

# Apogee: A New Plant Growth Regulator for Apples.

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**A**pogee, a new plant growth regulator for use on apples, received a label from EPA in 2000 and registration was received in New York in time for use in 2001. Apogee was registered by EPA as a “reduced risk” chemical because it presents negligible risks to human health or the environment. The preharvest interval (PHI) for Apogee is 45 days and the restricted entry interval (REI) is 12 hours. The active ingredient, prohexadione-calcium, has low mammalian toxicity and is not mutagenic, carcinogenic, or teratogenic. It is practically non-toxic to birds and aquatic life and will not harm honeybees. Prohexadione-calcium degrades rapidly in the environment and is rapidly metabolized by the tree, leaving no lasting or adverse effects.

The objective of this article is to report on the results of recent trials with Apogee in New York and to give growers some preliminary suggestions for getting good results.

## What It Does

Apogee reduces vegetative growth by blocking the synthesis of gibberellins; naturally occurring plant growth substances that promote cell elongation. The active ingredient in Apogee is prohexadione-calcium, a molecule that is similar in structure to a chemical substrate in the synthesis of gibberellins. When prohexadione-calcium is applied, the production of growth-promoting gibberellins is blocked and forms of gibberellins with no growth promoting activity accumulate. Apple trees that are treated with Apogee

produce shorter shoots with shortened internodes and dark green leaves. This reduction in growth provides a number of horticultural and pest management benefits (Table 1).

Apple trees that are treated with Apogee produce shorter shoots with shortened internodes and dark green leaves. Treating apple trees produces a number of horticultural and pest management benefits including better light penetration into the canopy, reduced tree row volume, better spray penetration, reduced fire blight susceptibility and less dormant and summer pruning.

TABLE 1

Potential benefits from growth reduction as a result of Apogee applications.	
Horticultural Benefits:	Pest Management Benefits:
Better light penetration in the canopy	Reduced tree row volume
More light = increased red fruit color	Better spray penetration
Less summer pruning	Better air circulation
Less dormant pruning	Reduced fire blight susceptibility

The results of several trials across New York suggest that Apogee will reduce shoot growth by about 40 percent (Table 2). This level of growth control can result in some very significant benefits. A study in Geneva in 1997 showed that a single spray of 250 ppm (12 oz / 100 gal.) Apogee, or a double application of 125 ppm (6 oz / 100 gal.) to 20-year-old McIntosh / M. 9 trees increased red fruit color by 53 and 32 percent, respectively. In 1999,

2 Apogee sprays of 125 ppm reduced dormant pruning time of 10-year-old Northern Spy trees in Granville, NY by 42 percent.

We have also shown in field trials that Apogee limits fire blight development in apple shoots if applied at the same time or shortly after blight infections occur. Apogee has no pesticidal activity on the fire blight bacteria itself. It affects the development of the disease by causing a cessation of shoot growth, which in turn makes the shoots less susceptible to fire blight development. Disease severity of Apogee treated Gingergold trees that were inoculated with fire blight bacteria was dramatically reduced compared to untreated trees (Fig. 1).

Apogee did not reduce fire blight severity when applied to young Gala / M.9 trees after fire blight infections were already visible. Tree mortality was the

Effect on Fire Blight, NY		
TREATMENT	BLIGHTED SHOOT LENGTH (%)	% CONTROL
Control	87a	--
Apogee 250 ppm X 2	45b	49

Figure 1. Disease severity of Apogee treated Gingergold trees that were inoculated with fire blight bacteria was dramatically reduced compared to untreated trees.

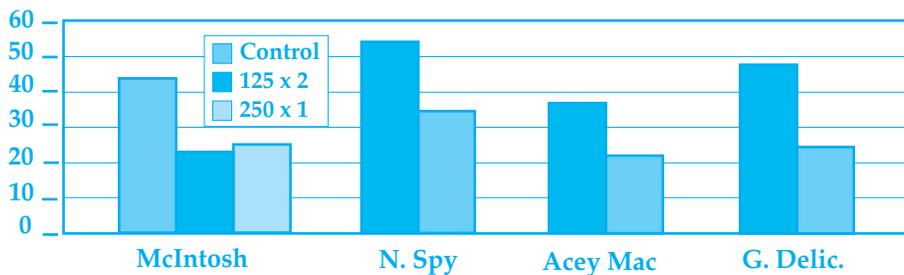


TABLE 2. The effect of one or two Apogee applications on shoot growth of 4 apple varieties.

same in treated and untreated rows. Since Apogee affects the fire blight bacteria indirectly, it does not immediately make a treated tree resistant to infection.

### How to Use It

In order to get the maximum benefit in growth reduction, it is important to make the first application when shoots are 1-3 inches long. This means Apogee must be applied at petal fall or soon thereafter to have a large effect on shoot growth. Later applications provide some benefit, but the level of control is reduced because a considerable amount of growth can take place before the Apogee takes effect.

