

Supplemental materials for Phenological sequences: How early-season events define those that follow

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Supplemental Tables

Table S1: Summary of linear models for relationships between later phenophases and earlier phenophases, as shown in Figure 3 in the main text. Two types of linear models were fit: those with the intercept only estimated and a forced slope of one, and those with both the slope and intercept estimated (i.e., a standard regression model). All models were fit with the species-level mean day-of-year of the later phenological stages as the response variable, and mean day-of-year of earlier phenostage as the explanatory variable.

| previous phenostage model | forced slope model | | | standard regression model | | | | |
|---------------------------|--------------------|----------------|--------|---------------------------|-------|--------|----------------|--------|
| | intercept | r ² | aic | intercept | slope | p | r ² | aic |
| leafout vs. budburst | 8.94 | 0.10 | 164.78 | 65.84 | 0.53 | <0.001 | 0.44 | 155.01 |
| flowering vs. budburst | 23.83 | 0.17 | 225.55 | 3.18 | 1.17 | 0.039 | 0.17 | 227.45 |
| fruiting vs. budburst | 140.71 | 0.13 | 260.44 | -32.03 | 2.42 | 0.029 | 0.19 | 260.48 |
| senescence vs. budburst | 158.84 | -0.12 | 210.97 | 243.88 | 0.30 | 0.427 | 0.03 | 209.43 |
| flowering vs. leafout | 14.90 | 0.23 | 223.60 | -105.28 | 1.92 | 0.005 | 0.30 | 223.26 |
| fruiting vs. leafout | 131.77 | 0.08 | 261.78 | -42.56 | 2.33 | 0.097 | 0.12 | 262.74 |
| senescence vs. leafout | 149.90 | -0.07 | 209.74 | 237.39 | 0.33 | 0.484 | 0.02 | 209.58 |
| fruiting vs. flowering | 116.87 | 0.29 | 255.39 | 109.80 | 1.05 | 0.006 | 0.29 | 257.37 |
| senescence vs. flowering | 135.00 | -1.79 | 233.74 | 261.65 | 0.13 | 0.332 | 0.04 | 209.08 |
| senescence vs. fruiting | 111.97 | -5.43 | 254.66 | 235.89 | 0.17 | 0.008 | 0.27 | 202.28 |

Table S2: Summary of linear models for relationships between later phenophases and interphase duration, as shown in Figure 4 in the main text. Linear models were fit with the species-level mean day-of-year of the later phenological stages as the response variable, and the number of days in each previous interphase duration as the explanatory variable. The random.slopes column gives the range in which 95 percent of slopes in the randomization occur (between 2.5 percent and 97.5 percent).

| interphase model | intercept | slope | r ² | p | aic | random.slopes |
|-------------------------------------|-----------|-------|----------------|--------|--------|---------------|
| leafout vs. leafout-budburst | 128.98 | 0.20 | 0.04 | 0.374 | 168.58 | 0.51-1.57 |
| flowering vs. flowering-budburst | 121.18 | 1.03 | 0.88 | <0.001 | 180.24 | 0.84-1.16 |
| fruiting vs. fruiting-budburst | 114.31 | 1.05 | 0.97 | <0.001 | 178.39 | 0.91-1.09 |
| senescence vs. senescence-budburst | 151.87 | 0.81 | 0.74 | <0.001 | 176.81 | 0.78-1.23 |
| flowering vs. flowering-leafout | 129.28 | 1.10 | 0.93 | <0.001 | 167.11 | 0.87-1.15 |
| fruiting vs. fruiting-leafout | 126.69 | 1.03 | 0.98 | <0.001 | 168.41 | 0.93-1.06 |
| senescence vs. fruiting-leafout | 149.22 | 0.88 | 0.82 | <0.001 | 167.30 | 0.81-1.19 |
| fruiting vs. fruiting-flowering | 143.56 | 1.02 | 0.74 | <0.001 | 232.15 | 0.75-1.23 |
| senescence vs. senescence-flowering | 247.41 | 0.25 | 0.17 | 0.041 | 205.51 | 0.59-1.38 |
| senescence vs. senescence-fruiting | 282.11 | -0.08 | 0.05 | 0.296 | 208.91 | 0.53-1.47 |

Table S3: Summary of linear models for relationships between later phenophases and interphase duration, with interphase duration calculated as the number of days between end day-of-year of the later phase and the end day-of-year for the previous phase (instead of from start day-of-year to start day-of-year, as in Table S2 and Figure 4 in the main text). Linear models were fit with the species-level mean day-of-year of the later phenological stages as the response variable, and the number of days in each previous interphase duration as the explanatory variable. The random.slopes column gives the range in which 95 percent of slopes in the randomization occur (between 2.5 percent and 97.5 percent).

