

GROWTH REGULATOR, THINNING, CALCIUM and POSTHARVEST TREATMENTS

CHEMICAL THINNING



Chemical thinning is an established and essential practice performed by fruit growers each spring. Because many factors influence the tree's response to chemical

thinners, there are always questions and concerns about chemical thinning as the season approaches. The purpose of this section is to summarize thinning recommendations and to discuss conditions that may influence your chemical thinning program. Consult your state Extension specialist if you have additional questions about thinning. As always, follow the label to assure proper use of thinning chemicals.

Thinning is done to increase fruit size and enhance repeat bloom. The more fruit that are allowed to develop on a tree the smaller each fruit will be. Thinning to a fruit density of less than 25 fruits per inch of limb circumference within 4 weeks of bloom should insure an adequate repeat bloom. Thinning to a fruit density of 13 to 15 fruits per inch of limb circumference will enhance repeat bloom and increase fruit size. It should be noted that these larger fruit are more susceptible to storage problems, so it is critical to follow a calcium management program that includes foliar calcium sprays to maintain optimum storage potential of these larger fruits.

Growers should consider thinning at least all mature bearing trees. Trees that carried a light crop the previous year will have a heavy bloom and will normally require extensive thinning. Furthermore, trees with a light bloom will set a higher percentage of flowers than those with a heavy bloom even when thinned with a moderate rate of chemical thinner.

FACTORS AFFECTING THINNING

Weather Conditions

Before application. Leaves that develop during predominately cool, cloudy, weather are more easily penetrated by thinning chemicals. Warm sunny conditions favor development of a waxy leaf surface that restricts penetration of thinning chemicals. When choosing the rate of a chemical thinner to use, weather during the week prior to spraying should be one of the factors considered.

At the time of application. Generally, warm temperatures (over 70°F) as well as long droplet drying time will result in greater thinner uptake. However, enhanced uptake at warm temperatures is sometimes offset by reduced uptake due to short drying time. Conversely, cool temperatures at the time of spraying usually result in reduced thinner uptake. However, reduced uptake due to low temperature is offset by increased uptake due to a longer drying time. Observation and recent research suggests that weather at the time of application has far less influence (or no influence at all) on thinning than previously thought.

After application. Temperature in the three or four days following thinner application is the dominant factor influencing the response to chemical thinners. Elevated temperature provides the stress required for thinners to work. Temperatures over 70°F intensifies competition among developing fruit at a time of high metabolic demand within the tree. If cool weather follows thinner application, thinning results frequently are disappointing. It is often better to wait 2 or 3 days until warm temperatures are forecast to occur after application than to apply a thinner when cool conditions are likely to prevail immediately after application. In this situation, less aggressive thinning may be appropriate.

It is not uncommon to have several days of cloudy weather occur during the postbloom period where solar radiation is reduced to 10% to 15% of full sun. In New England, this condition is usually accompanied by cool temperatures, and there is very little influence on fruit set or thinner efficacy. However, if cloudy conditions persist for several days during the thinning period and this is accompanied by warm temperature, one can expect reduced fruit set and an enhanced effect of chemical thinners.

The threat of rain during the chemical thinning period may be more of a deterrent for thinner application than it should be. Experience has shown that if a thinner is applied and the spray has been completely dry for at least 30 minutes, one can expect 80% or more of the response from the thinner.

After a period with daily temperatures in the mid-70's and above, fruitlets become physiologically less sensitive to chemical thinners. For example, fruitlets that reach 12 mm diameter in a year when temperatures were consistently in the mid-60's are more susceptible to thinners than fruitlets in another year that reach the same diameter after a short period of higher temperatures.

Tree Age and Vigor

Young trees that are growing vigorously are more easily thinned than older, slower growing trees. It is probably better to hand thin very young trees that overset. In this way the leader may be completely defruited to keep it upright, while main laterals are allowed to spread with the weight of some fruit. If no crop is preferred, a combination of NAA and Sevin (carbaryl) applied at petal fall at the maximum suggested rates for the cultivar, should remove most of the fruit.

Fruit on wood of low vigor due to shading, excessive crop in the previous year, or inadequate nitrogen are especially subject to chemical thinning. Whole trees in a state of low vigor should receive little or no chemical thinner. In healthy trees, the well exposed tops will be most difficult to thin. Presumably, a summer or fall mite infestation which was severe enough to cause foliage bronzing would reduce the vigor of the tree sufficiently to warrant lower rates of chemical thinner the following spring. Following an "off" year of very low crop, thinning is more difficult and the higher dosage is needed.

