Managing Bloom and Cropping in European Pear, Final Report 2008

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Summary

Based on four trial years, the broad definition of 850-1500 chill hours as a requirement for 'Bartlett' pear should be considered as 56 to 66 chill portions for a minimum to adequate requirement, based on observations of bloom timing and best response to dormancy-enhancing treatments.

Defoliation treatments in 2006 and 2007 tended to delay primary bloom. In both years, defoliation also tended to thin primary bloom, resulting in improved fruit size and yield with defoliation in both years with a later defoliation more beneficial (3-4 CP in 2006, 7 CP in 2007). Defoliation in 2007 at 7 CP had a pronounced thinning effect on rat tail bloom. This may be a tool to manage harvest timing and reduce the number of picks while reducing cullage, as well as reducing frost and fireblight risks. No phytotoxicity was found resulting from defoliation with fertilizer grade urea and chelated copper.

Leaf nitrogen status of shoot leaves in the defoliation trial was reduced in April by defoliation at 1 and 3 CP (Table 3). A similar trend was found in non-bearing spur leaves in April and June. It may be that early defoliation, whether by urea or not, disrupts the 'normal' storage of nitrogen in early fall. Nonetheless, all leaves except bearing spur leaves in June, showed nitrogen levels in excess of recommended N status for pear (Pear Production and Handling Manual, UC ANR Publ. 3483, 2007). This may be a concern for excessive vegetative vigor.

Timing applications of dormant oil by chill accumulation, as measured by the Dynamic Model, affected fruit size and yield with improvement after treatment at approximately 40 chill portions. Yield (lb) per tree was significantly highest when oil was applied at 40 CP for the first pick, and numerically (not statistically) reduced by oil applied at 45 CP in the second pick; the oil treatment at 45 CP significantly reduced estimated fruit per tree by 80 to 100 fruit, both for #1 and #2 fruit. The percentage of total crop that was harvested in the first pick was significantly lowest in the oil treatment at 35 CP. The percent yield as #1 fruit in the first pick was numerically reduced by oil treatment at 45 CP, and in the second pick by oil treatment at 35 CP. Thus, overall, the oil treatment at 40 CP (Jan 7) was the best timing. In three years of similar trials, we did not always apply dormant oil within the same chill accumulation (chill portion) time range, as we had to adjust to growers' practices and annual fluctuations, however, we believe that timing dormant oil to about 40 chill portion timing appears to provide the best benefit with respect to cropping and fruit size.

These results, obtained in repeated trial years with varying weather patterns substantiate the use of the Dynamic Model as a way to measure onset of chill accumulation and dormancy, and chemical defoliation as a means to enhance dormancy in European pear.

Problem and Its Significance

Chill requirement by a given tree species and variety, and chill accumulation from year-to-year, are important factors for growers in managing their orchard production. In California, as in many other low-chill areas of the world, this is particularly true, with chill accumulation variable in the pattern of accumulation during the dormant season and total chill accumulation variable annually. Patterns of chill accumulation vary geographically, based on location within a continent, altitude, marine influence, and seasonal weather patterns. Microclimates within California are also an important consideration because the state has large topographical changes. Thus, continental United States or Europe has very different growing conditions than California, and the Sacramento Delta pear-growing environment is different than that of the North Coastal valleys.

Methods of chill accumulation for tree crops were developed primarily for continental climates, and while the 'chill hour' method (accumulation of hours < 45 ºF), or the 'Modified chill hour' method (accumulation of hours ≤ 45 ºF) have been used historically in California, those methods do not appear to be best suited to California growing conditions (based on 10 years research in sweet cherry in California). The Dynamic Model (Fishman et al., 1987), developed for Israel's low chill Mediterranean conditions, appears to better explain tree behavior, taking into account heat cancellation of chilling until sufficient time at sufficiently low temperature has been experienced without interruption.

We began trials in the 2004-2005 dormant season; we have approached improving European pear bloom and cropping by two approaches, (1) dormant oil application timing by chill accumulation and (2) enhancing entrance into dormancy/deepened dormancy by early defoliation with urea and chelated copper, timed to early chill accumulation. We measured the response in bloom development, fruit quality and crop components, comparing chill hour and chill portion (Dynamic Model) accumulation to these phenological indices. Our goal is to develop a 'best practice' approach to dormant oil application timing and to improve bloom and cropping by chemical defoliation in a specific time range.

