

# Apple Preharvest-Drop-Control Sprays

**As apples mature they begin to produce large amounts of the ripening hormone, ethylene. One of the ripening processes stimulated by ethylene is stem loosening.**



Enzymatic cell wall breakdown is an irreversible process. Once the fruit stems loosen, there is no way to strengthen them up! Stop drops are plant growth regulators that interfere with the enzymatic breakdown of the cell walls in the abscission zone.

Ethylene stimulates the production of enzymes that break down the cell walls in the abscission zone of the stem, leaving the fruit connected to the tree by only the vascular strands, which are easily broken. Once this natural process is complete, susceptible varieties begin to drop. It should also be noted that enzymatic cell wall breakdown is an irreversible process. Once the fruit stems loosen, there is no way to strengthen them up!

Stop drops are plant growth regulators that interfere with the enzymatic breakdown of the cell walls in the abscission zone. Three plant growth regulators are currently registered for control of preharvest drop in apples. Harvista, naphthalenetic acid (NAA) and aminoethoxyvinylglycine (AVG) are all effective, but they are very different compounds with respect to the modes of action, optimal timing, and effect on the fruit. This article offers a brush up on stop drops—how the two work and how to optimize control of preharvest drop with each of them.

## Harvista

Harvista is a 1-mcp product designed for preharvest application to apples. 1-mcp blocks the ripening effects of ethylene by binding up the ethylene receptors on the plant cell membranes, making them unresponsive to ethylene action. Treatment with Harvista slows starch disappearance, fruit softening, red color development, and preharvest drop, and can delay the onset of watercore. Because Harvista can be applied close to anticipated harvest date (to within 3 days prior to harvest), the desired characteristics of fruit maturity can develop normally, and treatment can be applied just before deleterious effects begin. Do not use Harvista on stressed trees. The effects of using Harvista with other stop drops has not been fully evaluated. Harvista is applied by a proprietary in-line injector system. Contact AgroFresh for additional information.

## ReTain

The active ingredient in ReTain is aminoethoxyvinylglycine (AVG), a “look-alike” for one of the chemical precursors to ethylene. When absorbed into plant tissues, AVG binds irreversibly with a key enzyme. This prevents the ethylene precursor from binding, thus blocking the production of ethylene. Natural ripening processes are slowed, including stem loosening, fruit flesh softening, starch disappearance, and red color formation. ReTain is labeled for apples, pears, nectarines, peaches, plums, prunes, and apricots.

There are several potential harvest management benefits to slowing the fruit maturation process. Growers can spread the effective harvest window for a given variety, retaining fruit firmness and without excessive drop. Apples on unstressed healthy trees will continue to grow at the normal rate following ReTain treatment (about 1 mm per day). An additional week on the tree can add a quarter inch to fruit diameter. Fruit red color can be increased in cases where a delay in harvesting exposes the fruit to improved weather for coloring (warm sunny days and cool nights). The incidences of fruit disorders associated with ripening, such as water core and stem end cracking, can be reduced.

In order for AVG to be effective it must be applied well in advance of the climacteric rise in ethylene production that signals the onset of fruit maturity. The label recommends



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applying ReTain 4 weeks before anticipated harvest for cultivars that are normally harvested in a single picking. This has sometimes caused confusion, as the grower is timing the spray relative to some future date. ReTain should be applied 4 weeks before the natural climacteric rise in fruit ethylene. There is a fairly wide window when ReTain can be applied with optimal results, and a fairly easy way to determine when to apply it.

For early season varieties, such as McIntosh, start by estimating when you would normally expect to begin harvesting the variety if no ReTain or ethephon were used. Take the earliness of the season into consideration. For instance, if the bloom date and the ripening pattern of cherries, peaches, and summer apple varieties suggest that the season is about 10 days earlier than normal, the anticipated harvest date can be adjusted accordingly. Then count back 4 weeks and mark the calendar from that date through the next 7 days. This is your application window for that early season variety. Watch for good spray conditions and a 6-hour drying time within that week and apply the material at the first opportunity. Repeat the same process for later varieties, keeping in mind that later varieties are usually less affected by seasonal variation in maturity than stone fruit or early apple varieties. It is usually unnecessary to account for seasonal variation in fruit maturity for Empire and later varieties.

There is an alternative application timing for cultivars that have multiple harvest days, such as Gala or Honeycrisp. Apply ReTain 7 to 14 days before the anticipated beginning of harvest (first pick). Application at this time usually does not delay the first harvest but will help control maturity for later harvests.

Varieties differ in the production of ethylene and consequently differ in their response to ReTain. Low ethylene producers such as Gala are strongly influenced, while ethylene production is much harder to control for high ethylene varieties such as McIntosh. Fruit maturity of Gala on dwarfing rootstocks can be slowed with 6.0 to 7.5 oz (one-half to two-thirds of the pouch ) of ReTain if timing and application recommendations are followed closely. Most varieties, however, require a full pouch of ReTain per acre in order to obtain satisfactory results. In 2015 the ReTain label was expanded to allow use of up to two pouches per acre either as a single spray or as a split application for apple. ReTain use on pear is limited to a single pouch per spray, with up to two sprays allowed per season.

