WISCONSIN UNIVERSITY OF WISCONSIN-MADISON
UW Extension University of Wisconsin-Extension

Wisconsin Fruit News

Supplemental Apple Thinning Issue – May 25, 2018

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Precision apple thinning part IV: *Deciding what, when and how much thinner to apply*

By: Janet van Zoeren and Amaya Atucha

This week most orchards are reaching petal fall, and many growers are deciding when to begin spraying, what products to use, at what rate to apply, and how many thinning sprays to apply. These are all decisions that the precision thinning model can help address. "Precision thinning protocol" refers to three separate, but complementary procedures: calculating target crop load, using the carbohydrate model to adjust spray rates, and using the fruitlet growth model to determine when you have reached the target crop load. Each of these tools can be implemented on its own, or all can be used together to help guide your thinning decisions (Figure 1).

In today's article, we discuss some of the factors to take into account when deciding how much thinner to apply to an orchard block. We will also discuss how to convert that rate, in parts per million, to a quantity of product and volume of water to put in your tank.

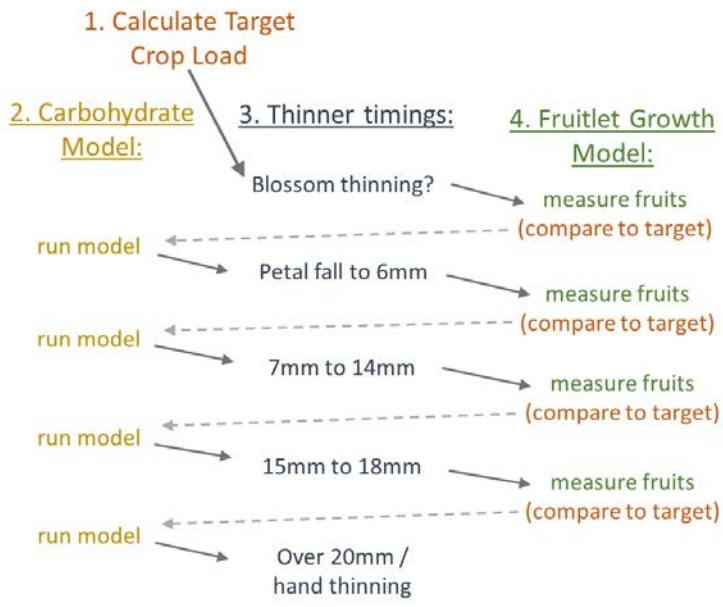


Figure 1: A flow chart depicting how the precision thinning processes can guide decision-making. The process involves calculating a target crop load, planning when to begin spraying, using the carbohydrate model to adjust thinning rates based on weather conditions, and using the fruitlet growth model to determine if another spray is necessary. (Source: T. Robinson, Cornell University)

Determining your optimal spray rate:

Determining optimal spray rate takes into account many factors, including 1, what product you are spraying, 2, the growth stage of the fruitlets, 3, the canopy size of the trees you are spraying, 4, and the carbohydrate balance of the trees. To determine the best rate, you can first find a baseline rate of application, which will be provided on the product label as well as in the 2018 Midwest Fruit Spray Guide. These sources will give you a range of best application rates. You can decide if you would like to set your baseline rate of application at the high or low end of that range, depending on your calculated target crop load, your observed flower-set, the weather during pollination season, and the size of the fruitlets at the time of thinner application. See the following section for more information about each of these spray windows.

Spray windows and products:

Spray Timing	**Products available**	**Notes**
Blossom Thinning:	Lime sulfur and oil Ammonium thiosulfate	• Not weather-dependent (rate not based on carb model) • Best applied at 70-80% bloom • Advantages – results in largest fruit and best return bloom • Disadvantages – possibility of over thinning (unable to take into account weather during bloom or pollinator activity); applications after 80% bloom may cause russetting
Petal fall to 6mm:	Carbaryl/Sevin NAA NAA + Carbaryl/Sevin NAD 6-BA (MaxCel; Exilis Plus; RiteWay)	• Good time to thin to encourage return bloom • Can apply any time after bees are removed • Fruits are **moderately sensitive** to thinners during this time • NAA + Carbaryl is most aggressive thinner • NAD and 6-BA are more mild thinners • 6-BA also promotes cell division (larger fruit)
7mm to 14mm:	Carbaryl/Sevin NAA 6-BA	• Fruits are **most sensitive** to thinners during this time
15mm to 18mm:	Ethephon + carbaryl	• Fruits are **much less sensitive** to thinners during this time • Higher thinner effectiveness if applied during warm weather • Provides very little effect on return bloom
Over 20mm:	Ethephon Hand thinning	• Becomes **difficult to chemical thin** after fruits reach 20mm

Calculating tank concentrations:

Once you have determined concentration at which to spray a thinner, before actually making the application, you will need to calculate what actual quantity of product to put into the tank. A resource to learn more about apple plant growth regulators, including chemical thinning, is UW Extension publication A3542. The information below on "Determining how much formulation to apply" is from that publication.

