In both 2023 and 2024 vines with a legume cover crop in the interrow produced the highest yield. The difference was in large parts due to the higher vegetative vigor of vines in the legume plots that resulted in more canopy fill than with crested wheatgrass as cover crop. The second observation is a significant increase in Yeast Assimilable Nitrogen in grape berries from the legume plots. This result from 4-

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[2] Sprinkler-irrigated vines with a grass cover crop growing in the inter-row area have produced on average 2.8 times more yield than drip irrigated vines with a bare soil inter-row area. Fruit maturity was almost always enhanced (berries higher in soluble solids and pH, and lower in titratable acidity) under drip irrigation and bare soil. An analysis of data from the 2012 grape grower survey also suggests higher yields with furrow or sprinkler irrigation versus drip irrigation.

year-old grafted vines (in 2024) in a replant condition confirms the results from our long-term study with 24- to 29-year-old own-rooted vines grown previously in this vineyard block.

Cover crop plots will be maintained and the establishment and performance of the new vines will be monitored in future years. Since October 2025, a small area of this trial is now part of the new vineyard Agrivoltaics trial with solar panels installed on single-axis trackers at a height of 14" above the vine rows (see below).

- Vineyard floor management – evaluation of low-growing grass cultivars (Caspari, Bertin, Gardner, and Gautam)

Results from the 2004 cultivar trial at WCRC-RM show a very strong effect of soil management and irrigation system on yield and fruit quality. Briefly, sprinkler-irrigated vines with a permanent grass cover crop growing in the inter-row area have produced on average 2.8 times more yield than drip irrigated vines with a bare soil inter-row area. The hard fescue cultivar used in the study at WCRC-RM was Aurora Gold, a cool-season turf with a natural tolerance to Roundup. It is a low maintenance grass with good drought and shade tolerance. In the study at WCRC-RM, as well as the more recent study at WCRC-OM, Aurora Gold has produced a very dense, low growing turf with minimum weed presence, even in the absence of Roundup applications. Due to its low growing nature and the oppression of weed species it is very easy to manage. Over the years we have received many grower enquiries about this grass cover crop, and where to buy seeds. Unfortunately, seeds of Aurora Gold are scarce.

In late summer of 2018, a new study to evaluate different grass species / cultivars with similar characteristics to Aurora Gold was established in a mature vineyard block at WCRC-OM. Irrigation in this block was changed from drip to micro-sprinkler. In early September 2018, five different turf cultivars and one blend were sown: 'Shademaster III' and 'Xeric' creeping red fescue (*Festuca rubra ssp arenaria*); 'Ambrose' and 'Enchantment' Chewing's fescue (*Festuca rubra ssp fallax*); 'Eureka' hard fescue (*Festuca brevipila*); and 'Earth Carpet Care Free', a commercial blend of Chewing's fescue (40 %), creeping red fescue (35 %), hard fescue (20 %), and blue fescue (*Festuca glauca,* 5 %). Turf cultivars were selected with assistance from Dr. Tony Koski, Professor and Extension Turfgrass Specialist at Colorado State University. All grass cultivars have growth characteristics similar to Aurora Gold, i.e. low growth habit forming a dense turf, with good drought and shade tolerance. The experimental design is a randomized block with six replications per treatment. Each replication is ~210' long (half a row). The focus of this study is on turf establishment, persistence, weed suppression, and drought and traffic tolerance. Yield data, when available, are reported as part of the "Multi-state evaluation of wine grape cultivars and clones" trial (see above).

All treatments continue to provide a dense soil cover. There are a few patches were while clover has established but these appear random and not associcated with any particular turf entry. As all the grasses in this cover crop trial are low growing species the entire block can be mowed quickly with an electric ride-on mower which eliminates the need for a tractor and mower.

