

## **Field Evaluation of Almond Varieties**

### **Project No. 21-Hort2-Lampinen**

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### **Summary:**

The current Regional Almond Variety Trial includes 30 varieties, planted in the winter of 2014 in Butte, Stanislaus, and Madera counties. At all three locations, Nonpareil was planted alongside the test and standards varieties. The selected rootstocks at Butte, Stanislaus, and Madera sites were Krymsk 86, Nemaguard, and Hansen 536 respectively, with exceptions as listed in Table 1. This trial consists of four replications of 11-12 trees of each variety or selection at each of the three sites. The peak bloom dates of all pollinizers in 2022 coincided with Nonpareil, except for the extremely early blooming variety UCD 3-40, which was dropped from the trial in the previous years. Despite three freeze events, yield for some varieties at the Butte trial were exceptional (4432 for Y117-86-03), however, yield was much lower for other varieties (1103 kernel pounds per acre for Supareil). In general, the bloom overlap has been good at all sites. Yields in the Salida trial continue to be moderated by irrigation water that is high in bicarbonates (Fig. 2). More mature almond orchards grown under favorable weather conditions resulted in higher yield in 2022 than the previous year at the Madera site (Fig. 3). In 2022 the most common kernel defects were doubles, twins, navel orange worm, creases, discoloration, and mold. Varieties no longer under evaluation are UCD 3-40, UCD 1-232, UCD 1-271, UCD 1-16, Self-frP13.019, UCD 8-27, Self-fr P16.013, Y121-42-99, and UCD 7-159 due to poor yields, poor harvestability (high mummy counts), or insufficient replications.

**Objectives:** To compare new almond varieties and experimental selections for parameters such as yield, bloom overlap, bloom timing, hull split occurrence, kernel quality, and susceptibility to insects and diseases.

### **Annual Results and Discussion**

#### **General observations for each site in 2022:**

**Butte-** Dry, warm weather conditions in Butte County with highs in the 70-80s led to a very quick bloom across all varieties. Temperatures dipped into 20's on 2/6/22 as well 2/22-23/22, which significantly affected the yield. Bloom density was high in Booth, Jenette, and UCD 8-201 (up significantly for UCD 8-201 from last year), but poor in Folsom and Sterling. For a third year, ALS symptoms were noted across the trial site, however they subjectively appeared less severe than in previous years. Trees had less hulltights (failure to complete hullsplits, often due to extreme water stress) throughout the trial than in 2021. Pick-up of late varieties was interrupted by rain in Mid-September after nuts had already been shaken and windrowed.

Stanislaus- Bloom weather in 2022 was mostly sunny and very dry, with no rain until 0.09 inches fell on March 15, well after petal fall for all varieties. Minimum temperatures dipped into the 20's for four consecutive nights from February 23-26, reaching a low of 25 degrees F on February 25, when most varieties were well into petal fall. A post-freeze inspection indicated that less than 10% of the flowers of any variety appeared to be damaged by the cold temperatures. Trees of all varieties exhibited interveinal leaf chlorosis through the first few months of the season, exacerbated by being on Nemaguard rootstock. There were no particular disease or insect problems in this trial in 2022.

Madera- Most of the varieties reached full bloom when temperatures were comparatively warmer (75-80's) than other sites during early February in Madera County. There was no frost reported in 2022. A significant amount of rain during mid-September delayed the pickup for late harvest varieties until the end of October. Rainfall fell after the nuts for the first variety harvest were shaken and wind-rowed, which caused higher growth of *Aspergillus* on the hulls and kernel staining. Nuts from some of the varieties got mixed when windrows were conditioned to facilitate drying after rain. We had to drop those replicates, which will result in less rigorous results. Other than that, there were no specific diseases and frost damage observed in 2022.

### **Bloom, Hullsplit, Yield and Quality 2022**

Butte- In 2022, Overall, bloom overlap was generally good across the varieties. Except for Kester, all the varieties reached peak bloom from February 10<sup>th</sup> to 19<sup>th</sup>. Kester reached full bloom on the February 26<sup>th</sup>, indicating that it would not be a suitable pollinizer for Nonpareil (Fig. 5). Hullsplit for all the varieties ranged from July 10<sup>th</sup> to September 7<sup>th</sup>, with nonpareil hullsplit ranged from 12<sup>th</sup> July to 14 August (Fig. 6). Midday canopy PAR interception ranged from 50% for UCD 8-160 to 81 % for Supareil, with Nonpareil at 76% (Table 2). Yield ranged from 1103 kernel pounds per acre for Supareil to 4432 for Y117-86-03 (Table 3). Yield per unit PAR intercepted ranged from 13.4 kernel pounds/% PAR for Supareil to a very high 67.7 for Y117-86-03 (Table 4). The cumulative yield (2016-2022) for Butte site ranged from 10,970 kernel pounds per acre for Supareil to 19,980 for Nonpareil (Table 5).

Stanislaus- Most varieties' peak bloom days ranged from February 14<sup>th</sup> to 18<sup>th</sup>, which coincided with Nonpareil. Self-fertile varieties Y117-86-03 and Y121-42-99, reached peak bloom on February 21<sup>st</sup> and 23<sup>rd</sup>, respectively (Fig. 5). Hullsplit ranged from July 6<sup>th</sup> to August 26<sup>th</sup>. Hullsplit duration for Nonpareil was 23 days, compared to other varieties that ranged from 14 days (Y-117-91-03) to 28 days (Supareil) (Fig. 6). The lowest midday canopy PAR interception was 41.4 % for UCD8-160 and the highest for Kester on Hansen rootstock at 72%, with 53% for Nonpareil. (Table 6). Yield in 2022 ranged from 1522 kernel pounds per acre (Jenette) to 4245 pounds (Kester/Hansen) (Table 7). The yield per unit PAR intercepted ranged from 22.3 kernel pounds/% PAR for Supareil to 58.7 for Kester/Hansen (Table 8). The cumulative yield (2016-2022) ranged from 10,139 kernel pounds per acre for Jenette to 16,994 for Kester/Hansen (Table 9). The Kester variety on Hansen rootstock has accumulated 13% more yield than Kester on Nemaguard at the Stanislaus site.

Madera- Due to the higher average temperature at bloom time in 2022 than in 2021, varieties reached their peak bloom earlier than they did in 2021. Bloom was condensed, with a difference of only 7 days between the full bloom dates for the earliest versus latest varieties. Full bloom dates ranged from February 12<sup>th</sup> to 19<sup>th</sup> (Fig. 5). Hullsplit duration ranged from a minimum of 10 days (Jenette) to a maximum of 36 days (Folsom) and 29 days for Nonpareil. (Fig. 6). Most of the varieties at this site had 70% or higher midday canopy PAR interception. The grower-cooperator has been hedging alternate rows to manage the light interception at this site. (Table 10). The PAR interception ranged from 61% (UCD 8-160) to 89% (Folsom), with 79% for Nonpareil. The yield in 2022 ranged from 2085 kernel pounds per acre for Supareil to 4024 for Capitola. (Table 11). The yield per unit PAR interception varied from 19.7 kernel pounds/%PAR for Kester to 48.4 for the Wood Colony (Table 12). The cumulative yield (2016-2022) ranged from 12,992 kernel pounds per acre for Folsom to 21,407 for Nonpareil (Table 13).