Thinning response to the various thinning

chemicals will vary from farm to farm and among blocks on a specific farm. Growers should develop a thinning history for each block, keeping detailed records of bloom, weather conditions, tree vigor and age, bee activity, thinning chemicals, timing and rates used, and fruit set. This data, collected over several years, will help fine tune a chemical thinning program that reduces the risk associated with both under and over thinning.

Wetting Agents

Additives such as Tween 20, X-77, etc., will increase the uptake of thinning chemicals. The rates suggested in this publication are for use without additives or additional pesticides. If a spreader-sticker is used, adjust the rate downward, especially when using NAA or NAD.

Concentration

Concentrate spraying of thinners is not recommended because of the lack of uniformity in response throughout the tree, and because of the increased chance for error. Rates of Sevin 50% WP in excess of 1 lb./100 gals. do not result in substantially more thinning than the 1 lb. rate, but when using NAA or NAD, thinning (and injury) increases with increasing amount applied.

Chemical thinners may be applied over a relatively wide range of time, and depending on the year, this may be from bloom to the time fruit reach 25 mm diameter. Weather largely determines this thinning window of opportunity. If the temperature remains relative cool and sunny, fruit growth is slow, and developing fruit are placed under little stress, so thinning can be carried out over a longer period of time. Conversely, if the weather is warm and hot following bloom, fruit growth is rapid, fruit are stressed by competition with other fruit and growing shoots. Under these conditions, the time period when fruit can be thinned is shortened and compressed.

Generally fruit are most sensitive to chemical thinners at the 7–12 mm stage of fruit development. Under ideal conditions, we would recommend the application of most thinners at this stage. However, temperature following application is the dominant factor determining thinner effectiveness. Since the weather can not be regulated, we now recommend multiple thinner application to increase the chances of having a thinner application coincide with weather favorable for thinning.

TIMING CHEMICAL THINNING

Thinning at Bloom

NAA and NAD may be applied at bloom. It is the first opportunity to apply a chemical thinner. Because carbaryl is toxic to bees, it should never be applied when bees are in the orchard. Accel is ineffective when applied at this time.

Petal Fall to 3 mm Fruit Diameter

Petal fall applications of carbaryl, NAA, NAD, or combinations have become one of the most important components in the revised thinning strategy for New England. Rarely is there overthinning as the result of thinner applications made at the recommended rates, and subsequent thinner applications may be made at lower, safer rates (if they are required at all). Further, the greatest positive effects on fruit size and return bloom are realized from early thinner application. Accel is less effective when applied at this time.

7 to 12 mm Fruit Diameter

This is the traditional time to apply chemical thinners. Thinners generally are maximally effective when applied at this time, but favorable temperatures should follow application for good thinning to occur.

12 to 18 mm Fruit Diameter

This is a marginal time to apply a chemical thinner. The effectiveness of chemical thinners increase as fruit size increases in this size category. Successful thinning at this stage of fruit development is generally restricted to years where the weather has been cool and sunny, and fruit at this point have not been subjected to stress by high temperature. Application of NAA at this time may result in thinning with no increase in fruit size, especially if warm weather follows NAA application. Sevin may provide some thinning in this period.

18 mm Fruit Diameter and Larger

When fruit reach this size only ethephon or ethephon with carbaryl will thin. Thinning with these materials at this time is erratic, and unpredictable. Use of ethephon at this time may advance ripening of fruit.

NOTES ON THINNING MATERIALS

CARBARYL (Sevin) is considered to be the least risky chemical in terms of overthinning. Carbaryl is a selective thinner in that it thins the weakest lateral fruitlets, thus reducing the number of fruits per cluster. It has been shown to be effective in increasing fruit size. It may be applied from petal fall to 28 days after full bloom. Often, best results are achieved by using another chemical thinner in combination with carbaryl. Carbaryl is toxic to bees and to other beneficial insects. Toxicity is dosage dependent. Do not apply during bloom until bees are removed from within foraging distance of the orchard. **Restricted entry interval is 12 hours.**

NAA. Naphthaleneacetic acid (NAA) is a powerful fruit thinning agent. There is a risk of overthinning, especially when temperatures over 80°F occur following application. The risk of overthinning can be reduced by applying a reduced amount of NAA in combination with carbaryl. Use of NAA may not always result in increased fruit size, especially if the NAA is applied at larger fruit sizes. Use of NAA hormonally stimulates return bloom over and above the increase in return bloom expected from removal of fruit alone.