- Evaluation of Agrivoltaics for grape production in Western Colorado (Caspari, Bertin, Gardner, and Gautam)

Agrivoltaics is a system that combines agricultural and solar energy production on the same land. While research with perennial crops like grapes is very limited, results from other cropping systems indicate that vineyards and orchards in Western Colorado could benefit when solar panels are installed above the vines/trees. The main potential benefits include reduced plant heat stress, less fruit sunburn, improved fruit quality, lower water demand, and reduced frost risk. The objective of this new project it to evaluate the impact of solar panels installed above mature Chardonnay vines on vine growth, grape yield and quality, vineyard microclimate, and solar energy production and value.

Project construction started in August with trenching and laying cables from the Veterinary Diagnostic Laboratory building (point of electric grid connection) to the vineyard. Installation of the support structure, single axis-trackers, and solar panels started on 20 September and was completed on 29 October. Electrical wiring of solar panels, inverters, and installation of cable management system was completed in the second week of December. The system started producing energy in mid January 2026.

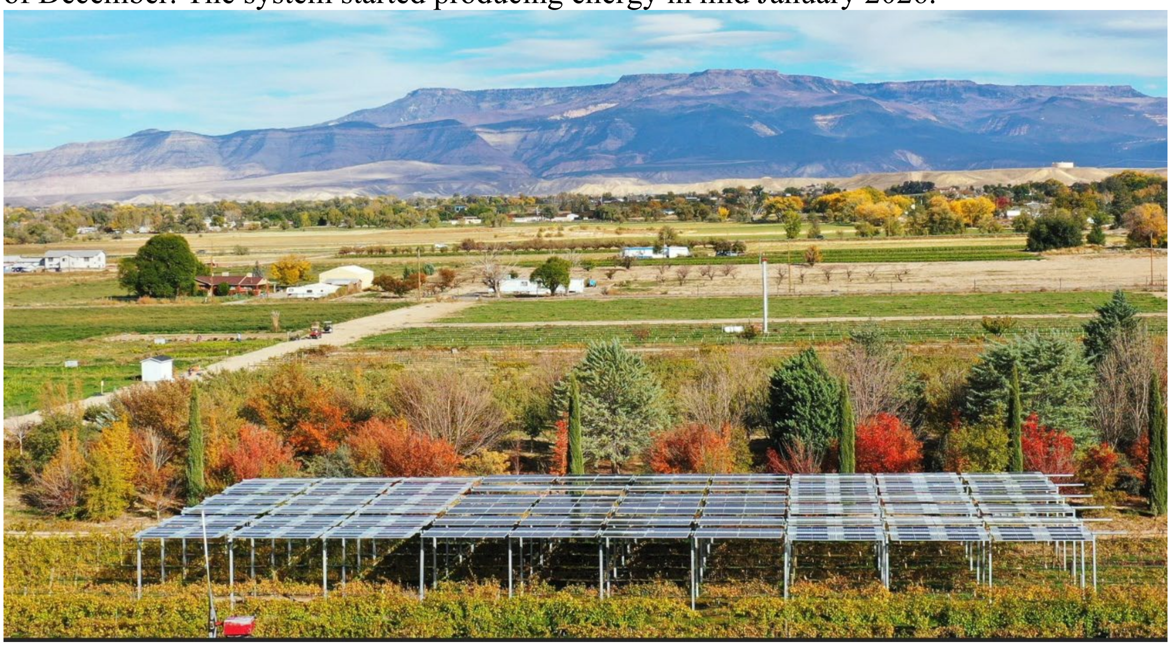

Photo showing the Agrivoltaics system in the Chardonnay vineyard at the Western Colorado Research Center – Orchard Mesa in late October 2025.

Initial results show that nighttime temperatures are indeed elevated underneath the Agrivoltaics system. From 21 October to 7 November 2025, temperatures were monitored at a height of 10" above ground in 10 locations inside the solar array (Agrivoltaics) and in five location each in the open area on the South and North side of the array (Control). A frost in the night from 27 to 28 October resulted in 100 % canopy kill in our vineyards, except for vines growing below the solar panels. Data from the temperature showed that the minimum temperature was 3.7 °F warmer with solar panels above the vines. During the entire observation period the daily minimum temperatures were always warmer in the Agrivoltaics treatment, averaging 2.7 °F.