All sites - The average cumulative yield for all three sites ranged from 12,212 kernel pounds per acre for Supareil to 18556 for Nonpareil, followed by Y117-91-03 at 16,855 (Table 14). Overall, Supareil has the lowest average cumulative yield (Fig. 4). The variety UCD 8-160 has the lowest PAR interception in 2021 and 2022 at all three sites.

### **Outreach Activities**

- Almond Variety Trial Field Day, Madera County Variety Trail. Chowchilla, CA. 5-5-22. Phoebe Gordon
- On 4-5-22. Phoebe Gordon gave talk on Almond Variety Trial in Almond meeting.
- Poster: "Field Evaluation of Almond Varieties" poster presented at Almond Conference, 2022.
- Podcast. Encore: Field Evaluation of Almond Varieties - Results Through 7th Leaf. 6-14-22. R. Duncan, P. Gordon, and L. Milliron.
- Regional Field Evaluations of Almond Varieties. R. Duncan, B. Lampinen, P. Gordon, L. Milliron, and T. Gradziel. West Coast Nut. May 2022; ppg 16-20.
- ABC produced Video. Almond Varieties. July 2022
- Presentation: Almond Varieties. North San Joaquin Valley Almond Day. 2-7-22
- Two Butte Regional Almond Variety Trial and Irrigation Management Field Meetings: 3-31-22 and 6-23-22.
- Presentation: "Almond Rootstock and Variety Selection in the Northern Sacramento Valley" at the North Valley Nut conference. 6-8-22.
- Interviewed by Taylor Chalstrom on MyAgLife podcast on the topic of "Almond Rootstock & Variety Selection in the Sacramento Valley". 7-15-22

### **Materials and Methods**

The current regional almond variety trials were planted in winter of 2014 in Butte (Chico State University), Stanislaus (Salida School District Site), and Madera (Creekside Farming Company) counties. Table 1 lists all varieties and selections that were planted in the trials. There are 29 common items across all the sites plus a few different items that were added to individual sites, as listed in Table 1. The selected rootstocks at Butte, Stanislaus, and Madera trials were Krymsk 86, Nemaguard, and Hansen 536 rootstocks respectively, with the

exceptions mentioned in Table 1. Tree spacing is 18'×22' (110 trees/acre) at Butte site, is 16'×21' (130 trees/acre) at Stanislaus site and 12'×21' at the Madera site (173 trees/acre). The trial consists of fourteen partially or fully self-fertile varieties (Table 1).

Bloom time, hull split, canopy light interception, yield data collection, and kernel quality are being evaluated at all three sites. Bloom data was recorded as the onset of bloom when 1% of blossoms are open, full bloom, when 80% of the flowers are open, and the end of petal fall. Bloom data was collected three times per week. Hullsplit data was collected when 1% of the first non-blank splits were open to when all the nuts in the monitored block had entered hullsplit.

### **List of publications:**

Duncan, R.; Milliron, L.; Gordon, P. (2018). Regional Almond Variety Trial - A Discussion with Roger Duncan, Luke Milliron, and Phoebe Gordon. *Growing the Valley*. L. Milliron. 19. December 3. <https://www.growingthevalleypodcast.com/podcastfeed/2018/12/3/regional-almond-variety-trial-a-discussion-with-roger-duncan-luke-milliron-and-phoebe-gordon>

Gordon, P.; Duncan, R.; Milliron, L.; Lampinen, B. (2020). Field Evaluation of Almond Varieties: A Look at Regional Trial Results through Sixth Leaf. *West Coast Nut*. September 17. <http://www.wcngg.com/2020/09/17/field-evaluation-of-almond-varieties/>

Gradziel, T.; Milliron, L. (2020). Breeding pt. 3: Almond with Tom Gradziel. *Growing the Valley*. February 18. <https://www.growingthevalleypodcast.com/podcastfeed/almond>

[Duncan, Roger. \(2021\). Regional Almond Variety Trials- Results through 7<sup>th</sup> leaf. https://www.growingthevalleypodcast.com/podcastfeed/ravt2](https://www.growingthevalleypodcast.com/podcastfeed/ravt2)

[R. Duncan, B. Lampinen, P. Gordon, L. Milliron, and T. Gradziel. \(2022\). Regional Field Evaluations of Almond Varieties. \*West Coast Nut\*. May 2022; ppg 16-20. https://issuu.com/myaglife/docs/wcn\\_may\\_2022\\_e](https://issuu.com/myaglife/docs/wcn_may_2022_e)

### Acknowledgements

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Table 1. Varieties planted at the regional almond variety trails. The selected rootstocks at Butte, Stanislaus, and Madera trail were Krymsk 86, Nemaguard, and Hansen 536 rootstocks, respectively.

| Variety or selection                      | Self-fertile* | Source   |
|-------------------------------------------|---------------|----------|
| Eddie                                     |               | Bright's |
| Capitola                                  |               | Burchell |
| Supareil                                  |               | Burchell |
| Self-fr P13.019***                        | yes           | Burchell |
| Self-fr P16.013***                        | yes           | Burchell |
| Booth                                     |               | Burchell |
| Sterling                                  |               | Burchell |
| Bennett-Hickman                           |               | Duarte   |
| Nonpareil                                 |               |          |
| Durango                                   |               | Fowler   |
| Jenette                                   |               | Fowler   |
| Aldrich                                   |               |          |
| Winters                                   | partial       | UCD      |
| Sweetheart                                | partial       | UCD      |
| Kester (2-19E)*                           |               | UCD      |
| UCD3-40***                                |               | UCD      |
| UCD18-20                                  |               | UCD      |
| UCD1-16***                                |               | UCD      |
| UCD8-160                                  | yes           | UCD      |
| UCD8-27***                                | yes           | UCD      |
| UCD1-271***                               | yes           | UCD      |
| UCD1-232***                               | yes           | UCD      |
| UCD7-159***                               | yes           | UCD      |
| UCD8-201                                  | yes           | UCD      |
| Y121-42-99***                             | yes           | USDA     |
| Y117-86-03                                | yes           | USDA     |
| Yorizane (Y116-161-99)                    | yes           | USDA     |
| Y117-91-03                                | yes           | USDA     |
| Folsom                                    |               | Wilson   |
| Wood Colony (Butte and Madera sites only) |               |          |

\*Kester was planted at all three sites on the usual rootstock for each site. In addition, the Kester was planted on Hansen 536 rootstock in the replicated trail at the Butte and Stanislaus sites.

\*\*Y116-161-99 was released as Yorizane in 2020.

\*\*\* Nine of the varieties was dropped from the data collection at all three sites.