Objectives

1. Defoliation: Validate defoliation with chelated copper and urea as a tool to manage bloom timing and fruit quality

2. Dormant oil: Validate the use of the Dynamic model and dormant oil at specific timings to affect bloom and maturity timing and to regulate cropping

Plans and Procedures

Chill accumulation:

Chill accumulation was calculated from hourly temperature data from two WatchDog Model 110-Temp 8K (Spectrum Technologies, Inc.) data loggers placed in our treatment site (Sacramento County) and compared to weather station data from the Russell Road PestCast network station. Chill accumulation models used were the 'Modified' Chill Hour (CH), in which 1 CH = 1 hour ≤ 45 F, and t
Model' in which chill portions (CP) are calculated in a program written in Excel and available for download at

http://groups.ucanr.org/treecrop/How-To_Guides/Dynamic_Model_&_Chill_Accumulation.htm

Temperature data collection began September 1, 2007 and ended April 30, 2008.

Experiment 1: Defoliation and the onset of dormancy with the Dynamic Model

Plant materials and treatments

The trial was applied to ‘Bartlett’ pear on ‘Winter Nellis’ rootstock, planted in 1960 spaced at 12’ x 20’ (182 trees/acre) on the Polder Ranch Orchard on Russell Road. The soil on-site was Columbia silt loam over Sacto silty clay. Fertilizer grade urea (2% v/v) and chelated copper (final concentration was 1% of Monterey Copper-All; Monterey AgResources) were applied to replicate tree rows (1 row per replicate, 3 treatment blocks) in a trial plot that was approximately 6.5 acres, including two guard rows between each treatment row. Rows ran north to south. Application timings were based on in-orchard chill accumulation as measured by the Dynamic Model. Timings were at 1 chill portion (CP, 11 October), 3 CP (20 Oct) and 7 CP (20 Nov), and an untreated control was used for comparison. Three uniform trees were chosen in each treatment row for sampling and two limbs on opposite sides (east and west) of each tree flagged prior to bloom for data collection on bloom progression. Treatments were applied by orchard speed sprayer at approximately 100 gallons per acre; both sides of treated rows received spray. Chemical defoliation was based on that used for chemical defoliation of nursery stock European pear trees (Bi et al., 2005; Guak et al., 2001).

<u>Data measurements and statistics</u>

We evaluated bloom progression, rat-tail bloom, number of dead buds per limb, crop load and fruit size on selected trees. Data taken for bloom progression began on March 13 and ended March 26, counting all inflorescences, rate of bloom (percentages of inflorescences with all flowers open), and percentage of bud death. Rat tail blooms were counted as they appeared, beginning March 19 and ending April 23. Rat tail blooms were separated by type as follows: counted together were Type I (those appearing on the current season bourse or bourse shoot of primary clusters) and Type II (those growing terminally on current season extension shoots in spring), defined by Deckers and Daemon, (1993), separate from Type V (single flowers near pruning cuts), as defined by Moran, Glozer and Lampenin, unpublished. Total percentages of rat tail blooms were expressed as a proportion of the ‘normal’ bloom.

Harvest occurred as ‘2 picks’, on July 15 and July 21, dates of commercial harvest. Prior to each pick we counted all fruit on the east side of each ‘sample’ tree to get crop load and percentage of the crop harvested for each pick. We collected 10 fruit from the upper and 10 fruit from the lower canopy from all exposures of each ‘sample’ tree, consistent with the fruit harvested at each pick and measured weight of the 20-fruit sample and diameter of all fruit.

A separate project evaluated treatment effects on leaf N status and lesion development by fireblight inoculation. Those results will be fully represented in a separate report, however, the results will be briefly summarized in this report as they relate to the defoliation project.

Experiment 2: Use of the Dynamic Model and ’timed’ dormant oil treatments to manipulate bloom and fruit development

