**Bloom models for DAS**

Bloom models come from several sources. The first is the data set from Tory Schmidt for the three cultivars below. Data was from 2010-2014 at 9 or so orchards throughout the fruit growing areas of the state. Each of the blooms were marked and referred to as a particular bud and what stage they were in each time they visited the orchard. This data all fit the normal distribution really well.

**All of the data in this document have the LT=42°F, UT=77.64, vertical cutoff and all DD are DDF**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Cultivar** | | |
| **stage** | **statistic** | **Cripps Pink** | **Gala** | **Red Delicious** |
| green tip | *mean* | 135.53 | 154.37 | 160.26 |
|  | *stdev* | 36.14 | 39.75 | 36.14 |
| 1/2 in green | *mean* | 187.34 | 212.00 | 212.37 |
|  | *stdev* | 42.00 | 45.31 | 41.01 |
| tight cluster | *mean* | 235.94 | 275.11 | 270.83 |
|  | *stdev* | 40.31 | 47.53 | 40.49 |
| first pink | *mean* | 276.36 | 341.02 | 323.78 |
|  | *stdev* | 43.57 | 50.24 | 41.13 |
| full pink | *mean* | 334.31 | 381.64 | 372.24 |
|  | *stdev* | 48.10 | 47.41 | 42.40 |
| first bloom | *mean* | 385.54 | 430.65 | 419.44 |
|  | *stdev* | 47.81 | 47.03 | 42.85 |
| full bloom | *mean* | 436.61 | 468.99 | 465.90 |
|  | *stdev* | 52.58 | 49.49 | 53.87 |
| petal fall | *mean* | 479.38 | 511.67 | 507.68 |
|  | *stdev* | 54.71 | 52.94 | 51.85 |

The second source of data was for the cultivar ambrosia only and came from Denise Nielsen from AgCanada. This data is taken differently where they had the average stage at a location in a particular time over again a large number of sites and a few trees at each location. Data from 2010-2012. In this case, we didn’t fit the data to a distribution, but used a regression approach to predict the average stage duration with the stages going from 100-900 (100=silver tip, 200 = green tip, etc as per the table below).

Summary for variables: ddf

by categories of: stage

stage | mean min max p5 p50 p95 N

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Silver Tip | 103 80 135 88 104 120 21

Green Tip | 141 114 200 119 137 181 51

1/4 in green | 171 136 234 146 164 218 48

1/2 in green | 202 171 255 173 202 241 53

tight cluster | 273 211 343 221 267 333 43

pink | 321 263 410 274 324 364 32

open cluster | 387 300 458 317 400 438 34

full bloom | 446 378 528 389 450 506 43

petal fall | 573 437 790 478 564 711 73

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And box plots show the variability



The regression is:

. regress avestage ddf ddf2

Source | SS df MS Number of obs = 398

-------------+---------------------------------- F(2, 395) = 6151.34

Model | 25551740.6 2 12775870.3 Prob > F = 0.0000

Residual | 820385.46 395 2076.92522 R-squared = 0.9689

-------------+---------------------------------- Adj R-squared = 0.9687

Total | 26372126 397 66428.5291 Root MSE = 45.573

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avestage | Coef. Std. Err. t P>|t| [95% Conf. Interval]

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ddf | 3.159903 .0658593 47.98 0.000 3.030424 3.289381

ddf2 | -.0041105 .0001602 -25.65 0.000 -.0044256 -.0037955

\_cons | -170.8315 10.30395 -16.58 0.000 -191.0889 -150.574

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The third set of data are two year’s worth of data on timing of bloom that Peter Shearer collected for the honeybee grant. The data were collected at WSU Sunrise orchard from 2018-2019. Peter took the data by looking at flowering clusters so that he had a lot more flowers, but you couldn’t track individual flower blooming. This means that this data had a lot higher number of flowers blooming on each date, but that the same flower would be recorded multiple times. You could look at the number of flowers before and after peak and they were roughly equal. However, for the analysis, I just used the number of flowers as the weighting factor in fitting the distributions. In general, the Gumbel distribution fit the data better for all the cultivars, although either the Johnson SB (Goldens) or lognormal (Fuji) might have been good fit. The normal was generally not as good either overestimating at the start and underestimating at the mid or end.

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| --- | --- | --- | --- | --- | --- |
| Cultivar | Alpha | mu | Alt dist | Alpha | mu |
| Cosmic Crisp | 32.61 | 411.53 |  |  |  |
| Fuji | 26.496 | 401.07 | gamma | 231.29 | 1.7917 |
| Gala | 28.53 | 391.88 |  |  |  |
| Golden | 29.799 | 394.98 |  |  |  |
| Granny | 35.15 | 403.13 |  |  |  |
| Jonagold | 30.007 | 387.72 | gamma | 141.83 | 2.8489 |

Lookup tables found in the spread sheet: bloom lookup tables.xls