Growers who are planning to use ethephon (Ethrel, Ethephon II, Motivate) to promote red fruit color should apply the full rate of ReTain at least 10 days before spraying ethephon. Research suggests ReTain used at an optimal timing can offset the deleterious effects of ethephon on fruit maturity and fruit softening.

Use a 100 percent organosilicone surfactant, such as Silwet L-77 or Sylgard 309 at 12 oz per 100 gallons. For optimum results, apply ReTain with 100 gallons of water per acre as a complete spray. Do not tank mix ReTain with sunburn reducing products.

Trees under stress (mites, drought, etc.) are less responsive to ReTain and are poor candidates for its use.

Ideally, no rain should fall for at least 6 hours after ReTain is applied; however if the coverage was good, the ReTain spray was applied with a full rate of Silwet, and the residue dried before it rained, you probably got most of the benefit of the spray. Monitor drop and fruit maturity to determine if a second application is warranted.

Application of ReTain under slow drying conditions is beneficial; however, spraying ReTain on wet foliage can result in a loss of performance due to the material dripping off before it can be absorbed. Postpone sprays until the foliage dries. If you must apply ReTain to damp foliage, reduce the rate of Silwet to 6 fluid oz to reduce the sheeting action and possible runoff.

## NAA

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Synthetic auxins interfere directly with the enzymes that create the abscission zone. Today, the one auxin that is registered for this use is NAA (Fruitone L, PoMaxa, Refine).

Unlike ReTain, fruit maturity of apples treated with NAA is not delayed; in some cases, it may be accelerated. Since the optimal application time for NAA is just before the onset of drop, NAA offers a “rescue” treatment, should the threat of preharvest drop be increased due to unforeseen circumstances.

A single spray of NAA can provide about 7 days of drop control. Since it is less expensive than ReTain, it may be more cost effective to use NAA when only a few days of drop control are needed to conduct an orderly harvest. For example, when using ethephon to promote fruit coloring, growers may also use NAA to prevent excessive fruit drop resulting from accelerated fruit maturation. When NAA is used to control drop on ethephon-treated trees, the two may be tank-mixed if the fruit are to be harvested within 7 days. If the fruit are to be left on the tree longer than 7 days after the ethephon, then NAA should be applied 2 to 3 days after the ethephon.

Timing an NAA stop-drop spray requires monitoring of fruit maturity. The label says to apply NAA 7 to 14 days before harvest. A single spray of 10 to 20 ppm NAA can control drop for 7 to 10 days from the date of application, but it takes 2 or 3 days to “kick in.” If NAA is applied too early, then effective drop control may wear off too soon. If NAA is applied a few days too late, a significant portion of the crop may drop before it takes effect. Predictive degree-day models and the pattern of starch disappearance, as gauged by the starch index test, can provide a general indication of whether the potential for drop is earlier or later than normal, but more direct monitoring is desirable for the actual timing of the sprays.

Varieties that are susceptible to preharvest drop should be monitored to determine when fruit drop is beginning. Limb tapping is one method that can be used to determine the onset of drop as fruit near maturity. Bump several scaffold limbs or leaders of 3 or 4 inches in diameter throughout the block on a daily basis. Use the palm of your hand with a short firm

stroke, striking the limb at its mid-point. If zero to one apple per limb drops on average, it is too soon to apply NAA. If the average is about two, check again later the same day or the next morning. When several apples drop in response to limb bumping, it is time to harvest within 2 days or apply NAA.

A concentration of 10 ppm NAA is usually adequate for an effective stop drop. To obtain the maximum drop control, use a split application of 10 ppm in the first spray, followed by a second spray of 10 ppm five days after the first. Split applications can provide some drop control for 10 to 14 days from the date of the first application.

NAA must be applied with good coverage and plenty of water. Concentrating beyond 4X (less than 75 gallons of water per acre for 300 gallon TRV trees) may diminish the effectiveness. The use of alternate row spraying is discouraged. Use of a nonionic or organosilicone surfactant is recommended to enhance uptake.

Weather conditions following the application also impact efficacy. Rewetting within 1 to 2 days of the spray application and spraying under slow drying conditions (high humidity) will increase the uptake of NAA. Temperatures in the mid-70s produce a better response than cooler temperatures, while excessively hot weather immediately following an NAA spray will likely result in accelerated fruit ripening.

When used as a stop-drop, NAA may advance ripening, especially at concentrations over 10 ppm and when applied in hot weather (>85 degrees F). The primary impact of this advance in maturity is loss of firmness in storage.

The deleterious effects of NAA sprays on fruit maturity and fruit softening may be minimized in Delicious by making repeated applications of 5 ppm NAA at four weekly intervals prior to harvest. This “preloading” technique has been included as an application option on the Fruitone labels. NAA preloading for McIntosh and other early season, high-ethylene varieties is not recommended. Growers should use caution when trying preloading on high-ethylene-producing varieties until more is known about how different varieties will respond.

The use of NAA on trees previously treated with ReTain results in drop control that is superior to that obtained by using either product alone. Fruit treated in this manner, then left for an extended time on the tree, may have limited storage potential. Half rates of ReTain are not sufficient to prevent the advanced ripening sometimes caused by NAA. If the fruit is destined for storage, then a full rate of ReTain should be used when tank-mixing ReTain and NAA.

Please refer to product labels and the [Penn State Extension Tree Fruit Production Guide](#) for details on chemical use.

## 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.

## Contact Information

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