<u>Plant materials, treatments and data collection</u>

The trial was applied to ‘Bartlett’ pear on ‘Winter Nellis’ rootstock, with approximately 1/3 of the trial on trees planted in 1960 and the rest of the trial on trees planted in 1970. These were in a single orchard, with the plantings side-by-side and adjacent to the defoliation trial. The ‘dormant oil’ trial trees were spaced at 10’ x 20’ (218 trees/acre) on the Polder Ranch Orchard on Russell Road. The soil on-site was Columbia silt loam over Sacto silty clay. Dormant oil (Clean Crop Dormant Plus, Platte Chemical Co.) was applied by orchard speed sprayer at 500 gallons per acre to replicate blocks of 10-12 tree rows per treatment block in a trial plot that was approximately 8 acres. Rows ran north to south and each treatment block of 10-12 tree rows included two ‘drive rows’ down which bins were loaded at harvest. Harvest data was taken from the drive row that was at the center of each block of rows, such that three rows on each side of the ‘drive row’ were harvested into the bins, keeping treatments discreet. The number of trees included in each of those six rows was counted after harvest, with smaller or weak trees distinguished from full-sized trees, and tree numbers adjusted to count smaller or weak trees as ‘half’ a tree. Number of bins that held ~1000 lb of fruit were counted for each pick, divided by number of trees per those six rows harvested into the specified bins, and total yield for the treatment block per tree estimated. Application timings for dormant oil were based on in-orchard chill accumulation as measured by the Dynamic Model (Table 5). Timings were at 35 CP (Dec 31), 40 CP (Jan 7) and 45 CP (Jan 14). Each treatment timing was applied to 3 replicate blocks of tree rows in a complete randomized block design. Although harvest data was obtained from approximately half of each block, flowering data was obtained from three uniform trees were chosen in each treatment row for sampling and two limbs on opposite sides (east and west) of each tree flagged prior to bloom for data collection on bloom progression.

Flowering data was recorded from each sample tree, as previously described for the defoliation trial. Harvest data as total yield per block and tree was calculated as described above. In addition, at each pick (July 15 and July 21), 100 fruit per treatment block were obtained from the harvest bins at random for fruit weight and size measurement. From the number of bins and number of trees, total yield in lb per tree was calculated. Fruit weight of the 100-fruit sample was used to estimate number of fruit per tree from the yield in pounds calculation. Individual fruit diameter was obtained from all 100 fruit per treatment replicate and fruit separated as #1 fruit (equatorial diameter ≥ 2 5/8) or #2 fruit.

Statistical analyses:

Analyses of variance were performed with Proc GLM in SAS (SAS Institute Inc., Cary, NC) and mean separations tested by Duncan=s Multiple Range Test, $P = 0.05$. All data were normal and did not require transformation (Adler and Roessler, 1964).

Results and Discussion

Chill accumulation

<u>Start of chill accumulation:</u>

- Chill accumulation began October 11, 2007 at the trial site, so that 4 chill portions had accumulated by November 1 (as in 2006), the traditional starting date of chill accumulation.
- In all trial years (Years 1-4), chill accumulation for CH and CP began prior to the traditional calendar date of November 1, thus total chill accumulation should be calculated based on the models used for either CH or CP with starting date determined by the models.
- Total chill hour accumulation and chill portion accumulation with comparisons made among the four years of trial results are shown in Figures 1 and 2.

<u>Full bloom date as affected by chill accumulation:</u>

- Full bloom (Fig. 1, 2) for years
    - 2004-5 -- 1206 CH and 96 CP
    - 2005-6 -- 1643 CH and 109 CP
    - 2006-7 -- 1568 CH and 87 CP

    - 2007-8 -- 1437 CH and 84 CP

- There was a 27% spread in chill hours accumulated by full bloom and a 12% spread in chill portions accumulated by full bloom
- The earliest full bloom date (March 18, 2005), corresponded to the highest chill portion accumulation (except for 2006, when full bloom was unusually late due to very cold spring temperatures), but the lowest chill hour accumulation.
- If minimum chill accumulation attained early leads to earliest bloom (given sufficient heat accumulation), then full bloom on the earliest date should correspond to early, high chill accumulation, which is the case when calculated in chill portions, but the opposite for chill hours.
- This was also the same year when chill portion accumulation was highest (61 CP) by 800 chill hours (the currently accepted minimum for 'Bartlett), compared to all other years which were 43-46 CP at 800 CH (Fig. 1).
- These facts would support the Dynamic Model for chill accumulation as better fitting California conditions for 'Bartlett' pear.

Re-thinking how to define minimum chill requirement for 'Bartlett' pear:

The broad definition of 850-1500 chill hours as a requirement for 'Bartlett' pear should be considered as 56 to 66 chill portions for a minimum to adequate requirement, based on observations of bloom timing and best response to dormancy-enhancing treatments.