Table 2. PAR interception for 2022 season for Butte site.

| Variety or selection | 2022 Yield (Kernels lbs/ac) |
|----------------------|-----------------------------|
| Y117-86-03           | 4432 a                      |
| Y117-91-03           | 3926 a b                    |
| UCD 18-20            | 3887 a b c                  |
| Capitola             | 3632 a b c d                |
| Aldrich              | 3412 a b c d e              |
| Kester/Hansen        | 3403 a b c d e              |
| Kester               | 3309 a b c d e              |
| UCD8-201             | 3252 a b c d e f            |
| Durango              | 3209 a b c d e f            |
| Nonpareil            | 3014 a b c d e f            |
| Bennett-Hickman      | 2926 a b c d e f            |
| Jenette              | 2889 a b c d e f            |
| Sweetheart           | 2533 b c d e f g            |
| Eddie                | 2358 c d e f g              |
| UCD8-160             | 2279 d e f g                |
| Yorizane             | 2269 d e f g                |
| Winters              | 2063 e f g                  |
| Booth                | 2000 e f g                  |
| Sterling             | 1700 f g                    |
| Folsom               | 1248 g                      |
| Wood Colony          | 1210 g                      |
| Supareil             | 1103 g                      |

Table 3. 2022 yield for Butte site.

| Variety or selection | Yield per unit PAR |   |          |          |          |          |          |
|----------------------|--------------------|---|----------|----------|----------|----------|----------|
| Y117-86-03           | 67.7               | a |          |          |          |          |          |
| Y117-91-03           | 56.2               | a | b        |          |          |          |          |
| UCD 18-20            | 55.5               | a | b        |          |          |          |          |
| Aldrich              | 52.9               | a | b        | c        |          |          |          |
| Capitola             | 50.2               | a | b        | c        | d        |          |          |
| Jenette              | 48.3               | a | b        | c        | d        | e        |          |
| UCD8-160             | 46.6               | a | b        | c        | d        | e        |          |
| Durango              | 46.6               | a | b        | c        | d        | e        |          |
| Bennett-Hickman      | 45.2               | a | b        | c        | d        | e        |          |
| Kester/Hansen        | 45.1               | a | b        | c        | d        | e        |          |
| Kester               | 44.7               |   | b        | c        | d        | e        |          |
| Yorizane             | 43.9               |   | b        | c        | d        | e        | f        |
| Eddie                | 40.2               |   | b        | c        | d        | e        | f        |
| <b>Nonpareil</b>     | <b>39.9</b>        |   | <b>b</b> | <b>c</b> | <b>d</b> | <b>e</b> | <b>f</b> |
| Sweetheart           | 33.5               |   | b        | c        | d        | e        | f g      |
| Winters              | 30.4               |   |          | c        | d        | e        | f g      |
| Sterling             | 29.5               |   |          |          | d        | e        | f g      |
| Booth                | 26.7               |   |          |          |          | e        | f g      |
| Wood Colony          | 21.7               |   |          |          |          |          | f g      |
| Folsom               | 16.8               |   |          |          |          |          | g        |
| Supareil             | 13.4               |   |          |          |          |          | g        |

Table 4. 2022 Yield per unit light intercepted at Butte site.

| Variety or selection | Cumulative yield (Kernel lbs/ac) |
|----------------------|----------------------------------|
| Nonpareil            | 19980 a                          |
| Aldrich              | 18157 a b                        |
| Y117-91-03           | 18118 a b c                      |
| UCD 18-20            | 17462 a b c d                    |
| Durango              | 16491 a b c d e                  |
| Booth                | 16214 a b c d e f                |
| Jenette              | 15665 a b c d e f                |
| Kester               | 15101 b c d e f                  |
| Y117-86-03           | 14788 b c d e f g                |
| Bennett-Hickman      | 14139 b c d e f g                |
| Winters              | 14070 c d e f g                  |
| Kester/Hansen        | 13884 d e f g                    |
| UCD 8-201            | 13794 d e f g                    |
| Yorizane             | 13636 d e f g                    |
| Folsom               | 12950 e f g                      |
| Sweetheart           | 12906 e f g                      |
| UCD8-160             | 12623 e f g                      |
| Eddie                | 12274 f g                        |
| Sterling             | 12253 f g                        |
| Wood Colony          | 12186 f g                        |
| Supareil             | 10970 g                          |



Table 5: Cumulative yield (2016-2022) for Butte site.

| Variety or selection | Cumulative yield (Kernel lbs/ac) |
|----------------------|----------------------------------|
| Nonpareil            | 19980 a                          |
| Aldrich              | 18157 a b                        |
| Y117-91-03           | 18118 a b c                      |
| UCD 18-20            | 17462 a b c d                    |
| Durango              | 16491 a b c d e                  |
| Booth                | 16214 a b c d e f                |
| Jenette              | 15665 a b c d e f                |
| Kester               | 15101 b c d e f                  |
| Y117-86-03           | 14788 b c d e f g                |
| Bennett-Hickman      | 14139 b c d e f g                |
| Winters              | 14070 c d e f g                  |
| Kester/Hansen        | 13884 d e f g                    |
| UCD 8-201            | 13794 d e f g                    |
| Yorizane             | 13636 d e f g                    |
| Folsom               | 12950 e f g                      |
| Sweetheart           | 12906 e f g                      |
| UCD8-160             | 12623 e f g                      |
| Eddie                | 12274 f g                        |
| Sterling             | 12253 f g                        |
| Wood Colony          | 12186 f g                        |
| Supareil             | 10970 g                          |

Table 6: PAR interception for 2022 season for Stanislaus site.

| Variety or selection |             | PAR interception (%) |
|----------------------|-------------|----------------------|
| Kester/Hansen        | 72.4        | a                    |
| Sweetheart           | 67.7        | a b                  |
| Supareil             | 67.3        | a b                  |
| Sterling             | 62.4        | a b c                |
| Folsom               | 62.4        | a b c                |
| Y117-91-03           | 62.1        | a b c                |
| Eddie                | 61.3        | a b c d              |
| Booth                | 60.9        | a b c d              |
| Capitola             | 59.4        | b c d e              |
| Bennett-Hickman      | 57.7        | b c d e              |
| Winters              | 54.5        | c d e f              |
| Kester               | 54.3        | c d e f              |
| Aldrich              | 53.7        | c d e f g            |
| UCD18-20             | 53.6        | c d e f g            |
| <b>Nonpareil</b>     | <b>53.1</b> | <b>c d e f g</b>     |
| UCD8-201             | 50.9        | c d e f g            |
| Durango              | 50.4        | c d e f g            |
| Jenette              | 49.3        | d e f g              |
| Yorizane             | 46.9        | e f g                |
| Y117-86-03           | 43.7        | f g                  |
| UCD8-160             | 41.4        | g                    |

Table 7: 2022 yield for Stanislaus site.

