

Modifying Tree Growth and Increasing Return Bloom in Orchards

Plant growth regulators are useful tools for increasing branching, suppressing shoot growth (for example to manage fire blight), and increasing return bloom.



An effective chemical thinning program is essential to obtaining adequate return bloom. It is also important to use return bloom sprays on apple cultivars that tend to be biennial.

The process of actually modifying plant growth processes is very complicated, and considerable research is conducted to develop effective programs.

Increasing Branching

A growth regulator composed of cytokinin (BA), (MaxCel, Exilis plus or RiteWay) or BA and gibberellins (BA+GA) products, such as Promalin, Perlan or Typy, can be used to stimulate additional branches to grow on young trees. Foliar applications should be made when new shoot growth is approximately 1 to 3 inches long, approximately 2 to 4 weeks after bloom. Follow labeled directions for rates. Thoroughly soak the area of the tree where branching is desired. A buffering agent or nonionic wetting agent should be added to the tank before adding BA+GA. The final spray solution should have a pH no greater than 8.

Thoroughly wet the foliage and bark of trees to be treated. Five to 10 gallons of spray mixture applied with a pressurized hand sprayer will treat 200 to 300 nonbearing trees 1 to 4 years old.

Both the BA products alone and the BA+GA products may also be mixed with latex paint and applied directly to buds. Apply in the spring when terminal buds begin to swell, but before shoots emerge. **DO NOT** apply after buds break. Applications made after buds have broken may cause injury to tender shoot tips and fail to promote shoot growth from that point. The application rate is 5,000 to 7,500 ppm (0.2 to 0.33 pt/pt of latex paint). Add a buffering agent or a nonionic wetting agent to the latex paint at a rate of 0.5 to 1.0 percent (0.1 to 0.15 oz/pt of paint) before adding BA+GA. The wetting agent improves the dispersion of BA+GA in the latex paint; it also improves wetting and absorption through the waxy layer of the bark.

Uniformly apply the BA+GA-latex paint mixture with a brush or sponge and thoroughly cover the bark surface. **NOTE:** Apply only to 1-year-old wood. Notching the bark above the bud with a hacksaw blade prior to treatment will greatly increase efficacy of obtaining bud break on 1-year-old wood. To learn more about how this technique works, see these articles by [Jon Clements](#) from the University of Massachusetts and [Win Cowgill et al.](#) from Rutgers University.

Shoot Growth Suppression

Prohexadione calcium (Apogee, Kudos) is a PGR for vigor control in apples to reduce the length of shoots. Prohexadione calcium (PCa) is also labeled for the control or reduction of fire blight in apples. Shoot growth suppression by PCa is very consistent when the first application is properly timed and where a sufficient dosage is applied during the active growth season. PCa acts to retard shoot growth by blocking the production of gibberellic acid (GA). By decreasing the level of GA in the plant, PCa will inhibit the shoot's ability to elongate, thereby resulting in shorter shoots. Since there is some residual GA in the plant, it usually takes about 10 days for shoot extension growth to slow. One application of PCa will last for about 2 to 4 weeks, depending on tree vigor and dosage used. Repeated applications of PCa are required to maintain growth control when conditions are favorable for further growth. PCa sprays can be suspended when the season's shoot growth on untreated trees is completed.

It is critical that the first application be applied when the longest shoots on the trees are between 1 and 3 inches long. In most situations, this will be between late bloom and petal fall.



Careful monitoring is essential to proper timing of this application.

The interval between sprays can range from 1 to 4 weeks, depending on tree vigor and the dosage of PCa that had been previously applied. Subsequent applications should be made when the first few shoots show signs of regrowth. Failure to reapply PCa when conditions are still favorable for growth can result in loss of growth control.