Experiment 1: Defoliation and the onset of dormancy with the Dynamic Model

- In 2006, defoliation was timed as 26 October, 3 and 10 November at 0, 2 and 4 CP, respectively.
    - Defoliation on 26 Oct, 0 CP, delayed bloom development. Fruit weight and firmness were greatest in the trees defoliated on 26 Oct; proportion of the crop that was #1 fruit was greatest. This defoliation resulted in a reduction of the crop, by reduction of #2 fruit by approximately 50%.
    - Defoliation on 3 Nov, 2 CP tended to advance bloom.
    - Results were inconclusive due to temperature gradient down the row, coincidental with treatments, so clear results could not be assumed.
- In 2007, defoliation treatments were applied on October 11, (1 CP), October 20 (3 CP) and on November 20 (7 CP)
    - Defoliation at 7 CP reduced the percentage of Type I and II rat tail blooms by 31% and Type V rat tail blooms by 51% (Table 1). These differences were not statistically different, probably due to small sample size (3 trees per replicate treatment row and 2 limbs per tree), however, this is a strong indication of a benefit, both in reduction of rat tail fruit, but also in potential fireblight infection sites.
    - All defoliation treatments delayed primary bloom significantly (Table 1).
    - Defoliations at the first 2 timings reduced yield per tree (pounds), and defoliation slightly increased yield per tree (Table 2), although treatment differences were not significant statistically (low sample size).

- Defoliation at 7 CP significantly increased the percentage of the total crop picked in the first harvest, from 22.3% to 51.4%, an increase of 43%.
- Number of fruit per tree may have been slightly reduced by defoliation at 7 CP; earlier defoliation appears to have resulted in substantial reduction in number of fruit per tree, with corresponding reduction in yield.
- Fruit size in the first pick was increased in by all defoliation treatments (although not different statistically), probably as a result of thinning.
- Despite a possible mild thinning response by defoliation at 7 CP, percentage of yield as #1 fruit was not different from the control and yield per tree (in pounds) appears to have been slightly improved.
- Thus, defoliations appear to have a mild thinning effect on primary bloom and defoliation at 7 CP had a good thinning effect on rat tail bloom. Overall, yield and fruit size appears to benefit.
- Defoliations delayed primary bloom, but did not delay harvest. This may have a benefit in frost damage avoidance.
- Percentage of dead buds for any treatment was less than 1% and not different among treatments, therefore, we can assume there was no phytoxicity potential in this use of fertilizer grade urea on 'Bartlett' pear.

- Leaf nitrogen status of shoot leaves in the defoliation trial was reduced in April by defoliation at 1 and 3 CP (Table 3). A similar trend was found in non-bearing spur leaves in April and June. It may be that early defoliation, whether by urea or not, disrupts the 'normal' storage of nitrogen in early fall. Nonetheless, all leaves except bearing spur leaves in June, showed nitrogen levels in excess of recommended N status for pear (Pear Production and Handling Manual, UC ANR Publ. 3483, 2007). This may be a concern for excessive vegetative vigor.
- Defoliation at 1 CP appeared to enhance susceptibility to fireblight shoot lesion development (Table 4). A conclusive relationship between N status (lower than the control) and this susceptibility can't be drawn from this data, particularly as N levels were excessive in all tissues tested at both timings, with the exception of fruiting spurs in June.

Experiment 2: Use of the Dynamic Model and 'timed' dormant oil treatments to manipulate bloom and fruit development

Primary bloom was most advanced in the dormant oil treatment at 35 CP on Dec 31 very early in bloom on March 19 (Table 6). There was no difference in bloom progression by March 26, however, when all treatments showed 80-90% of flowers open. Types I and II rat tail blooms were not statistically different among treatments, however, the lowest number of these was found in the oil treatment at 40 CP (Jan 7), less than 1%. There was no difference in Type V rat tail bloom percentages among treatments.

Yield (lb) per tree was significantly highest when oil was applied at 40 CP for the first pick, and numerically (not statistically) reduced by oil applied at 45 CP in the second pick; the oil treatment at 45 CP significantly reduced estimated fruit per tree by 80 to 100 fruit, both for #1 and #2 fruit. The percentage of total crop that was harvested in the first pick was significantly lowest in the oil treatment at 35 CP. The percent yield as #1 fruit in the first pick was numerically reduced by oil treatment at 45 CP, and in the second pick by oil treatment at 35 CP. Thus, overall, the oil treatment at 40 CP (Jan 7) was the best timing. In three years of similar trials, we did not always apply dormant oil within the same chill accumulation (chill portion) time range (Table 8), as we had to adjust to growers' practices and annual fluctuations, however, we believe that timing dormant oil to about 40 chill portion timing appears to provide the best benefit with respect to cropping and fruit size.

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Figure 1. Chill accumulation as chill hours 1 CH = 1 hour ≤ 45EF for 4 years.