| Variety or selection | 2022 Yield (Kernel lbs/ac) |                |
|----------------------|----------------------------|----------------|
| Kester/Hansen        | 4245                       | a              |
| Capitola             | 3118                       | b              |
| Winters              | 2993                       | b c            |
| Y117-91-03           | 2850                       | b c d          |
| <b>Nonpareil</b>     | <b>2831</b>                | <b>b c d e</b> |
| Eddie                | 2811                       | b c d e f      |
| UCD 8-201            | 2681                       | b c d e f g    |
| Yorizane             | 2647                       | b c d e f g    |
| Sterling             | 2460                       | b c d e f g h  |
| UCD 18-20            | 2499                       | b c d e f g h  |
| UCD 8-160            | 2452                       | c d e f g h    |
| Booth                | 2274                       | d e f g h i    |
| Durango              | 2227                       | d e f g h i    |
| Kester               | 2175                       | e f g h i j    |
| Sweetheart           | 2167                       | f g h i j      |
| Aldrich              | 2130                       | g h i j        |
| Supareil             | 1954                       | h i j          |
| Y117-86-03           | 1912                       | h i j          |
| Bennett-Hickman      | 1870                       | h i j          |
| Folsom               | 1745                       | i j            |
| Jenette              | 1522                       | j              |

Table 8: 2022 yield per unit light intercepted for Stanislaus site.

| <b>Variety or selection</b> | <b>Yield per unit PAR</b> |            |
|-----------------------------|---------------------------|------------|
| Kester/Hansen               | 58.7                      | a          |
| UCD 8-160                   | 58.7                      | a          |
| Winters                     | 54.9                      | a b        |
| <b>Nonpareil</b>            | <b>53.1</b>               | <b>a b</b> |
| UCD 8-201                   | 53                        | a b        |
| UCD 18-20                   | 46.8                      | a b        |
| Eddie                       | 46                        | a b        |
| Durango                     | 43.9                      | a b        |
| Y117-86-03                  | 43.8                      | a b        |
| Yorizane                    | 40.6                      | a b        |
| Kester                      | 39.9                      | a b        |
| Aldrich                     | 38.9                      | a b        |
| Booth                       | 37.7                      | a b        |
| Y117-91-03                  | 32.6                      | a b        |
| Sweetheart                  | 32                        | a b        |
| Jenette                     | 30.8                      | a b        |
| Sterling                    | 28.6                      | a b        |
| Folsom                      | 28.2                      | a b        |
| Bennett-Hickman             | 26.9                      | a b        |
| Supareil                    | 22.3                      | b          |

Table 9: Cumulative yield for Stanislaus site (2016-2022)

| <b>Variety or selection</b> | <b><u>Cumulative yield kernel lb/ ac</u></b> |          |          |          |
|-----------------------------|----------------------------------------------|----------|----------|----------|
| Kester/Hansen               | 16994                                        | a        |          |          |
| Y117-91-03                  | 15688                                        | a        | b        |          |
| <b>Nonpareil</b>            | <b>14282</b>                                 | <b>a</b> | <b>b</b> | <b>c</b> |
| UCD 18-20                   | 13848                                        | a        | b        | c d      |
| Aldrich                     | 13586                                        | a        | b        | c d      |
| UCD 8-160                   | 13300                                        | a        | b        | c d      |
| Yorizane                    | 13178                                        | a        | b        | c d      |
| Booth                       | 13045                                        | a        | b        | c d      |
| Eddie                       | 12793                                        |          | b        | c d      |
| Winters                     | 12788                                        |          | b        | c d      |
| Capitola                    | 12720                                        |          | b        | c d      |
| UCD 8-160                   | 12419                                        |          | b        | c d      |
| Kester                      | 12416                                        |          | b        | c d      |
| Bennett-Hickman             | 12330                                        |          | b        | c d      |
| Durango                     | 12279                                        |          | b        | c d      |
| Sterling                    | 12197                                        |          | b        | c d      |
| Sweetheart                  | 11289                                        |          | b        | c d      |
| Supareil                    | 11129                                        |          |          | c d      |
| Y117-86-03                  | 11050                                        |          |          | c d      |
| Folsom                      | 10847                                        |          |          | c d      |
| Jenette                     | 10139                                        |          |          | d        |

Table 10: PAR interception for 2022 season for Madera site.

| <b>Variety or selection</b> | <b>PAR interception (%)</b> |              |
|-----------------------------|-----------------------------|--------------|
| Folsom                      | 89.3                        | a            |
| Sterling                    | 86.7                        | a b          |
| Supareil                    | 85.8                        | a b          |
| Booth                       | 84.4                        | a b          |
| Capitola                    | 84.3                        | a b          |
| Eddie                       | 84                          | a b          |
| Kester                      | 82.2                        | a b          |
| <b>Nonpariel</b>            | <b>79.1</b>                 | <b>a b c</b> |
| Aldrich                     | 78.9                        | a b c        |
| Sweetheart                  | 78                          | a b c        |
| Durango                     | 77.8                        | a b c        |
| Bennett-Hickman             | 72.4                        | a b c        |
| UCD 8-20                    | 72.2                        | a b c        |
| Y117-86-03                  | 71.8                        | a b c        |
| Yorizane                    | 70.3                        | a b c        |
| Y117-91-03                  | 70.1                        | a b c        |
| Winters                     | 69.1                        | a b c        |
| Jenette                     | 68.5                        | a b c        |
| UCD8-201                    | 67.5                        | b c          |
| Wood Colony                 | 67                          | b c          |
| UCD8-160                    | 60.9                        | c            |

Table 11: 2022 yield for Madera site.

| <b>Variety or selection</b> | <b>Yield (Kernel lbs/ac)</b> |            |
|-----------------------------|------------------------------|------------|
| Capitola                    | 4024                         | a          |
| Sterling                    | 3668                         | a b        |
| <b>Nonpareil</b>            | <b>3445</b>                  | <b>a b</b> |
| Bennett-Hickman             | 3327                         | a b        |
| Kester                      | 3182                         | a b        |
| Aldrich                     | 3196                         | a b        |
| Booth                       | 3173                         | a b        |
| Yorizane                    | 3154                         | a b        |
| UCD8-201                    | 3045                         | a b        |
| Y 117-86-03                 | 3034                         | a b        |
| Durango                     | 3025                         | a b        |
| Eddie                       | 2912                         | a b        |
| Wood Colony                 | 2877                         | a b        |
| Y117-91-03                  | 2820                         | a b        |
| UCD8-160                    | 2795                         | a b        |
| Jenette                     | 2755                         | a b        |
| UCD 18-20                   | 2750                         | a b        |
| Sweetheart                  | 2744                         | a b        |
| Folsom                      | 2603                         | a b        |
| Winters                     | 2245                         | a b        |
| Supareil                    | 2085                         | b          |

Table 12: 2022 yield per unit light intercepted for Madera site.

| <b>Variety or selection</b> | <b>Yield per unit PAR</b> |            |
|-----------------------------|---------------------------|------------|
| Wood colony                 | 48.4                      | a          |
| Capitola                    | 47.7                      | a          |
| Bennett-Hickman             | 46                        | a          |
| UCD8-160                    | 45.6                      | a          |
| Yorizane                    | 45.5                      | a b        |
| UCD8-201                    | 44.5                      | a b        |
| Sterling                    | 42.3                      | a b        |
| Y117-86-03                  | 42.2                      | a b        |
| Jenette                     | 42.1                      | a b        |
| <b>Nonpareil</b>            | <b>41.7</b>               | <b>a b</b> |
| Aldrich                     | 40.7                      | a b        |
| Y117-91-03                  | 40.3                      | a b        |
| Booth                       | 39                        | a b        |
| Durango                     | 38.9                      | a b        |
| UCD 18-20                   | 38.4                      | a b        |
| Sweetheart                  | 37.4                      | a b        |
| Eddie                       | 34.7                      | a b        |
| Winters                     | 31.1                      | a b        |
| Folsom                      | 29.4                      | a b        |
| Supareil                    | 24.6                      | b          |
| Kester                      | 19.7                      | b          |