On 7 November 2025 the temperature loggers were repositioned to record temperatures at four different heights (0.3 m, 1.0 m, 1.5 m, 2.0 m) at five different positions along a single row of vines. Three positions were under the solar array and one each in the Control area on the South and North side of the array. The data collected since confirm consistently higher minimum temperatures with Agrivoltaics. The effect is strongest near the ground and declines with height of the sensors.

**III. Enology research**

Enological research was limited to a few small-scale wine lots produced from fruit donated by a commercial grower. Using Itasca and Traminette, wines were made from grapes selectively harvested based on light exposure. With Itasca, wines were made from fully sun exposed clusters only and from a standard harvest (both exposed and shaded fruit). Separate wine lots were made from both treatments using two different yeasts (58W3, Vin13). With Traminette, treatments were full sun exposure and shaded fruit. Traminette was vinified using 58W3 yeast. At the end of 2025, all wines were still in carboys.

## Engagement / Outreach / Communications

The ever-increasing number of growers and wineries in the state means that individual consultations are a very inefficient, and costly way of providing information. We therefore try to conduct our engagement / outreach primarily through industry workshops / seminars, formal presentations (e.g. at VinCO), and field days. However, on an annual basis we respond to a large number of phone and email inquiries. Since her hiring in June 2022, we have closely collaborated with Dr. Charlotte Oliver, Viticulture Extension Specialist, on outreach activities.

We continue to use our web site and other internet resources such as our "Fruitfacts" messages as well as Dr. Oliver's regular extension newsletter to provide information resources for Colorado growers. Also, as part of the "Application of Crop Modeling for Sustainable Grape Production" project, weather information from three vineyard sites in the Grand Valley was accessible to grape growers and the public via the internet until a hardware or software malfunction in December 2025. The weather information was still unavailable at the time of report writing. It is questionable if the system can be repaired and/or if a repair of the 20+ year old system makes sense financially. Up-to-date weather information is available for both WCRC-OM and WCRC-RM via the CoAgMET site (https://coagmet.colostate.edu/).

Agrivoltaics in general and the new vineyard Agrivoltaics system at WCRC-OM was at the center of outreach activities during the last three months of 2025:

Conference Presentations:

Caspari, H.: Vineyard Agrivoltaics at Western Colorado Research Center. Fireside Chat. 3rd California – Germany Agrivoltaics Conference, UC Davis, Davis, CA, 5 Nov 2025.

Caspari, H.: Powering the Future: Application in modern agriculture. Panel member. 3rd California – Germany Agrivoltaics Conference, UC Davis, Davis, CA, 5 Nov 2025.

Presentations at workshops/seminars/webinars

Caspari, H.: Vineyard Agrivoltaics at Western Colorado Research Center. Presentation and tour of new Agrivoltaics facility during ribbon cutting ceremony, CSU Western Campus, Grand Junction, CO, 30 Oct 2025.

Caspari, H.: Agrivoltaics – A way to reduce the food-energy land-use conflict. Agrivoltaics Seminar, CSU Western Campus, Grand Junction, CO, 30 Oct 2025.

Caspari, H.: Vineyard Agrivoltaics at WCRC-OM. Colorado Research-Extension Working Group on Agrivoltaics: State of the Science Webinar. 1 Dec 2025.

Other presentations:

Caspari, H.: Agrivoltaics in Western Colorado. Panel member following screening of documentary "Save the Farm, Save the Future". Paonia, CO, 21 Oct 2025.

Caspari, H.: Cold injury – Cold hardiness. Guest lecture, CMU Tech Viticulture class, 19 Nov 2025.