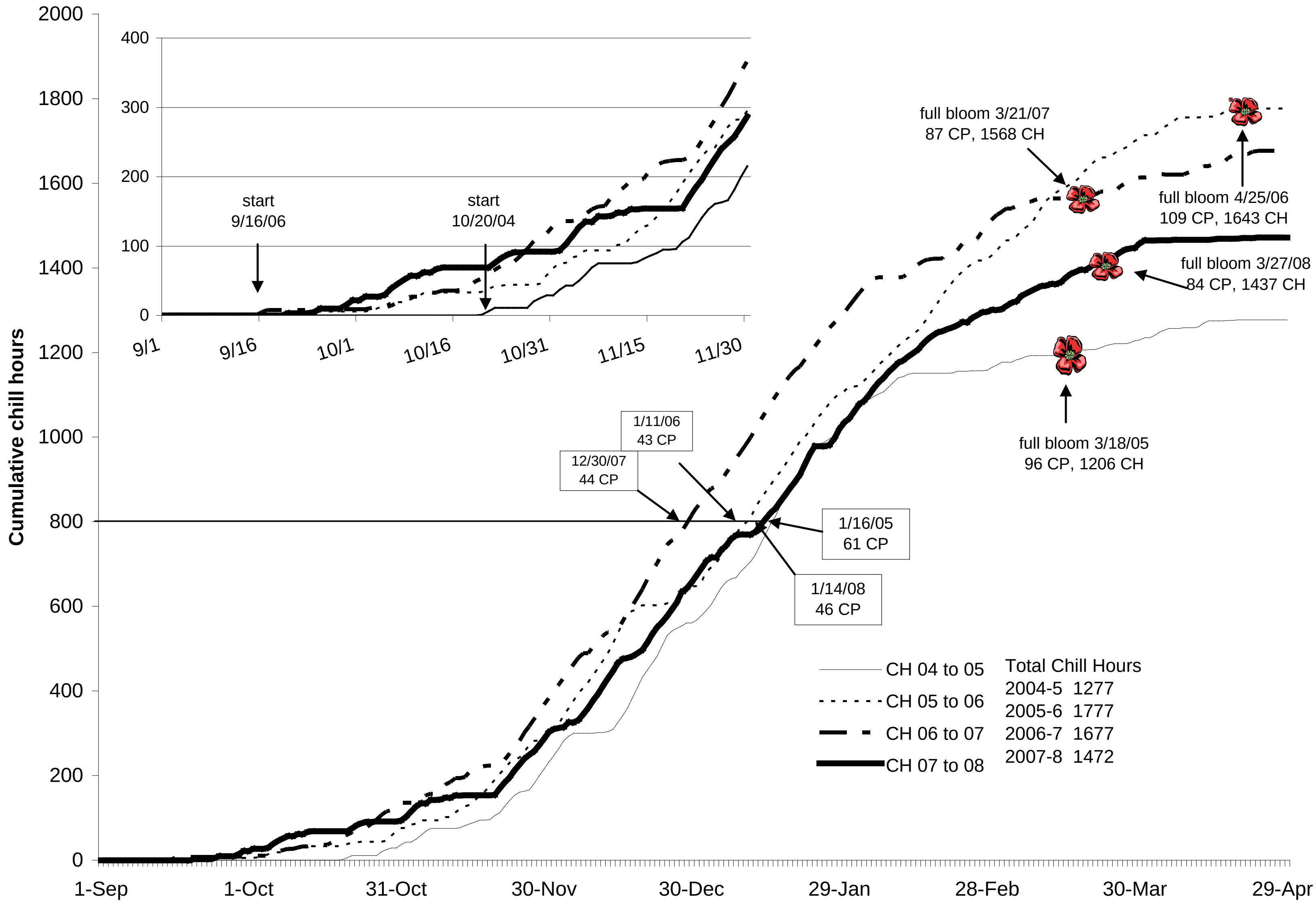

Figure 2. Chill accumulation over 4 years as chill portions calculated by the Dynamic Model.