This timing is also best with regard to fire blight protection. Apogee will not protect against blossom blight infection, and the onset of resistance against shoot infections develops within 10 to 14 days after treatment. Thus, apple trees have to be treated in a protective manner before shoot blight symptoms develop. After resistance is acquired it should last from 4-6 weeks. To maintain fire blight protection, a second spray is required if shoots begin to grow again.

Apogee begins to affect shoot growth about 10-14 days after application, and the duration of the effect depends on dose. A low dose controls growth for only about 3-4 weeks. It is likely that 2 applications of 6 to 12 ounces of Apogee per 100 gallons of water will be needed to achieve season-long growth control in most New York orchards. Three applications may be required for vigorous cultivars growing on vigorous soils.

One strategy is to apply the second spray by the calendar, 2 weeks after the first. Another strategy would be to monitor shoot growth after the first spray and apply the second spray as soon as the shoot terminals resume growth. This second strategy may extend the time interval between Apogee sprays, and in some cases, eliminate the need for a third spray. This strategy will require careful monitor-

ing to ensure that the resumed growth doesn't go on so long as to diminish the benefits. Also, once growth resumes, it may require a higher concentration of Apogee to arrest it than is needed to maintain growth control in shoots that are not growing.

The effectiveness of Apogee isn't greatly affected by how many gallons of water are used in the spray, so long as it is applied with enough water to obtain good coverage. A surfactant is recommended, but which one is used doesn't matter. A number of non-ionic and organosilicone surfactants have been used in research trials with good success.

If spray water comes from a source with high concentrations of dissolved calcium carbonates (hard water), a water conditioner is recommended. If you are uncertain, have your water tested for hardness. Water conditioners will provide some benefit when the hardness exceeds 200 ppm. Spray grade ammonium sulfate (AMS) has proven to be effective for this purpose. Use an equal weight of ammonium sulfate to the weight of Apogee used as a starting point. Retest for hardness to be sure that you have lowered it below the 200 ppm threshold. Commercially available water conditioning products may be more convenient to use and may provide additional benefits over ammonium sulfate. A cost/benefit comparison should be done to decide which conditioner is best in your situation.

Do not apply Apogee with calcium sprays, as calcium reduces the uptake and effectiveness of Apogee. Apogee has worked well when tank-mixed with most commonly used fungicides and insecticides. How Apogee-treated trees will react to sprays of plant growth regulators that contain gibberellins, such as ProVide, Promalin, Accel, and similar generic products, is not known and under study. The label will contain a precaution stating that use of GA materials on Apogee-treated trees may reduce the efficacy of the Apogee and/or the GA product. For



Figure 2. Fruit cracking and checking caused by lenticel spotting and subsequent fruit growth after Apogee applications during dry seasons.

this reason, it may be best to avoid using GA products on Apogee treated trees, until more is known.

Apple trees treated with Apogee often set more fruit than untreated trees, so it will be important to adjust thinning strategies to remove more fruit. This may mean increasing the dosage of a chemical thinner or making multiple applications of chemical thinners to achieve desired crop load and fruit size.

Research on this side effect of Apogee is still in progress, but our initial estimate is that the strength of the thinner needs to be increased by 30-50 percent. For example, if you determine that untreated trees in a given block would require a thinning spray of 5 ppm NAA, then Apogee treated trees in that block may require 7.5 ppm NAA or 5 ppm NAA plus Sevin to get the same degree of thinning. Apogee has no direct effect upon return bloom, but excessive fruit set could reduce return bloom.

Apogee has apparently caused lenticel spots on Empire apples in several trials in the Northeast. The lenticel spots often result in fruit cracking as the fruits continue to grow (Fig. 2). The damage has been observed in New York in wet, cloudy years (1998 and 2000), but not in a dry, sunny year (1999). Because of this fruit finish problem, the Apogee label contains a cautionary statement about its use on Empire. Other than this concern about fruit finish of Empire, Apogee has no direct effects on fruit quality. Increased red color from improved light penetration, and the possibility of smaller fruit if the increase in fruit set is not corrected by thinning, are the important indirect effects.

### Summary

Apogee is a new growth regulator for apples that can reduce shoot growth by

about 40 percent resulting in increased light and spray penetration that improves fruit color and quality with less pruning. For maximum growth control, make the first application as soon as shoot growth begins and apply a second spray 2 to 3 weeks after the first. Apogee should be applied with sufficient water to ensure thorough coverage. Use a surfactant and a water conditioner such as ammonium sulfate if the spray water source has high amounts of dissolved calcium carbonate, (i.e. "hard water"). Never tank-mix Apogee with sprays containing calcium. Use of Apogee often increases fruit set, which

may require the grower to thin Apogee treated trees more aggressively.

Apogee applied at bloom can reduce susceptibility of trees to the shoot blight phase of fire blight. Where Apogee is used to control fire blight during summer, inoculum levels in orchards may be lower the following year, thereby resulting in reduced selection pressure to development of resistance to streptomycin. Fire blight suppression is a result of growth control, so Apogee must be applied well in advance of the appearance of fire blight symptoms to be effective for fire blight suppression.

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