Determining how much formulation to apply

Calculating the how exactly how much plant growth regulators to apply based on ppm can be difficult. Parts per million is not an amount, but a concentration of PGR in the spray water. Therefore, to determine the correct application rate, you need to know how much water per acre you will be applying and the desired ppm. The correct rate can be calculated using this formula.

$$\text{lb of material needed} = \frac{\text{(desired ppm)}}{1{,}000{,}000} \times \frac{\text{(gallons of water)} \times 8.345}{\text{(\% active ingredient)}}$$

To convert pounds to ounces, multiply the result by 16.

Example: A commercial formulation of NAA contains 3.5% active ingredient. How much formulation per 100 gallons is needed to make a solution of 10 ppm for thinning 'Golden Delicious'?

$$\frac{10 \text{ ppm}}{1{,}000{,}000} \times \frac{100 \text{ gal} \times 8.345}{0.035 \text{ a.i.}} = 0.24 \text{ lb}$$

To convert the rate to ounces: 0.24 lb x 16 oz/lb = 3.85 oz

Relevant Resources:

2018 Midwest Fruit Pest Management Guide, pp. 76-79.

Roper, T. 2005. *Plant growth regulator use in apples.* University of Wisconsin Extension, publication A3524.

Current carbohydrate model outputs

By: Janet van Zoeren and Amaya Atucha

Following are screen shots of the current NEWA carbohydrate model outputs from across the state. The green bar shows the current day's temperature and solar radiation data, and the model's estimate of tree's carbohydrate balance. Below the green bar, in tan, is the forecasted weather data and corresponding forecasted carbohydrate balance.

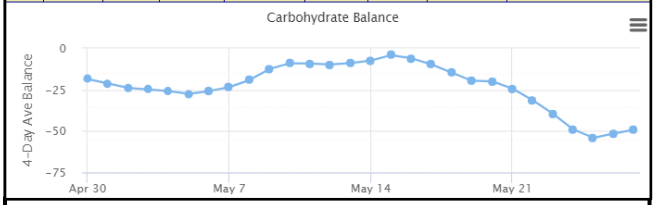
We have experienced a couple of very warm and cloudy days this week, which makes the trees more sensitive to the chemical thinners. For that reason, model results for the sites presented below suggest using a ***reduced*** rate (from 15% to 60% reduced) of chemical thinner than what you would normally use. As mentioned above, this model does not give a specific recommendation of the rate to use, but rather it gives a recommendation for how to adjust the "standard" rate you would normally use, by taking into account how sensitive the trees will be during the next four day from the date you ran the model. For example, if you were to apply an X rate of chemical thinner expecting to drop 50% of the fruitlets and you apply the thinner in the next 3 days at a rate of X, you will most probably drop more than the 50% you were expecting, because the trees are more sensitive to the thinner due to the negative balance in carbohydrate.

Richland County

Current phenological stage: petal fall – 6mm fruit
Green tip: 4/30
Full bloom: 5/16

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/22	65	52	9.8	8.65	30.26	-21.62	-31.35	Decrease chemical thinner rate by 15%
5/23	79	54	21.4	25.29	44.06	-18.76	-39.58	Decrease chemical thinner rate by 15%
5/24	86	59	24.4	25.79	59.61	-33.82	-49.03	Decrease chemical thinner rate by 30%
5/25	84	64	19.1	17.59	68.78	-51.19	-54.1	Decrease chemical thinner rate by 30%
5/26	89	64	24.4	24.81	79.38	-54.56	-51.46	Decrease chemical thinner rate by 30%
5/27	89	64	25.0	27.68	84.22	-56.54	-49.22	Decrease chemical thinner rate by 30%
5/28	87	64	24.7	30.60	84.72	-54.12		
5/29	83	63	25.1	37.31	77.94	-40.63		
5/30	83	63	20.6	29.49	75.10	-45.61		