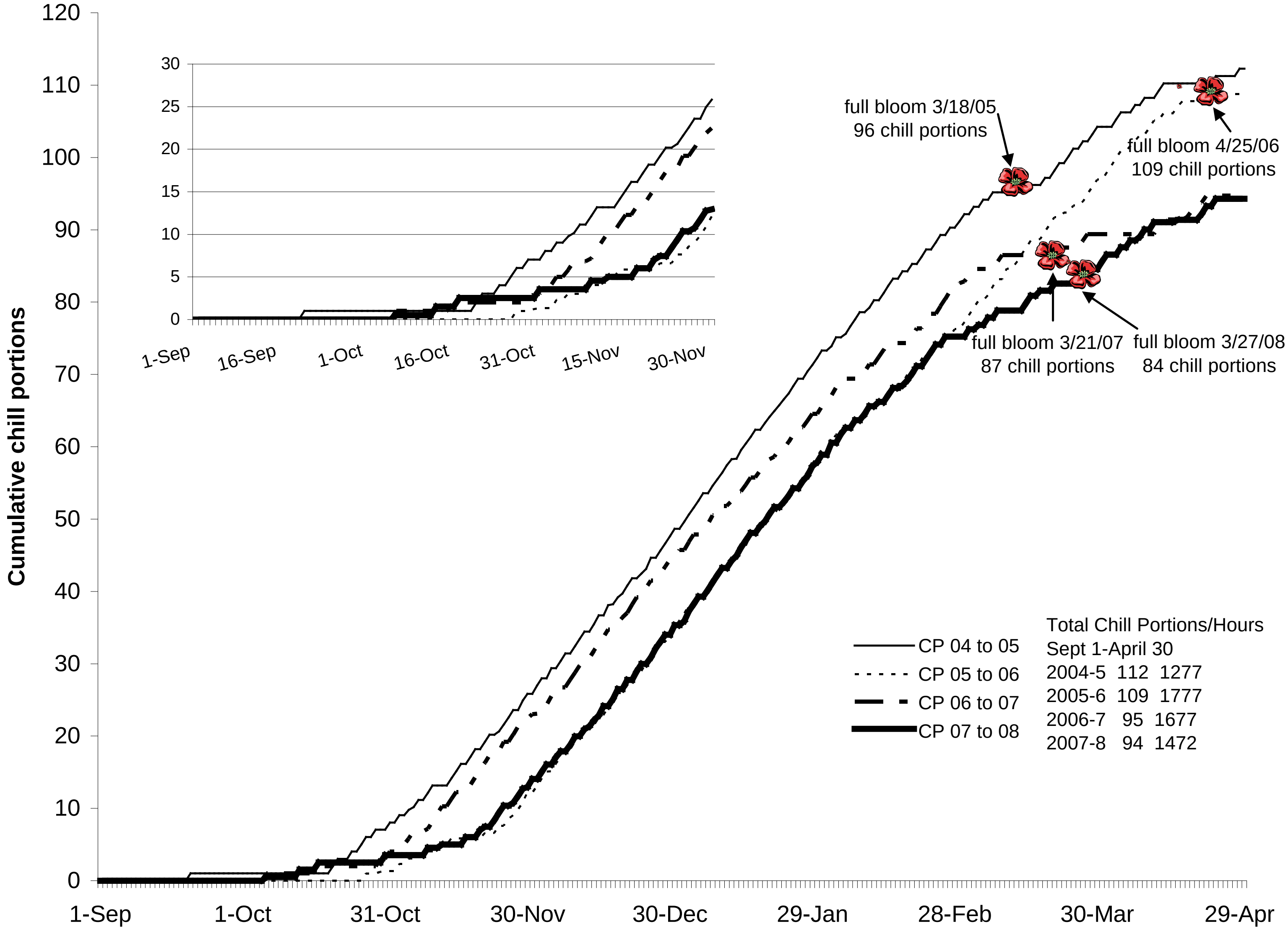

Table 1. Effects of chemical defoliation in 2007 (10 lb urea + 10 lb copper chelate per acre) on bloom of ‘Bartlett’ pear in 2008. Chill portion accumulation timed by the Dynamic Model (Fishman et al., 1987), beginning September 1, 2007 and ending April 30, 2008.[z]

Application timing[y]	%Primary bloom open			%Rat tail bloom open						Rat tail bloom (% of total bloom)	
				Type I + II			Type V				
	Mar 13	Mar 19	Mar 26	Mar 26	Apr 9	Apr 23	Mar 26	Apr 9	Apr 23	Type I+II	Type V
Untreated	0.4 a[x]	7.8 a	90.0 a	0.78 a	1.06 a	0.39 a	0.39 a	2.50 a	0.39 b	8.68 a	16.29 a
1 CP Oct 11	0 a	0.8 b	73.6 b	0.17 b	0.67 a	0.39 a	0.44 a	2.11 a	0.94 ab	4.64 a	13.08 a
3 CP Oct 20	0.1 a	0.7 b	74.5 b	0.22 b	0.61 a	0.44 a	1.00 a	1.11 a	1.17 a	5.19 a	14.36 a
7 CP Nov 20	0 a	5.8 a	76.7 b	0.39 ab	1.11 a	0.44 a	0.33 a	1.17 a	0.83 ab	5.98 a	7.92 a

[x] Mean separation within columns by Duncan’s Multiple Range Test, *P* = 0.05.

