

# Can Carbaryl Enhance Ethephon's Value as a Late-season Thinner?

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Over the last several years, we have attempted to develop solid recommendations for the use of ethephon as a late-season or rescue thinner. In 2003 and 2004, we compared several concentrations of ethephon, all including 1 pound of carbaryl active ingredient per 100 gallons and applied when fruit were about one inch in diameter. In both years, 0 ppm ethephon plus carbaryl provided no thinning, but 200 to 300 ppm (2/3 to 1 pint/100 gallons) ethephon plus carbaryl thinned McIntosh fruit very nicely. In 2005, 2006, and 2007, we conducted similar experiments, eliminating carbaryl, since it had no obvious effect on thinning by itself. Thinning was inadequate to nonexistent in all three years. Although it took us a few years to question it, carbaryl may have enhanced ethephon's effects in 2003 and 2004.

To assess the potential benefits of the addition of carbaryl to ethephon for late-season thinning, we conducted a study in 2008, utilizing 40 15-year-old Gatzke McIntosh trees on M.26 rootstock. Trees were allocated among 10 replications of four trees each, based on initial fruit set. Within each rep, one tree was not treated, a second was treated with carbaryl (1.25 pounds of Sevin® 80S/100 gallons — 1 pound a.i./100 gallons), a third was treated with ethephon (as 1 pint of Ethephon 2/100 gallons — 300 ppm a.i.), and the fourth tree was treated with a tank mix of carbaryl and ethephon at the same rates as when used alone. All treatments included Regulaid® as a surfactant (at 12.8 ounces/100 gallons — 0.1%) and were applied on June 10, 2008 when fruit were 21.8 mm average diameter.

Well after June drop, final fruit set was counted. When mature, a 20-apple sample was collected randomly from each tree and weighed to determine average fruit size. The internal ethylene concentration of 10 of the 20 fruit sampled was measured by extracting a gas sample from the core of each fruit and injecting it into a gas chromatograph equipped with an 18-inch activated alumina column and a flame ionization detector. After ethylene measurement, flesh firmness was measured with two punctures per fruit, and the soluble solids concentration was assessed with a hand refractometer using the juice expressed in the firmness testing. Fruit were then cut equatorially and dipped in an iodine/potassium iodide solution for starch staining. The Cornell Starch Chart was used to rate the degree of staining on an index from 1 to 8, with 1 being complete staining and 8 being no staining.

In 2008, both ethephon and carbaryl alone provided some degree of thinning, each about 15%, and when applied together, the effect was additive (Table 1). Only the addition of carbaryl (with or without ethephon) positively affected fruit size (Table 1). Fruit ripening and quality were not affected by ethephon or by carbaryl (Table 1).

The 2008 results were better than those from the previous three years, but they were not what we expected. We expected that the combination of ethephon and carbaryl would provide the best thinning, but we did not expect that the two chemicals alone would give similar degrees of thinning and that the combination of the two would be a simple additive response. It

Table 1. Effects of carbaryl and ethephon applied alone or in combination on June 10 (fruit at 21.8 mm diameter) on fruit set, fruit size, and fruit maturity in 2008.<sup>z</sup>

Carbaryl (lbs.a.i./ 100 gallons)	Ethephon (ppm)	Initial set (no./ cm <sup>2</sup> LCSA)	Final set (no./ cm <sup>2</sup> LCSA)	Final set (%)	Fruit weight (g)	Internal ethylene conc. (ppm)	Climac- teric fruit (%) <sup>y</sup>	Flesh firmness (lbs.)	Soluble solids conc. (%)	Starch index value <sup>x</sup>
0	0	23.0	10.9	48	154	0.10	11	15.1	11.7	6.0
0	300	22.9	9.4	42	152	0.13	11	15.2	11.7	6.1
1	0	22.9	9.3	42	162	0.12	13	14.8	11.6	5.9
1	300	22.7	8.2	37	157	0.11	7	15.0	11.8	6.0
Carbaryl effect		ns	*	**	*	ns	ns	ns	ns	ns
Ethephon effect		ns	*	*	ns	ns	ns	ns	ns	ns
Interaction		ns	ns	ns	ns	ns	ns	ns	ns	ns

<sup>z</sup> Carbaryl was applied as Sevin® 80S at 1.25 pounds of formulated product per 100 gallons (1 lb. a.i./100 gallons), and ethephon was applied as Ethephon 2 at 1 pint of formulated product per 100 gallons (300 ppm). All treatments included 0.1% Regulaid® as a surfactant.

<sup>y</sup> Percent climacteric fruit refers to the proportion of the sample where the internal ethylene concentration was greater than 1 ppm, indicating that the fruit had begun to ripen.

<sup>x</sup> Starch index values were determined with the Cornell Starch Chart: 1=complete staining, 8=no staining.

\*\*,\* ,ns: Significantly different at odds of 99 to 1, 19 to 1, or nonsignificant, respectively.

is clear from this research that all applications of ethephon for late-season, rescue thinning should include carbaryl. We will continue to study ethephon plus

carbaryl for rescue thinning to better define the response and the conditions under which we can expect superior results.