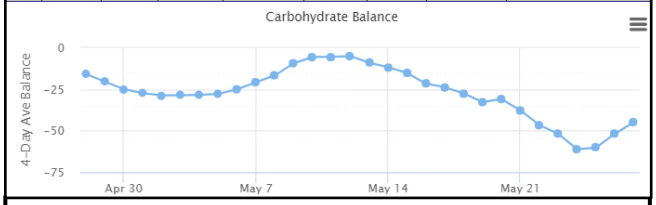
Green tip occurred on 4/30, and full bloom occurred of 5/16. Based on the predicted carbohydrate balance over the next four days, of around -50 g/day, the recommended rate is to decrease the standard chemical thinner rate by 30%.

Trempealeau County

Current phenological stage: petal fall – 6mm fruit
Green tip: 4/28
Full bloom: 5/16

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/22	68	57	5.9	0.00	41.84	-41.84	-46.59	Decrease chemical thinner rate by 30%
5/23	81	55	21.2	29.35	55.23	-25.87	-51.87	Decrease chemical thinner rate by 30%
5/24	87	64	24.1	25.80	76.45	-50.65	-61.07	Decrease chemical thinner rate by 50%
5/25	85	67	17.6	13.51	81.51	-68.00	-60.12	Decrease chemical thinner rate by 50%
5/26	90	65	24.3	25.91	88.89	-62.98	-51.79	Decrease chemical thinner rate by 30%
5/27	91	65	24.5	26.45	89.11	-62.65	-44.82	Decrease chemical thinner rate by 30%
5/28	88	65	24.8	31.55	78.40	-46.84		
5/29	84	66	22.6	35.20	69.88	-34.69		
5/30	83	65	18.3	31.51	66.63	-35.12		



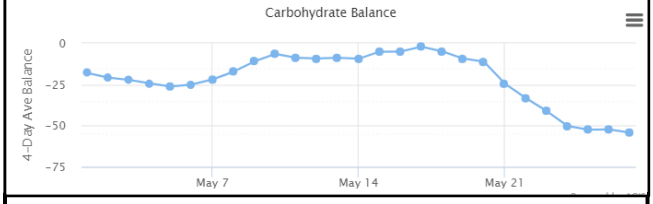
Green tip occurred on 4/28, and full bloom occurred on 5/16. Based on the predicted carbohydrate balance over the next four days, of around -60 g/day, the recommended rate is to decrease the standard chemical thinner rate by 50%.

Eau Claire County

Current phenological stage: petal fall – 6mm fruit
Green tip: 5/1
Full bloom: 5/16

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/22	70	54	13.0	10.95	29.21	-18.26	-33.19	Decrease chemical thinner rate by 15%
5/23	81	49	19.8	21.08	37.39	-16.31	-41.06	Decrease chemical thinner rate by 30%
5/24	88	66	22.5	14.82	60.53	-45.71	-50.16	Decrease chemical thinner rate by 30%
5/25	85	66	17.7	11.71	64.19	-52.48	-52.45	Decrease chemical thinner rate by 30%
5/26	89	63	24.5	23.57	73.30	-49.73	-52.25	Decrease chemical thinner rate by 30%
5/27	89	63	24.4	25.64	78.37	-52.73	-54.33	Decrease chemical thinner rate by 30%
5/28	88	64	25.0	28.53	83.39	-54.86		
5/29	83	64	21.9	28.37	80.05	-51.67		
5/30	83	63	17.3	20.47	78.53	-58.06		



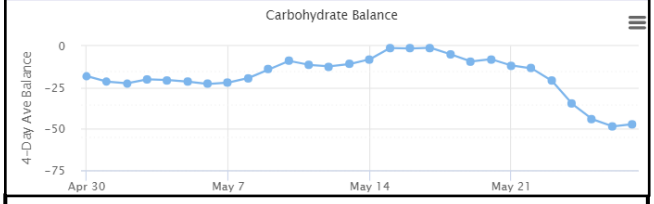
Green tip occurred on 5/1, and full bloom occurred on 5/16. Based on the predicted carbohydrate balance over the next four days, of around --50 g/day, the recommended rate is to decrease the standard chemical thinner rate by 30%.