[y] Defoliant application timing by chill portion (CP) accumulation and date.

[z] Chill portion accumulation: March 13 (79), March 19 (82), March 26 (84), April 9 (90), Apr 23 (93).

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Table 2. Effects of chemical defoliation[y] in 2007 (10 lb urea + 10 lb copper chelate per acre) on yield components and fruit quality of 'Bartlett' pear in 2008. Chill portion accumulation timed by the Dynamic Model (Fishman et al., 1987), beginning September 1, 2007 and ending April 30, 2008. [y] First 'pick' on 15 July; second 'pick' on 21 July.

Pick 1	Yield/tree (lb)	%Total yield in first pick	#Fruit/tree	Fruit wt (oz)	%Yield as #1 fruit	#1 Fruit/tree
Untreated	546.1 a[x]	22.3 b		12.4 a	88.3 a	
1 CP Oct 11	482.9 a	22.5 b		12.7 a	93.3 a	
3 CP Oct 20	520.1 a	18.7 b		12.9 a	93.9 a	
7 CP Nov 20	562.4 a	51.4 a		12.7 a	90.0 a	
Pick 2						
Untreated	254.0 a			5.7 a	70.4 a	
1 CP Oct 11	214.4 a			5.6 a	61.1 ab	
3 CP Oct 20	213.7 a			5.3 a	55.0 b	
7 CP Nov 20	253.5 a			5.8 a	68.3 a	
Pick 1+2						
Untreated	800.1 a		712 a		79.4 a	565 a
1 CP Oct 11	697.2 a		610 a		77.2 ab	471 b
3 CP Oct 20	733.7 a		641 a		74.4 b	477ab
7 CP Nov 20	816.0 a		699 a		79.2 a	554 a

[x] Mean separation within columns by Duncan's Multiple Range Test, *P* = 0.05.

[y] Defoliant application timing by chill portion (CP) accumulation and date.

Table 3. Effects of chemical defoliation[y] in 2007 (10 lb urea + 10 lb copper chelate per acre) on leaf nitrogen (N) status in 2008. Chill portion accumulation timed by the Dynamic Model (Fishman et al., 1987), beginning September 1, 2007 and ending April 30, 2008. First 'pick' on 15 July; second 'pick' on 21 July.

Treatment[y]	Collection timing	
	April	June
Shoot leaf		
Untreated	3.00a [x]	2.83a
1 CP Oct 11	2.83b	2.69a
3 CP Oct 20	2.84b	2.71a
7 CP Nov 20	2.98a	2.75a
Non-bearing spur leaf		
Untreated	2.89a	2.77ab
1 CP Oct 11	2.66b	2.64b
3 CP Oct 20	2.76ab	2.68ab
7 CP Nov 20	2.95a	2.79a
Fruit-bearing spur leaf		
Untreated		2.52a
1 CP Oct 11		2.33a
3 CP Oct 20		2.34a
7 CP Nov 20		2.47a
Comparing Treatment only, leaf types combined		
Untreated	2.94a	2.71a
1 CP Oct 11	2.74b	2.55a
3 CP Oct 20	2.80b	2.58a
7 CP Nov 20	2.96a	2.67a

[x] Mean separation within columns and leaf types by Duncan's Multiple Range Test, *P* = 0.05.
[y] Defoliant application timing by chill portion (CP) accumulation and date.

Table 4. Effect of defoliation[z] on fireblight lesion length on artificially inoculated (May 28, 2008) 'Bartlett' pear shoots.		
Application timing[y]	Lesion length (cm; average of 10 lesions per treatment	
	June 11 (inoculated shoots assessed in orchard)	June 12 (inoculated shoots assessed after 24 hr incubation)
Untreated	1.56 b[x]	2.72 ab
1 CP Oct 11	2.84 a	4.48 a
3 CP Oct 20	1.64 b	1.96 b
7 CP Nov 20	1.69 b	2.29 b

[x] Mean separation within columns by Duncan's Multiple Range Test, P = 0.05.

.[y] Defoliant application timing by chill portion (CP) accumulation and date.

[z] 1% CuEDTA + 2% urea u per 100 gallons water per acre applied by orchard sprayer.