Table 13: Cumulative yield (2016-2022) for Madera site. Wood Colony is not listed as crackout samples from 2021 are missing.

| Variety or selection | Cumulative yield (Kernel lbs/ac) |     |
|----------------------|----------------------------------|-----|
| Nonpareil            | 21407                            | a   |
| Yorizane             | 18779                            | a b |
| Capitola             | 18220                            | a b |
| Y117-86-03           | 17983                            | a b |
| UCD 18-20            | 17561                            | a b |
| Jenette              | 16889                            | a b |
| Y117-91-03           | 16759                            | a b |
| Bennett-Hickman      | 16153                            | a b |
| Booth                | 15682                            | a b |
| Sterling             | 15651                            | a b |
| Durango              | 15593                            | a b |
| Eddie                | 15292                            | b   |
| UCD8-201             | 15152                            | b   |
| UCD8-160             | 14651                            | b   |
| Supareil             | 14537                            | b   |
| Aldrich              | 14464                            | b   |
| Sweetheart           | 14177                            | b   |
| Winters              | 14095                            | b   |
| Folsom               | 12992                            | b   |

Table 14: Cumulative yield for all the sites combined.

| <b>Variety or selection</b> | <b>Cumulative yield<br/>(Kernel lbs/ac)</b> |
|-----------------------------|---------------------------------------------|
| Nonpareil                   | 18556                                       |
| Y117-91-03                  | 16855                                       |
| UCD 18-20                   | 16290                                       |
| Kester/Hansen               | 15439                                       |
| Aldrich                     | 15402                                       |
| Capitola                    | 15347                                       |
| Yorizane                    | 15198                                       |
| Booth                       | 14980                                       |
| Durango                     | 14959                                       |
| Bennett-Hickman             | 14446                                       |
| Jenette                     | 14231                                       |
| Y117-86-03                  | 14607                                       |
| UCD8-201                    | 13788                                       |
| Kester                      | 13759                                       |
| Winters                     | 13651                                       |
| UCD8-160                    | 13525                                       |
| Sterling                    | 13367                                       |
| Eddie                       | 13453                                       |
| Sweetheart                  | 12791                                       |
| Folsom                      | 12263                                       |
| Supareil                    | 12212                                       |
| Wood Colony*                | 12186                                       |

\*Wood Colony cumulative yield includes data only from Butte site.



Figure 3. Average Kernel yield (lbs ac<sup>-1</sup>) from 2016-2022 for all the varieties and selections at Madera site. Wood colony yields from 2021 are not included.

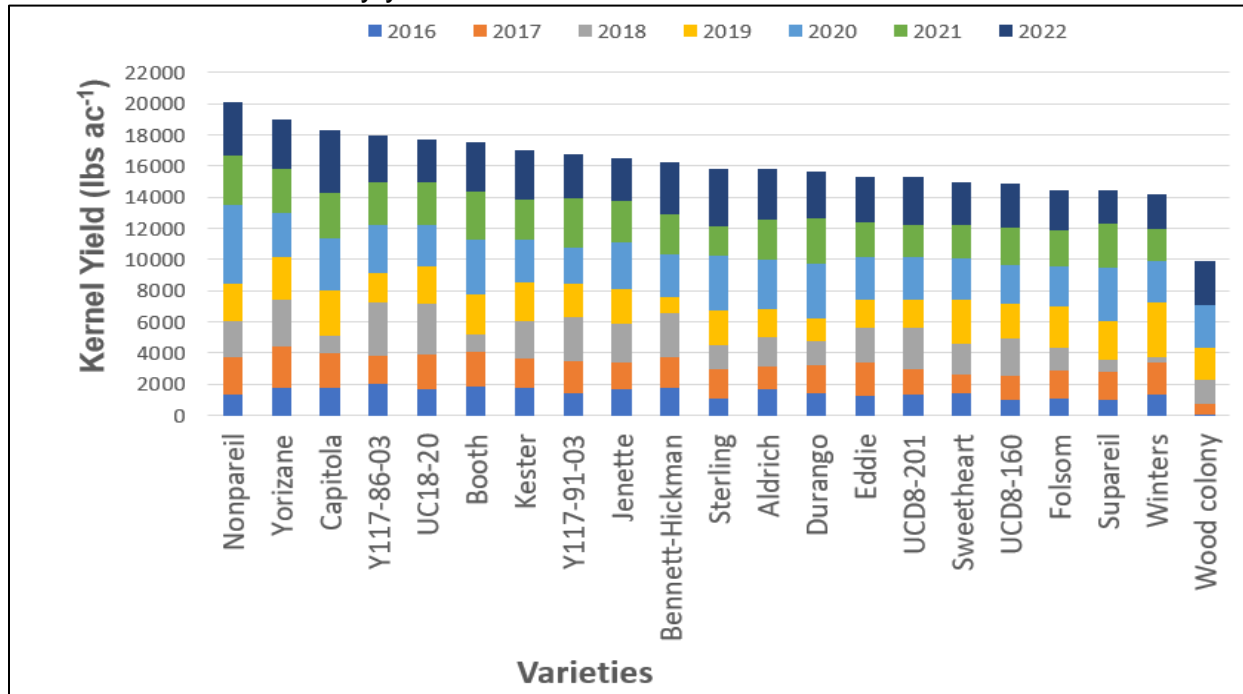
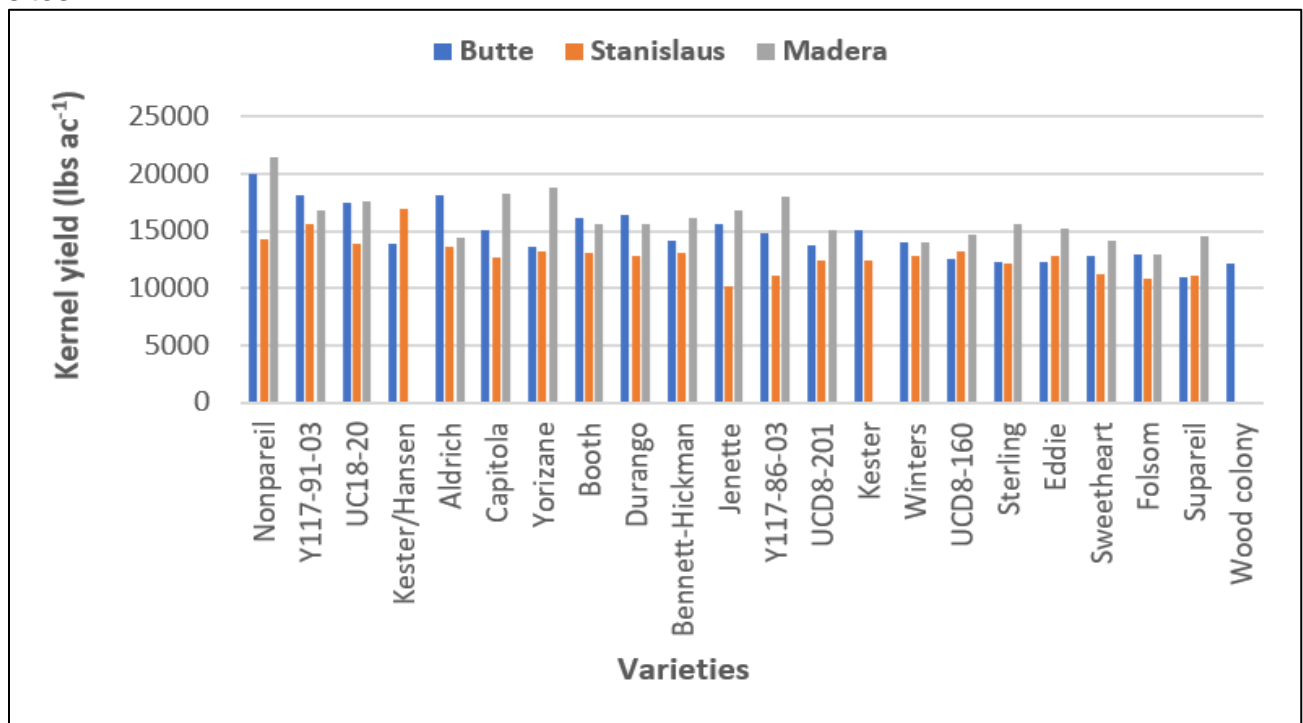