Racine County

Current phenological stage: petal fall – 6mm fruit
Green tip: 4/30
Full bloom: 5/17

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/22	68	49	10.9	9.43	22.37	-12.94	-13.5	Apply standard chemical thinner rate
5/23	77	48	22.4	24.60	30.67	-6.08	-20.99	Decrease chemical thinner rate by 15%
5/24	79	53	23.4	25.74	40.48	-14.74	-34.9	Decrease chemical thinner rate by 15%
5/25	83	52	25.0	29.51	49.76	-20.25	-44.21	Decrease chemical thinner rate by 30%
5/26	82	60	19.9	21.68	64.57	-42.89	-48.47	Decrease chemical thinner rate by 30%
5/27	78	62	11.9	8.91	70.65	-61.74	-47.17	Decrease chemical thinner rate by 30%
5/28	78	61	17.3	22.22	74.18	-51.96		
5/29	79	59	23.4	36.95	74.22	-37.28		
5/30	81	57	22.4	37.90	75.62	-37.72		



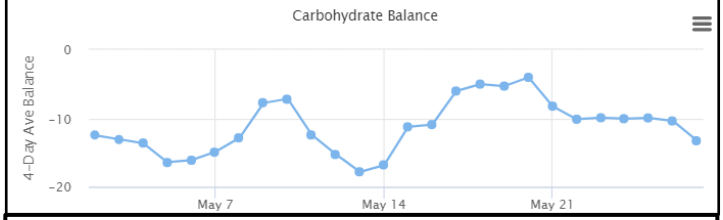
Green tip occurred on 4/30, and full bloom occurred on 5/17. Based on the predicted carbohydrate balance over the next four days, of around -40 g/day, the recommended rate is to decrease the standard chemical thinner rate by 15%.

Door County

Current phenological stage: king bloom
Green tip: 5/2
Full bloom: not yet happened

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/20	60	39	26.4	18.57	14.56	4.01	-4.03	-
5/21	60	33	11.3	9.12	12.15	-3.03	-8.24	-
5/22	71	48	22.0	16.09	25.09	-9.00	-10.15	-
5/23	77	51	27.3	20.39	28.50	-8.10	-9.93	-
5/24	76	57	21.1	15.77	28.60	-12.83	-10.07	-
5/25	78	56	19.1	15.37	26.03	-10.66	-9.96	-
5/26	77	58	22.1	19.60	27.74	-8.15	-10.4	-
5/27	73	54	22.6	24.19	32.84	-8.65	-13.29	-
5/28	72	54	23.6	27.71	40.10	-12.39		-
5/29	70	53	25.1	32.78	45.19	-12.40		-
5/30	70	54	22.5	31.83	51.54	-19.71		-



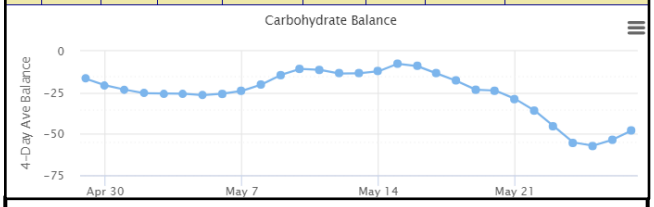
Green tip occurred on 5/2, and full bloom has not yet occurred. Because full bloom has not occurred, there is no thinning recommendation output at this time.

Dane County

Current phenological stage: petal fall – 6mm fruit
Green tip: 4/29
Full bloom: 5/16

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Status (g/day)				Thinning Recommendation
				Production	Demand	Balance	4-Day Ave Balance	
5/22	67	51	9.1	7.82	31.88	-24.06	-35.83	Decrease chemical thinner rate by 15%
5/23	78	54	18.3	21.52	45.67	-24.15	-45.4	Decrease chemical thinner rate by 30%
5/24	85	61	21.7	22.64	65.79	-43.16	-55.19	Decrease chemical thinner rate by 30%
5/25	85	62	20.2	21.51	73.48	-51.97	-57.12	Decrease chemical thinner rate by 30%
5/26	89	65	24.1	24.66	86.98	-62.32	-53.53	Decrease chemical thinner rate by 30%
5/27	88	65	24.0	27.10	90.42	-63.31	-47.94	Decrease chemical thinner rate by 30%
5/28	85	64	24.8	33.78	84.66	-50.88		
5/29	82	62	24.9	40.14	77.73	-37.60		
5/30	83	62	21.0	36.88	76.85	-39.96		



Green tip occurred on 4/29, and full bloom occurred on 5/16. Based on the predicted carbohydrate balance over the next four days, of around -50 g/day, the recommended rate is to decrease the standard chemical thinner rate by 30%.