The rate of PCa recommended for shoot growth control varies from 3 to 12 ounces per 100 gallons of dilute spray. The rate of PCa to be applied per acre should be calculated by determining the tree row volume of a block and multiplying the dilute rate by this figure.

$$\frac{\text{Ounces of PCa}}{100 \text{ gal of water}} \times \frac{\text{Tree Row Volume (in 100's of gallons)}}{\text{acre}} = \frac{\text{ounces}}{\text{acre}}$$

The total dosage and timing of sprays will depend on the inherent vigor in an orchard. The vigor in an orchard is dependent on many factors, including fruit load, rainfall, variety, rootstock, soil type, nutritional status, and pruning severity. Pruning is a major factor in increasing the vigor and shoot growth of trees. These factors should all be considered when selecting an application regime for a specific orchard block.

Apply PCa with sufficient water to obtain thorough coverage and use a nonionic surfactant. The sprayer must be able to deliver the spray to the parts of the tree that have excessive vigor. Conversely, if shoot growth suppression is desired in only a portion of the tree, it is possible to spray only that portion of the tree.

If calcium is present in the spray water, the water is said to be “hard” and it deactivates PCa. Therefore, when the source of spray water is hard, a proprietary water conditioner or high-grade, sprayable, ammonium sulfate should be used. The amount of conditioner to use depends on the degree of hardness. Test strips for water hardness can be obtained through swimming pool and spa suppliers.

Likewise, calcium fertilizer materials applied in the tank with PCa deactivate it. Therefore, it is recommended that a PCa application be delayed until ½ inch of rain has fallen after a spray of calcium has been applied. It is permissible to apply calcium sprays a few days after a PCa spray without a reduction in effectiveness.

PCa is labeled to decrease June drop in apples when applied at between 10 and 12 ounces per 100 gallons. This would be 30 to 36 ounces per acre for an orchard with a tree row volume of 300 gallons. However, at lower rates typically used for shoot growth control, PCa also may increase the set of apples. Avoid the use of excessive rates of PCa during the thinning window to minimize this effect. When PCa is used for shoot growth control, the aggressiveness of the thinning program may need to be increased. This may include increasing the strength of the thinner or making an additional application of thinner, depending on the circumstances.

Increasing Return Bloom

An effective chemical thinning program is essential to obtaining adequate return bloom; however, in some years it is desirable to enhance return bloom on apple cultivars that tend to be biennial. This is especially important on trees that have a full crop load. Treatments of summer NAA applied starting 6 to 8 weeks after bloom will increase return bloom even on cultivars that tend to be biennial bearers. This timing is after any potential thinning from NAA has passed. Fruits that are 1 inch in diameter won't respond to NAA thinning action. Flower bud initiation has already begun but can be enhanced by NAA treatments during the next 30 days after the thinning period ends. The rate of NAA applied per acre should be adjusted to tree row volume levels. The applications can be concentrated. These sprays can be added right to the cover sprays during that time period. Some years these treatments do not perform well, especially during drought years. Cultivars that have a moderate to high biennial bearing tendency should be considered for bloom-enhancement sprays. Fruitone L PoMaxa or Refine 3.5WSG should be applied at 5 ppm concentration of NAA. Multiple applications (3 to 4) of a low rate work better than a stronger concentration single application. Multiple applications should be spaced at 7 to 10 days apart.

Summer ethephon can also enhance return bloom by the application of 0.5–3.0 pints of material per acre at 2–4 weeks after bloom on young nonbearing apple trees or at 6 weeks after bloom on bearing trees. However, summer ethephon can in some years thin 1-inch-diameter fruit and may also advance maturity of early maturing varieties. Treatments during extremely hot temperatures (maximum temperatures above 85°F) should be avoided.

Record Keeping for the Application of Plant Growth Regulators

Evaluating your application of plant growth regulators to your orchards is an important but often overlooked aspect of record keeping. The response of most PGRs is highly influenced by the weather conditions before, during, and after they are applied to the trees. Therefore, it is important that you have good weather records so you can learn how weather influences your use of PGRs in your orchard.

Please refer to the [Penn State Extension Tree Fruit Production Guide](#) for recommendations on plant growth regulator use.

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