Figure 4. Average cumulative Kernel yield (lbs ac<sup>-1</sup>) accumulated from 2016-2022 at all three sites.



\*Wood Colony cumulative yield data is only from Butte site. Wood Colony data from Madera site is not presented in the report, because we are missing data from last year.



Figure 6. Hullsplit by site, variety or selection for 2022.

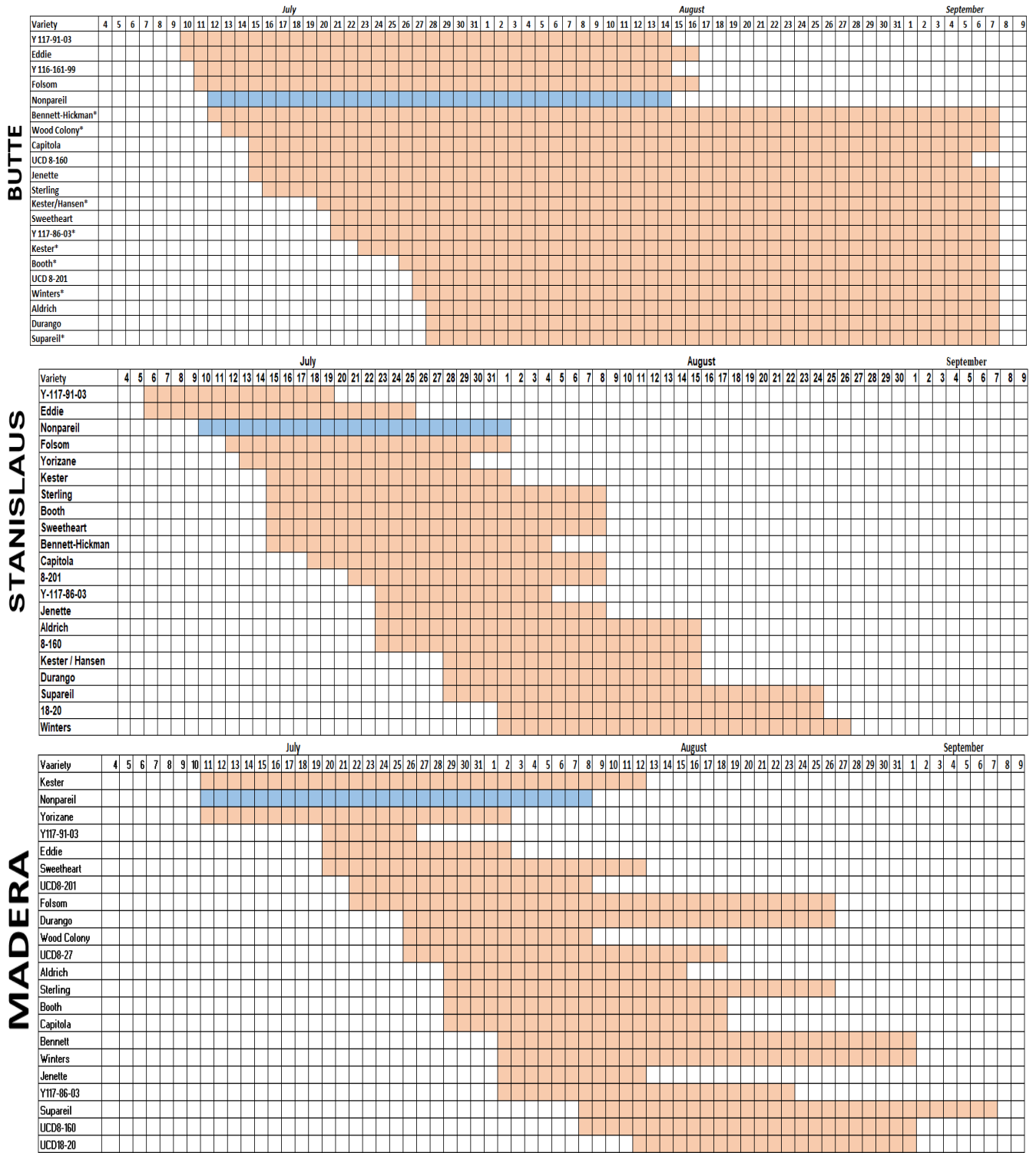


Figure 7. Defects observed in 2022 harvest. All photos were contributed by Roger Duncan.



The variety Yorizane had high incidences of staining on nuts at Stanislaus and Madera site in 2022.



We have observed high incidences of creases on nuts for UCD 8-160 and Jenette varieties.



UCD 8-201 has about 6.5 % twin kernels at Butte and Madera site in 2022.



This is variety Booth having incidences of brown spots.

