MANAGING HEAT AT BLOOM IN ‘FRENCH’ PRUNE, 2019

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PROBLEM AND ITS SIGNIFICANCE

Excessive heat or extended wet, cool weather at bloom are linked to significantly reduced prune production in five of the last fifteen years (2004, 2005, 2007, 2014, and 2016) in key California growing regions. Total grower economic losses in Sutter and Yuba Counties – with 40% of the prune acres in the state -- were in the range of $240 million for 2004, 2005, and 2007, based on county ag commissioners’ data. Overall economic damage to the regional economy was probably 1.5x that loss -- $360 million.

Bloom weather crop disasters further destabilize the prune economic situation in California. Crop value rises in the years following “off years”, encouraging growers to focus on increasing production. In addition, light cropping in the disaster year results in strong bloom the following year and high yield potential the following year. Consequently, the crop following weather impacted crop year(s) is usually very large with a significant volume of small, low value fruit that is slow to sell in a world market, impacting sales and pricing for that year and potentially subsequent years. Crop disasters impact prune growers and industry in California in the disaster year and for years afterwards.

As the probability of heat in March appears to be increasing (Rick Snyder, retired UCCE microclimate specialist, personal communication), California prune growers must develop management strategies to mitigate heat damage at bloom to remain economically viable, while remaining aware of crop risk due to unusually cool bloom weather,

Recent research results show that temperatures >75oF begin to negatively affect pollen tube growth rate and viability, but research has not identified temperature thresholds for actual crop damage. Cool bloom periods slow pollen tube growth. Temperature effects on ovule longevity of ‘French’ prune flowers has not been successfully evaluated.

OBJECTIVES

* Determine bloom-time temperature thresholds above and below which crop damage occurs and bloom patterns that present crop risk.

PROCEDURES

Madera, Sutter, Glenn, Solano/Yolo and Tehama Counties:

Bloom timing and temperature have been monitored since 2010 along most of the length of the major fruit growing regions of the Sacramento Valley, home to 85% of the bearing acres in California. In 2018, a study site in Madera County in the San Joaquin Valley was added. Additional sites in Tehama County (3), Glenn County (3), Sutter County (2) and Solano County (1) were monitored for bloom timing and orchard weather (temperature and percent relative humidity).

Combined temperature and relative humidity sensors housed in radiation shields were placed in between trees down the tree row at 6-8’ above the orchard floor within the study orchard. Sensors were not placed in tree canopies. Temperatures and relative humidity in each block were continually recorded during bloom at all sites. Average hourly temperatures are reported, not maximum temperature for the day.

Bloom progression was measured by counting open flowers on 2-5 short branches (roughly 100 flowers, each) at approximately 6’ height around 3 trees in each orchard. Initial set was measured in late April/May.

RESULTS AND DISCUSSION

Bloom, 2019, was late with full bloom the last few days of March or the first days of April. Weather during the 2019 prune bloom in the Sacramento Valley was wet, with moderate temperatures heading to warm towards the end of bloom. Very similar temperatures were recorded in Butte, Glenn, Sutter, and Madera Counties for the same time period (Table 1). Bloom lasted for 11-14 days, depending on location. Fruit set was good to excellent/excessive, ranging from 23-84%.

CONCLUSIONS

Excellent fruit set (23-84% of flowers set fruit) occurred. There was an extended bloom under relatively mild temperatures. In 2005, when extreme heat at bloom produced very poor set (5%) in prune orchards, bloom was rapid (5 days from first flower to full bloom) so that flowers did not have time to be fertilized and set fruit before the damaging extreme heat occurred.

Weather conditions have not revealed any conditions that would cause a change/adjustment in our Beta Model for prune fruit set prediction (Figure 1).

**Financial value of this research**: Prune crop loss in the Sacramento Valley in 2016 was at best estimate, at least 1.5 dry tons/acre across 90% of the acres in the region (37,000 acres using 2015 crop report data). At $1800/dried ton, that loss = $100M in farm gate value before the multiplier effect on local economies. This research, developing information to allow growers to more accurately predict crop risk at bloom, will help growers use management tools to minimize damage from unseasonable weather at bloom.