- Field demonstrations/workshops/tours

Caspari, H., A. Sarno: Tour of research station with special emphasis of new vineyard agrivoltaics installation. Colorado Agrivoltaics Learning Center staff, 22 Oct 2025.

Caspari, H., A. Sarno: Tour of of new vineyard agrivoltaics installation. Fall Campus and Farm Tour, 14 Nov 2025.

Media interviews and publications

This American Land, Season 13 Episode 5. Ruffed Grouse #2, Agrivoltaics, Clean Water from Farmlands, Beaver Corps, Right Whales. 2 Oct 2025. https://www.pbs.org/video/ruffed-grouse-2-agrivoltaics-clean-water-from-farmlands-beaver-corps-right-whales-fehu1w/

Interview by Sharon Sullivan for Colorado Newsline on new vineyard agrivoltaics system at WCRC-OM. 2 Oct 2025. https://coloradonewsline.com/2025/10/28/solar-panels-go-up-at-grand-junction-vineyard-colorados-newest-ag-and-energy-project/

Interview by Dan West, The Grand Junction Daily Sentinel, on new vineyard agrivoltaics system at WCRC-OM. 30 Oct 2025. https://www.gjsentinel.com/news/western_colorado/csu-unveils-new-agrivoltaic-system-at-its-western-colorado-research-center-in-mesa-county/article_6ad03cbf-fb2d-4757-83d6-a96e7f37295d.html

Interview by Trek Salzer, Marketing Specialist with Nautilus Solar Energy on new vineyard agrivoltaics system at WCRC-OM for January 2026 Newsletter. 12 Nov 2025.

Crop prioritization, agrivoltaics, AI vs the data deluge, and an evolving tracker from Solargik. PV Magazine, 19 Nov 2025. https://pv-magazine-usa.com/2025/11/19/crop-prioritization-agrivoltaics-ai-vs-the-data-deluge-and-an-evolving-tracker-from-solargik/

From frost protection to energy generation: The promise of 'Vitivoltaics'. Colorado Department of Agriculture. 21 Nov 2025. https://ag.colorado.gov/blog-post/from-frost-protection-to-energy-generation-the-promise-of-vitivoltaics

Could your wine's tasting notes include wattage? A researcher in Western Colorado is working on it. CPR News, 27 Nov 2025. https://www.cpr.org/2025/11/27/solar-powered-wine-vineyard/

Interview by Erika Street Hopman on agrivoltaics for *Climate Connections*, a nationally syndicated, daily radio program about climate change produced by the Yale Center for Environmental Communication. 2 Dec 2025. https://yaleclimateconnections.org/2026/01/This-vineyard-now-grows-power-too/ (started airing on 27 Jan 2026 on more than 700 radio frequencies).

Grape + solar panels: Vineyard farming in Grand Junction. Nautilus Solar, 9 Dec 2025. https://nautilussolar.com/blogs/grapes-solar-panels-vineyard-farming-in-grand-junction

- Off-station research and demonstration plots

The uptake of new research results and new production techniques is fastest when growers are directly involved in their development. One way of involving growers in research is to establish research plots on grower properties. We currently have two replicated rootstock studies - one with Cabernet Sauvignon and one with Souzao (see above) - located in commercial vineyards. Also, growers often grant us access to vineyards to collect canes for cold hardiness evaluation. We will continue to use the vineyard at the Western Colorado Research Center at Orchard Mesa in the first or early stages of testing of new methods and/or trials that carry a high risk of crop damage.

- Colorado Wine Grower Survey

Colorado State University has conducted this annual survey since 1984. Survey forms were sent out in November 2025. All forms were sent electronically. By mid January 2025 we had received 23 responses (representing 70 vineyard sites) totaling 323 acres. The very preliminary results of the survey are:

- Average yield 3.5 ton/acre; up 6 % on 2024
- 1,138 ton production reported so far
- Expected total state production >2,000 ton
- About 32 % of production was not utilized
- Average price very similar to 2024
- Continued removal of vineyards