Table 15: Percent kernel defects and insect at damage at Butte site in 2022.

| Variety         | Doubles (%) | Twins (%) | Crease (%) | Brown spots <sup>1</sup> (%) | NOW (%) | Kernel discolor <sup>2</sup> (%) |
|-----------------|-------------|-----------|------------|------------------------------|---------|----------------------------------|
| Y117-86-03      | 12.2        | 2.2       | 2.0        | 2.0                          | 0.7     | 1.2                              |
| UCD 8-201       | 8.7         | 6.0       | 7.5        | 1.5                          | 2.2     | 1.0                              |
| Booth           | 5.0         | 4.7       | 4.0        | 0.7                          | 3.0     | 0.0                              |
| UCD 18-20       | 4.0         | 2.2       | 2.7        | 0.5                          | 0.0     | 1.7                              |
| UCD 8-160       | 3.5         | 6.0       | 14.7       | 0.5                          | 1.7     | 0.0                              |
| Y117-91-03      | 2.2         | 2.5       | 0.7        | 0.2                          | 0.2     | 0.0                              |
| Kester          | 1.5         | 1.5       | 1.0        | 0.5                          | 0.2     | 0.0                              |
| Nonpareil       | 1.2         | 2.7       | 1.7        | 0.0                          | 0.7     | 0.2                              |
| Folsom          | 1.2         | 5.7       | 2.0        | 0.0                          | 2.5     | 0.0                              |
| Supareil        | 1.2         | 3.2       | 4.0        | 0.0                          | 7.5     | 0.5                              |
| Winters         | 1.0         | 4.2       | 1.0        | 0.2                          | 3.2     | 0.7                              |
| Kester/Hansen   | 0.7         | 0.2       | 1.0        | 0.0                          | 0.2     | 0.2                              |
| Sterling        | 0.5         | 5.5       | 4.5        | 0.2                          | 1.7     | 1.0                              |
| Durango         | 0.5         | 1.0       | 1.0        | 0.0                          | 3.0     | 0.2                              |
| Yorizane        | 0.5         | 1.5       | 2.0        | 0.0                          | 0.2     | 4.0                              |
| Capitola        | 0.2         | 2.7       | 0.7        | 1.0                          | 0.2     | 0.5                              |
| Aldrich         | 0.2         | 0.2       | 0.7        | 1.2                          | 3.7     | 0.0                              |
| Jenette         | 0.2         | 3.0       | 7.5        | 0.2                          | 0.2     | 0.0                              |
| Sweetheart      | 0.2         | 1.7       | 2.2        | 0.0                          | 0.7     | 2.5                              |
| Eddie           | 0.2         | 2.2       | 0.2        | 0.2                          | 1.7     | 1.0                              |
| Bennett-Hickman | 0.0         | 1.0       | 0.0        | 1.0                          | 3.5     | 0.2                              |

<sup>1</sup>Brown spots mostly from plant bug / stink bug feeding injury

<sup>2</sup>Kernel pellicle discolor / staining from unknown cause(s).



Table 16: Percent kernel defects and insect at damage at Stanislaus site in 2022.

| Variety         | Doubles (%) | Twins (%) | Crease (%) | Brown spots <sup>1</sup> (%) | NOW (%) | Kernel discolor <sup>2</sup> (%) |
|-----------------|-------------|-----------|------------|------------------------------|---------|----------------------------------|
| UCD 8-201       | 32.8        | 3.0       | 0.3        | 1.8                          | 0.0     | 1.5                              |
| UCD 18-20       | 9.0         | 1.5       | 0.0        | 1.0                          | 0.3     | 0.5                              |
| Booth           | 5.0         | 2.8       | 0.8        | 4.3                          | 0.0     | 1.0                              |
| UCD 8-160       | 4.3         | 3.0       | 2.5        | 1.8                          | 0.0     | 0.8                              |
| Kester/Hansen   | 3.5         | 1.0       | 3.8        | 0.0                          | 0.0     | 0.3                              |
| Y117-86-03      | 3.0         | 1.3       | 0.3        | 1.3                          | 0.0     | 8.5                              |
| Winters         | 2.3         | 0.8       | 0.0        | 6.3                          | 0.0     | 0.8                              |
| Aldrich         | 1.8         | 0.0       | 0.3        | 0.8                          | 0.0     | 0.5                              |
| Nonpareil       | 1.3         | 0.5       | 0.0        | 0.3                          | 0.0     | 0.0                              |
| Yorizane        | 1.0         | 0.3       | 0.0        | 1.8                          | 0.0     | 17.0                             |
| Y117-91-03      | 1.0         | 0.3       | 0.0        | 1.8                          | 0.0     | 0.5                              |
| Kester          | 0.8         | 1.5       | 0.8        | 0.0                          | 0.0     | 0.3                              |
| Capitola        | 0.5         | 0.3       | 0.5        | 0.5                          | 0.0     | 1.5                              |
| Folsom          | 0.5         | 0.8       | 1.5        | 0.8                          | 0.0     | 0.5                              |
| Durango         | 0.5         | 0.0       | 0.5        | 1.5                          | 0.0     | 0.3                              |
| Supareil        | 0.3         | 1.5       | 0.0        | 1.0                          | 0.3     | 0.3                              |
| Sterling        | 0.3         | 1.0       | 0.3        | 1.0                          | 0.0     | 0.5                              |
| Bennett-Hickman | 0.3         | 0.8       | 0.3        | 1.5                          | 0.0     | 0.3                              |
| Jenette         | 0.0         | 2.0       | 2.8        | 1.8                          | 0.0     | 0.3                              |
| Sweetheart      | 0.0         | 3.0       | 0.0        | 0.8                          | 0.0     | 2.3                              |
| Eddie           | 0.0         | 0.3       | 0.0        | 0.0                          | 0.0     | 0.5                              |

<sup>1</sup>Brown spots mostly from plant bug / stink bug feeding injury

<sup>2</sup>Kernel pellicle discolor / staining from unknown cause(s)

Table 17: Percent kernel defects and insect at damage at Madera site in 2022.

| Variety         | Doubles (%) | Twins (%) | Crease (%) | Brown spots (%) | NOW (%) | Kernel Discolor (%) |
|-----------------|-------------|-----------|------------|-----------------|---------|---------------------|
| UCD 8-201       | 46.5        | 0.5       | 11.2       | 0.0             | 6.0     | 9.2                 |
| UCD 18-20       | 25.0        | 0.0       | 9.7        | 0.0             | 3.7     | 24.2                |
| UCD 8-160       | 13.2        | 0.5       | 8.5        | 0.5             | 5.2     | 10.0                |
| Y117-86-03      | 13.7        | 0.2       | 5.5        | 12.7            | 4.2     | 0.0                 |
| Booth           | 12.5        | 1.0       | 6.7        | 0.0             | 8.0     | 21.5                |
| Kester          | 5.0         | 2.5       | 2.5        | 0.0             | 0.0     | 33.5                |
| Folsom          | 5.0         | 0.0       | 0.2        | 0.2             | 4.0     | 48.5                |
| Y117-91-03      | 4.5         | 0.0       | 6.0        | 2.5             | 8.0     | 12.5                |
| Wood colony     | 4.3         | 0.2       | 2.6        | 1.3             | 4.0     | 42.6                |
| Yorizane        | 3.7         | 0.2       | 4.5        | 0.5             | 1.6     | 26.6                |
| Capitola        | 2.7         | 0.0       | 14         | 0.5             | 1.5     | 12.2                |
| Winters         | 2.2         | 0.0       | 8.0        | 0.0             | 11.5    | 29.5                |
| Durango         | 2.2         | 0.0       | 3.2        | 0.0             | 7.7     | 8.0                 |
| Bennett-Hickman | 1.5         | 0.0       | 2.7        | 0.0             | 13.5    | 38.2                |
| Supareil        | 1.3         | 0.0       | 7.0        | 0.0             | 13.6    | 7.3                 |
| Nonpareil       | 1.2         | 0.5       | 4.7        | 0.0             | 4.0     | 2.0                 |
| Sterling        | 1.2         | 0.0       | 28.0       | 0.0             | 7.0     | 26.5                |
| Jenette         | 1.0         | 0.2       | 17.6       | 0.7             | 5.3     | 13.3                |
| Sweetheart      | 1.0         | 0.0       | 8.5        | 0.0             | 3.0     | 6.0                 |
| Aldrich         | 0.7         | 0.0       | 6.0        | 0.0             | 4.0     | 14.6                |
| Eddie           | 0.5         | 0.7       | 0.7        | 0.2             | 7.0     | 58.7                |