NAA may be applied at concentrations of 2.5 to 20 ppm, depending upon the cultivar to be thinned and whether or not it is used in combination with carbaryl. See Table 26 for specific recommendations. NAA sprays have traditionally been applied when the fruitlets are 10 – 12 mm in diameter, which usually occurs by 14 to 21 days after full bloom. Growers may want to try earlier timings if previous applications of NAA at 10 – 12 mm fruit diameter have not increased fruit size. The rate of fruit growth varies depending upon the weather, therefore fruit measurement is the best method to determine when to apply NAA for consistent results. Use Tables 23 and 24 to assist with NAA concentrations.

NAA has no effect on beneficial insects. Do not use NAA and BA (Accel) on Delicious or Fuji in the same season, as pygmy fruit may result. Also, do not use NAA and Promalin on Delicious or Fuji in the same season as this combination also may cause development of pygmy fruits. NAA is not labeled for use above 20 ppm. **Restricted entry intervals: K-Salt Fruit Fix 24 hours; 48 hours for Fruitone-N.**

NAD. Naphthaleneacetimide is a less potent form of NAA. It frequently is used in situations where foliar damage caused by NAA is a problem, especially for summer cultivars. NAD is applied at 25 to 50 ppm at petal fall, or in a postbloom spray when the fruitlets are 10 – 12 mm in diameter. NAD may be combined with carbaryl, in place of NAA. It is never used on Delicious since small seedless fruit (pygmies) will result and persist until harvest.

Not labeled for use beyond 2 1/2 weeks after full bloom; no more than 50 ppm in a single spray each year. **Restricted entry interval is 48 hours.**

ACCEL includes the same chemicals (benzyladenine and GA₄₊₇) as Promalin but in a markedly different ratio. When applied alone, Accel is not a strong thinner. It can increase fruit size above that attributed to crop-load reduction. Accel plus carbaryl is a strong thinning combination. The following thinning sequence has been very successful:

- At petal fall, apply carbaryl.
- When fruit are between 5 and 10 mm diameter, apply Accel at 30 grams active ingredient (a.i.) per acre. If fruit set appears heavy, include carbaryl in this second thinning spray.

Table 23 – Concentration of NAA related to Ounces of Fruitone N.

| | | Fruitone N (ozs. per acre) | | | | | | | |
|--|--|-----------------------------|-----|-----|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | NAA Parts per million (ppm) | | | | | | | |
| | | 2.5 | 5.0 | 7.5 | 10.0 | 12.5 | 15.0 | 17.5 | 20.0 |

Table 24 – Relationships among Dilute Gallons per Acre, Fruitone N per Acre, and NAA Concentration.

| Gallons per acre required for dilute spray | Fruitone N (ozs. per acre) | | | | | | | | |
|--|----------------------------|------|------|------|------|------|------|------|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| | Parts per million (ppm) | | | | | | | | |
| 50 | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 30.0 | 35.0 | 40.0 | |
| 100 | 2.5 | 5.0 | 7.5 | 10.0 | 12.5 | 15.0 | 17.5 | 20.0 | |
| 150 | 1.7 | 3.3 | 5.0 | 6.7 | 8.3 | 10.0 | 11.7 | 13.3 | |
| 200 | 1.3 | 2.5 | 3.8 | 5.0 | 6.3 | 7.5 | 8.8 | 10.0 | |
| 250 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | |
| 300 | 0.8 | 1.7 | 2.5 | 3.3 | 4.2 | 5.0 | 5.8 | 6.7 | |

Warm weather is required for Accel to work effectively. As a general rule, if the temperature is below 70°F, put the Accel back on the shelf. Temperature of 80–85°F is ideal, resulting in the best thinning result. Ideally, a 3-day window of appropriate weather is needed if Accel is to work best. Follow weather forecasts and apply Accel when the first ideal or nearly ideal 3-day window within this 5 – 15 mm fruit diameter window is expected.

Accel can be tried on a number of cultivars; however, it has worked poorly with Gala. Use the 30 gram a.i. rate except for blocks with a low tree row canopy volume (see Table 25 for the relationship between concentration and dilute gallonage required). Do not use Accel and NAA on Delicious or Fuji in the same season as pygmy fruits may result. **The restricted entry interval for Accel is 12 hours.**

Table 25 – Relationship among Dilute Gallons per Acre, Active Ingredient, Bottles per Acre, and Accel Concentration.

| Gallons per acre required for dilute spray | Accel rate (g active ingredient per acre) | | | | |
|--|--|------|-----|------|-----|
| | 10 | 15 | 20 | 25 | 30 |
| | (bottles per acre)* | | | | |
| | 0.5 | 0.75 | 1.0 | 1.25 | 1.5 |
| | Concentration (ppm) | | | | |
| 50 | 53 | 79 | 106 | 132 | 159 |
| 100 | 26 | 40 | 53 | 66 | 79 |
| 150 | 18 | 26 | 35 | 44 | 53 |
| 200 | 13 | 20 | 26 | 33 | 40 |
| 250 | 11 | 16 | 21 | 26 | 32 |
| 300 | 9 | 13 | 18 | 22 | 26 |

* Accel is sold in 35.6-oz. bottles.