Table 1. Prune bloom timing, 2019. Length of bloom, full bloom (80% open flowers) date and average prune fruit set (late April or May) for individual orchards with maximum daily temperatures during bloom in Tehama, Butte, Glenn, Sutter, Solano, and Madera Counties. Maximum orchard temperatures on the day of full bloom in each orchard appear in BOLD font. Shaded cells indicates dates with open flowers before bloom (and after in orchards where bloom was tracked after full bloom). “ND” in the % set column indicates the block was thinned before fruit could be counted.

 ------------------------------------------------March------------------------------------------------- --------------April----------------

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| County | Location | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **1** | **2** | **3** | **4** | **5** | **6** | **% set** |
| Tehama | Red Bluff |   |   |   |   |   |   |   |   |  |   | 55 | 61 | 63 | 56 | 65 | 73 | 78 | 68 | **63** | 63 | 64 | 62 | 63 | 40 |
| Tehama | S. Red Bluff  |   |   |   |   |   |   |   |   |   |   | 55 | 61 | 62 | 56 | 64 | 73 | 77 | 68 | **63** | 63 | 64 | 61 | 63 | 28 |
| Tehama | S. Los Molinos  |   |   |   |   |   |   |   |   |   |   | 55 | 63 | 62 | 58 | 66 | 73 | 78 | 70 | 63 | 63 | **65** | 61 | 64 | 23 |
| Butte | N. Chico |   |   |   |   |   |   |   |   |   |   | 55 | 62 | 63 | 57 | 65 | 73 | 77 | **71** | 63 | 63 | 64 | 61 | 65 | 23 |
| Butte | West Chico |   |   |   |   |   |   |   |   |   |   | 55 | 63 | 62 | 58 | 66 | **73** | 78 | 70 | 63 | 63 | 65 | 60 | 65 | ND |
| Glenn | Capay 1 | 60 | 61 | 67 | 72 | 75 | 76 | 79 | 72 | 64 | 67 | 52 | 59 | 65 | 56 | 62 | 65 | 58 | 65 | **72** | 78 | 71 | 64 | 65 | ND |
| Glenn | Capay 2 | 72 | 74 | 76 | 79 | 72 | 63 | 66 | 53 | 58 | 65 | 56 | 62 | 65 | 58 | 67 | 74 | 77 | **71** | 65 | 63 | 65 | 63 | 65 | 84 |
| Glenn | Road S | 72 | 75 | 75 | 79 | 71 | 64 | 66 | 52 | 58 | 64 | 56 | 63 | 67 | 58 | 66 | 74 | 78 | **70** | 65 | 64 | 66 | 65 | 67 | 57 |
| Sutter | SW Yuba City |   |   |   |   | 73 | 65 | 66 | 55 | 65 | 65 | 58 | 66 | 65 | 60 | 66 | 73 | 77 | 70 | **64** | 65 | 64 | 63 | 68 | 24 |
| Sutter | Dingville |   |   |   | 78 | 73 | 65 | 66 | 55 | 66 | 66 | 60 | 66 | 64 | 61 | 66 | **72** | 75 | 69 | 66 | 66 | 65 | 63 | 69 | 41 |
| Solano | Wolfskill |  |  |  |  |  |  |   | 54 | 51 | 64 | 60 | 66 | 65 | 61 | 65 | 73 | 76 | 69 | **66** | 65 | 67 | 64 | 68 | 30 |
| Madera | S Madera | 70 | 73 | 76 | 83 | 78 | 64 | 66 | 67 | 63 | 67 | 77 | 72 | 68 | **67** | 67 | 70 | 75 | 78 | 75 | 71 | 67 | 69 | 76 | 41 |

Figure 1. Beta bloom weather model for estimating prune fruit crop set conditions.

|  |  |  |
| --- | --- | --- |
| Bloom Temperatures (±1 day around 80% bloom) | Details | Outcome |
| **<60oF** | **If cool conditions extend for 7-10 days before FB** | **Poor fruit set conditions** |
| **<60oF** | **If early bloom temperatures are above 60oF**  | **Good fruit set conditions**  |
| **60-81oF** |  | **Good fruit set conditions** |
| **>81oF**  | **If “flash bloom: 5 or less days between first flower and full bloom** | **Poor fruit set conditions** |
| **>81oF**  | **If bloom starts cool and is extended (7-14 days)** | **Good fruit set conditions** |