Table 5. Treatment timings for dormant oil in dormant season 2005-2006, 2006-2007 and 2007-2008. Treatments shown by dates of application and chill portion accumulation based on temperatures recorded hourly on site in trial orchard and the most beneficial treatment timing[y].	
Trial year	Chill accumulation (chill portions)[x]
2005-2006	
23 December	30 (worst results)
29 December	34
9 January	43
25 January	54
2006-2007	
22 December	38
29 December	43
6 January	49
19 January	57
26 January	62
2007-2008	
31 December	35
7 January	40
14 Jan	45

[x] Calculated by the Dynamic Model (Fishman et al., 1987).

Table 6. Response of 'Bartlett' pear bloom to dormant oil application timed to chill accumulation in 2008; chill hours = number of hours ≤ 45EF (CH), chill portions (Dynamic Model; CP). Full bloom date determined when ~85% of all inflorescences were entirely open, with some flowers in petal fall.

	%Primary bloom open			Rat tail bloom (secondary bloom; % of total bloom) Mar 26 – Apr 9 [y]	
	Mar 13 79 CP	Mar 19 82 CP	Mar 26 84 CP	Types I and II	Type V
Oil @ 35 CP Dec 31	0	11.0 a [x]	82.0 a	2.2 a	11.7 a
Oil @ 40 CP Jan 7		2.8 b	86.6 a	0.8 a	9.1 a
Oil @ 45 CP Jan 14		4.0 ab	79.8 a	5.1 a	10.8 a

[x] Mean separation within columns by Duncan's Multiple Range Test, $P = 0.05$.

[y] Type I secondary bloom arises on the current season bourse or bourse shoot of primary clusters, and Type II occurs terminally on current season extension shoots in spring (Deckers and Daemon, 1993). Type V occurs as single flowers or very reduced and elongated inflorescences near pruning cuts (Moran et al., unpublished).

Table 7. Effects of dormant oil application timed to chill accumulation in 2008; chill hours = number of hours ≤ 45EF (CH), chill portions (Dynamic Model; CP) on yield components and fruit quality of 'Bartlett' pear in 2008. Chill portion accumulation timed by the Dynamic Model (Fishman et al., 1987), beginning September 1, 2007 and ending April 30, 2008.[y] First 'pick' on 15 July; second 'pick' on 21 July.

Treatment (dormant oil and timing (by chill portion accumulation and date)						
Pick 1	Yield/tree (lb)	%Total yield in first pick	#Fruit/tree	%Yield as #1 fruit	#1 fruit (2.5" or larger diameter)	
					#Fruit/tree	Yield (lb)/tree
35 CP Dec. 31	50.5 b[x]	18.3 b	683 a	91.1 a		
40 CP Jan. 7	57.4 a	20.3 ab	701 a	89.8 a		
45 CP Jan. 14	52.2 ab	21.7 a	605 b	83.1 a		
Pick 2						
35 CP Dec. 31	216.3 a			66.2 a		
40 CP Jan. 7	214.9 a			72.0 a		
45 CP Jan. 14	184.4 a			75.6 a		
Pick 1+2						
35 CP Dec. 31	133.4 a			78.6 a	534 ab	208.6 ab
40 CP Jan. 7	136.2 a			80.9 a	567 a	220.3 a
45 CP Jan. 14	118.3 a			79.4 a	480 b	187.4 b

[x] Mean separation within columns by Duncan's Multiple Range Test, *P* = 0.05.

Table 8. Response of 'Bartlett' pear to chill accumulation in 4 trial years; chill hours = number of hours ≤ 45EF (CH), chill portions (Dynamic Model; CP). Full bloom date determined when ~85% of all inflorescences were entirely open, with some flowers in petal fall.

Dormant season (full bloom date)	Chill hours			Chill portions		
	Onset	Full bloom	At most effective dormant oil timing for optimal crop	Onset	Full bloom	At most effective dormant oil timing for optimal crop
2004-5 (Mar 18)	Oct 20	1207	505-972 (Dec 20-Jan 18)[y]	Sept 20	96	34-56
2005-6 (Apr 25)	Sept 18	1777	787-1051 (Jan 9-25)	Oct 27	109	43-54
2006-7 (Mar 21)[x]	Sept 16	1568		Oct 6	87	
2007-8 (Mar 27)	Oct 2	1481	759 (Jan 7)	Oct 6	84	40 (Jan 7)

[x] Harvest data not available.
[y] Range of effective timing of dormant oil application, based on bloom development, number of Type I rat tail flowers, fruit size and yield components. In 2005-6 the results were complicated by a temperature gradient down the row with both application date of dormant oil and amount of chill accumulated increasing down the row.