| interphase model | intercept | slope | r ² | p | aic | random.slopes |
|-------------------------------------|-----------|-------|----------------|--------|--------|---------------|
| leafout vs. leafout-budburst | 128.83 | -0.16 | 0.06 | 0.238 | 167.91 | 0.67-1.35 |
| flowering vs. flowering-budburst | 143.83 | 0.86 | 0.76 | <0.001 | 196.86 | 0.84-1.15 |
| fruiting vs. fruiting-budburst | 145.31 | 0.86 | 0.75 | <0.001 | 230.82 | 0.91-1.09 |
| senescence vs. senescence-budburst | 218.01 | 0.40 | 0.14 | 0.062 | 206.27 | 0.77-1.23 |
| flowering vs. flowering-leafout | 131.47 | 1.02 | 0.94 | <0.001 | 160.64 | 0.86-1.13 |
| fruiting vs. fruiting-leafout | 127.71 | 0.92 | 0.82 | <0.001 | 223.32 | 0.93-1.07 |
| senescence vs. fruiting-leafout | 158.10 | 0.72 | 0.23 | 0.014 | 203.43 | 0.73-1.26 |
| fruiting vs. fruiting-flowering | 154.97 | 0.81 | 0.53 | <0.001 | 246.93 | 0.77-1.23 |
| senescence vs. senescence-flowering | 274.05 | 0.04 | 0.01 | 0.734 | 210.00 | 0.61-1.36 |
| senescence vs. senescence-fruiting | 285.25 | -0.20 | 0.34 | 0.002 | 199.80 | 0.4-1.43 |

Supplemental Figures

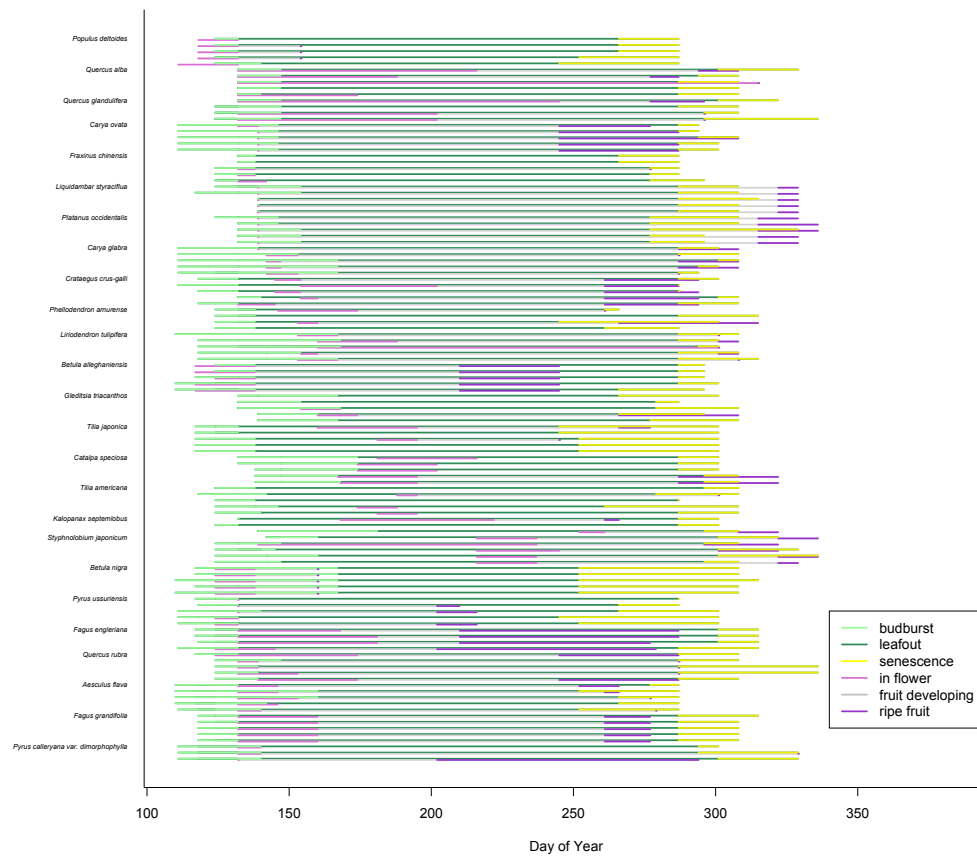


Figure S1: **Individual tree phenology during the 2015 growing season, ordered by species-level mean first-flower dates.** Growth phenology is shown for budburst (from its mean start day-of-year to the mean start day-of-year for leafout, across all individuals within a species), leafout (from the mean day-of-year when fully-expanded leaves were first observed through the start of senescence), and senescence (from the mean day-of-year when leaves first began changing color through the mean day-of-year when more than 95% of leaves on the tree had changed color). Reproductive phenology is shown for flowering (from the mean day-of-year when flowers first appeared to the mean day-of-year when fruits first appeared, across all individuals within a species) and fruiting (from the mean day-of-year when fruits first appeared to the mean day-of-year when more than 95% of fruits were first observed as ripe).