Table 26 – Chemical Thinning Suggestions Related to Stage of Development and Variety¹

| | | | | | | | | | | | |
|---|-------------------|--------------|---------------------------|-------------------|--------------|--------------------------|------------------|------|--------|----------|-------------|
| <p><i>Petal fall to 3 mm fruit diameter</i> Sevin, Sevin + 6 ppm NAA, or 6 ppm NAA A petal fall application of chemical thinner is a desirable way to initiate the thinning season for all cultivars. The choice of chemicals varies with the season and the desired level of aggressiveness. If proper conditions exist, a petal fall thinner may be all that is required.</p> | | | | | | | | | | | |
| <p><i>Fruit diameter 7 to 12 mm</i> Sevin Cortland</p> | | | | | | | | | | | |
| <p>Sevin plus 3–8 ppm NAA</p> <table border="0"> <tr> <td>Gala</td> <td>Jerseymac</td> <td>Northern Spy</td> </tr> <tr> <td>Ginger Gold ²</td> <td>McIntosh</td> <td>Rome</td> </tr> <tr> <td>Idared</td> <td>Mutsu</td> <td>Vista Bella</td> </tr> </table> | | | Gala | Jerseymac | Northern Spy | Ginger Gold ² | McIntosh | Rome | Idared | Mutsu | Vista Bella |
| Gala | Jerseymac | Northern Spy | | | | | | | | | |
| Ginger Gold ² | McIntosh | Rome | | | | | | | | | |
| Idared | Mutsu | Vista Bella | | | | | | | | | |
| <p>Sevin plus 8–10 ppm NAA</p> <table border="0"> <tr> <td>Braeburn ²</td> <td>Jonamac</td> <td>Wealthy</td> </tr> <tr> <td>Delicious (no Promalin)</td> <td>Macoun</td> <td></td> </tr> <tr> <td>Empire</td> <td>Paulared</td> <td></td> </tr> </table> | | | Braeburn ² | Jonamac | Wealthy | Delicious (no Promalin) | Macoun | | Empire | Paulared | |
| Braeburn ² | Jonamac | Wealthy | | | | | | | | | |
| Delicious (no Promalin) | Macoun | | | | | | | | | | |
| Empire | Paulared | | | | | | | | | | |
| <p>Sevin plus 10–15 ppm NAA</p> <table border="0"> <tr> <td>Baldwin</td> <td>Fuji ²</td> <td>Quinte</td> </tr> <tr> <td>Early McIntosh</td> <td>Golden Delicious</td> <td></td> </tr> </table> | | | Baldwin | Fuji ² | Quinte | Early McIntosh | Golden Delicious | | | | |
| Baldwin | Fuji ² | Quinte | | | | | | | | | |
| Early McIntosh | Golden Delicious | | | | | | | | | | |
| <p>Sevin plus 50–75 ppm Accel</p> <table border="0"> <tr> <td>Empire</td> <td>McIntosh</td> <td></td> </tr> </table> | | | Empire | McIntosh | | | | | | | |
| Empire | McIntosh | | | | | | | | | | |
| <p>Sevin plus 75–100 ppm Accel</p> <table border="0"> <tr> <td>Delicious (with Promalin)</td> <td>Golden Delicious</td> <td>Spartan</td> </tr> <tr> <td>Fuji ²</td> <td>Macoun</td> <td></td> </tr> </table> | | | Delicious (with Promalin) | Golden Delicious | Spartan | Fuji ² | Macoun | | | | |
| Delicious (with Promalin) | Golden Delicious | Spartan | | | | | | | | | |
| Fuji ² | Macoun | | | | | | | | | | |
| <p><i>Fruit diameter 12 to 18 mm</i> Sevin If adequate thinning has not occurred by the time that fruit reach 15 mm in diameter, the only safe option available that may provide some degree of thinning is Sevin.</p> | | | | | | | | | | | |

1. In all cases, Sevin is recommended to be applied at 1 quart Sevin XLR per 100 gallons dilute application. NAA and Accel recommendations are in parts per million (ppm). Product labels describe procedures for achieving desired ppm dosage. Also see Tables 23, 24, and 25.

2. Little experience exists with these newer varieties; therefore, recommendations are a rough estimate and likely will change in the future.