<sup>1</sup>Brown spots mostly from plant bug / stink bug feeding injury

<sup>2</sup>Kernel pellicle discolor / staining from unknown cause(s)

Table 18: Kernel Mass and Crackout Percentage at Butte site in 2022.

| Variety         | Kernel Mass<br>(g/100 kernels) | Crackout <sup>1</sup><br>(%) |
|-----------------|--------------------------------|------------------------------|
| Eddie           | 154.3 a                        | 73.9 a                       |
| Supareil        | 150.0ab                        | 56.2 abcd                    |
| Booth           | 147.3 abc                      | 53.2 bcd                     |
| UCD 8-160       | 146.0 abcd                     | 60.7 abc                     |
| Capitola        | 138.5 abcde                    | 54.4 bc                      |
| UCD 18-20       | 136.3 abcd                     | 51.7 bcd                     |
| Nonpareil       | 132.7 abcdef                   | 67.8 abc                     |
| Wood colony     | 128.9 abcdef                   | 59.7abcd                     |
| Yorizane        | 128.8 abcdef                   | 58.1 abcd                    |
| Folsom          | 128.5 abcdef                   | 64.4 abc                     |
| Y117-86-03      | 122.9 abcdef                   | 69.3 ab                      |
| Sterling        | 120.4 bcdef                    | 61.9 abc                     |
| Durango         | 116.0 cdef                     | 53.7 bc                      |
| Jenette         | 113.3 def                      | 61.2 abcd                    |
| Bennett-Hickman | 111.1fgh                       | 65.0 abc                     |
| Aldrich         | 110.6 ef                       | 43.3 d                       |
| Winters         | 108.1 ef                       | 56.2 abcd                    |
| Y117-91-03      | 107.9 ef                       | 67.1 abc                     |
| UCD 8-201       | 100.4 f                        | 60.7 abcd                    |
| Kester          | 100.3 f                        | 51.1 bc                      |
| Sweetheart      | 100.2 f                        | 61.6 abc                     |
| Kester/Hansen   | 98.8 f                         | 53.2 bcd                     |

<sup>1</sup>Crackout percentage is kernel weight divided by the weight of kernel and shell  
Data followed by the same letters are not statistically different. (Tukey's  $P \geq 0.05$ )

Table 19: Kernel Mass and Crackout Percentage at Stanislaus site in 2022

|                 | Kernel Mass<br>(g/100 kernels) | Crackout <sup>1</sup><br>(%) |
|-----------------|--------------------------------|------------------------------|
| Supareil        | 134.7 a                        | 51.2 hi                      |
| Booth           | 122.8 ab                       | 61.7 bcde                    |
| UCD 8-160       | 116.6 bc                       | 60.4 bcde                    |
| Eddie           | 110.0 bcd                      | 71.6 a                       |
| Nonpareil       | 106.2 cde                      | 63.2 bc                      |
| UCD 18-20       | 104.9 cdef                     | 50.3 hi                      |
| UCD 8-201       | 99.4 defg                      | 57.9 defg                    |
| Bennett-Hickman | 99.2 defg                      | 64.2 b                       |
| Sterling        | 98.0 defg                      | 62.5 bcd                     |
| Folsom          | 96.5 efgh                      | 61.6 bcde                    |
| Yorizane        | 95.1 efghi                     | 60.7 bcde                    |
| Kester/Hansen   | 92.6 fghi                      | 52.7 ghi                     |
| Durango         | 91.0 ghi                       | 54.0 fghi                    |
| Aldrich         | 89.2 ghij                      | 57.0 efg                     |
| Capitola        | 87.6 ghij                      | 54.2 fgh                     |
| Jenette         | 87.2 ghij                      | 58.3 cdef                    |
| Y117-86-03      | 86.9 ghij                      | 61.9 bcde                    |
| Winters         | 84.8 hij                       | 53.3 fghi                    |
| Y117-91-03      | 84.0 hij                       | 64.2 b                       |
| Sweetheart      | 82.9 ij                        | 61.2 bcde                    |
| Kester          | 77.0 j                         | 48.8 i                       |

<sup>1</sup>Crackout percentage is kernel weight divided by the weight of kernel and shell  
 Data followed by the same letters are not statistically different. (Tukey's  $P \geq 0.05$ )

Table 20: Kernel Mass and Crackout Percentage at Madera site in 2022.

| Variety         | Kernel Mass<br>(g/100 kernels) | Crackout <sup>1</sup><br>(%) |
|-----------------|--------------------------------|------------------------------|
| Supareil        | 150.7 a                        | 41.5 ab                      |
| UCD 8-160       | 135.7 ab                       | 64.8 a                       |
| Eddie           | 123.6 bc                       | 73.5 a                       |
| UCD 18-20       | 119.9 bcd                      | 58.7 a                       |
| Booth           | 119.1 bcde                     | 31.6 ab                      |
| Wood colony     | 107.6 cdefg                    | 51.5 ab                      |
| Folsom          | 108.7 cdef                     | 33.4 ab                      |
| UCD 8-201       | 107.5 cdefg                    | 67.1 a                       |
| Y117-86-03      | 106.4 cdefg                    | 68.3 a                       |
| Durango         | 101.1 cdefg                    | 61.9 a                       |
| Capitola        | 99.9 cdefg                     | 59.0 a                       |
| Nonpareil       | 99.2 cdefg                     | 70.5 a                       |
| Sterling        | 95.8 defg                      | 66.9 a                       |
| Bennett-Hickman | 94.5 efg                       | 70.0 a                       |
| Winters         | 93.4 fg                        | 57.8 a                       |
| Yorizane        | 93.3 fg                        | 67.8 a                       |
| Jenette         | 90.7 fg                        | 49.7 ab                      |
| Y117-91-03      | 84.7 fg                        | 66.7 a                       |
| Aldrich         | 83.6 g                         | 47.8 ab                      |
| Sweetheart      | 83.1 g                         | 31.7 ab                      |

<sup>1</sup>Crackout percentage is kernel weight divided by the weight of kernel and shell  
Data followed by the same letters are not statistically different. (Tukey's  $P \geq 0.05$ )