A MODEL FOR EARLY ASSESSMENT OF CHEMICAL THINNER RESPONSE ON APPLES

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Chemical thinning time is one of the most stressful periods during the year because of the importance of decisions involved in the process, and the uncertainties involved in the outcome. In recent years researchers and extension personnel have complicated the problem even more, because they have been recommending multiple thinner applications. This is a very good approach since it improves the probability of achieving a good thinner response. The question remains, however, how does a grower assess whether or not a thinner worked, and if it did work, how well did it work? Two years ago we presented preliminary data on assessment of initial set and thinner response. This communication provides an update of the chemical thinning information, and presents a model we have developed to predict thinner response early enough to make a follow up thinner application.

Once fruit reach the 6 to 7 mm stage of development they are entering the most vulnerable stage in their young lives, where they are competing with other fruit, rapidly growing shoots, and other sinks for metabolites and photosynthate. Weak fruit and fruit that are unable to compete with other stronger carbohydrate sinks will most likely abscise. This is one of the most common times to apply a chemical thinner. During this period of time growers face a dilemma. They must answer one or more questions. Did my chemical thinner work? Should I have applied a chemical thinner? Should I now apply a thinner (or another thinner)?

Assessing Thinner Response

The response to chemical thinner application can be assessed in two ways: either by counting persisting fruit, or by following individual fruit growth rates. Thinning experiments were done in 1998 and 1999 that illustrated the relative effectiveness of these two methods. Ten spurs on each of twelve McIntosh trees were selected and tagged. When fruit reached an average of 8 to 9 mm in size, all fruit on each spur were counted and individually identified by numbering them with a Magic Marker. NAA at 8 ppm was applied as a dilute handgun spray to six of the trees while the remaining trees were left unsprayed and served as the controls. At 2 to 3-day intervals from the time of application to the end of June drop, fruit were measured, using a digital caliper, and the number of persisting fruit on each spur was counted.

In 1998 fruit set on spurs treated with NAA was similar to that on unsprayed control trees until 14 days after application (Fig. 1). It was not until over 3 weeks after NAA application that it was possible to make a true assessment of final fruit set and thinner response. Likewise, differences in fruit set between NAA and control trees in 1999 did not manifest themselves until two weeks after application, and it required an additional week to get a clear picture of final set. If a grower was to wait 2 to 3 weeks to apply a followup thinner, fruit development would have proceeded too far so that they would not respond reliably to a thinner application.

Growth rates of fruit that persisted to harvest and those that abscised 2 to 3 weeks after NAA application are shown in Fig. 2. In 1998 growth rate of fruit treated with NAA and later abscised during June drop slowed noticeably 4 days after application, and the reduction in growth was statistically significant 7 days after application. In 1999, 5 days after application growth rate of abscising fruit treated with NAA was significantly less than fruit that would persist to harvest. These results are significant in that they confirm that measurable reductions in fruit growth precede abscission by nearly 2 weeks, and declining fruit growth rates provides a very good indicator of which fruit will abscise well in advance of when they actually do abscise. Fruit growth rate appears to be useful to assess thinner response while fruit are still vulnerable to chemical thinners.

A Model to Predict Fruit Set and Thinner Response

Growth of fruit that drop during the June drop period slows well in advance of abscission. Based upon observations of fruit growth in previous studies, we advanced the hypothesis that all fruit will drop if their growth rates slow to 50% or less of the growth rate of fruit that persist. We feel that there are two key elements in being able to predict thinning response. First, you must be able to identify fruit that will persist to harvest so that you can use these as a standard to determine a reduction in growth rate. Second, you must measure fruit individually, just as fruit are starting to respond to the thinner, which usually occurs between 3 and 7 days after application.

In 1999 we set up an experiment to test our hypothesis and to see if we could predict the thinning response to NAA within 7 days of application, thus allowing us time to make subsequent thinner applications, if necessary. Two limbs 4 to 6 inches in diameter were selected on six mature McIntosh/M.7 trees growing at the University of Massachusetts Horticultural Research Center in Belchertown. At the pink stage of flower development all blossom clusters were counted on the tagged limbs and the blossom cluster density was calculated by dividing the number of blossom clusters by the limb cross sectional area. Five well exposed spurs were selected and tagged on each of the identified limbs. When developing fruit averaged 8 to 9 mm in diameter, all fruit on each spur were individually identified using a Magic Marker and then measured using a digital caliper. NAA at 8 ppm was then applied on one of the two limbs on each tree. The remaining tagged limb was left unsprayed and served as a control which represents normal June drop. We have measured fruit at 2 to 3 day intervals starting on the day of application, but measurement at 2 or 3 days after application and again at 7 days may be all that is necessary. In order to identify fruit that will persist to harvest we selected the largest fruit on each spur on the untreated check limb, and from these we only used growth rates of the 15 fastest growing fruit. After June drop, the numbers of fruit persisting on tagged limbs were counted.

Seven days after NAA application, 84% of fruit on spurs treated with NAA had growth rates that were 50% or less of those for the 15 fastest growing fruit on spurs of control limbs (Table 1). Since 84% of the fruit are predicted to abscise, we can predict that final fruit set will be 16%. Similarly, 42% of the fruit on control spurs had growth rates 50% or less that of the fastest growing fruit, so we can predict that fruit set following June drop on these limbs will be 58%.

We determined actual fruit set on limbs where fruit were measured and predictions were made. Actual fruit set on limbs treated with NAA was 16% and 1.9 fruit per cm limb cross-sectional area (Table 2). Fruit per cm limb cross-sectional area was predicted to be 1.6 (16% of 10.1 blossom clusters per cm lim cross-section area) while the actual measure was extremely close at 1.9 . Fruit set on control limbs was predicted to be 58% and 4.8 fruit per cm limb cross-section area, while it actually turned out to be 61% set and 5.4 fruit per cm limb cross-sectional area.

We are extremely encouraged by the accuracy of this predictive system and the flexibility that it may allow us to predict thinning problems early enough to make additional thinning treatment(s). We hope to test this system more widely this coming season. This system can be used now, but the calculations will take considerable time, and some help may be needed in the setup. We hope to have a system in place in the Spring of 2001 on the UMass Agroecology Fruit Team web page (www.umass.edu/fruitadvisor/) to help with the prediction. Growers will be able to enter the fruit growth data, the spread sheet will do the calculations, and growers will come up with a fruit set prediction almost immediately.

Table 1. Predicted fruit set 4 to 7 days after thinner application based upon the percent of fruit with growth rates 50% or less that of the rate of fruit proposed to persist.

Treatment (Mg.L $^{-1}$)	Predicted fruit abscission (%)	Predicted fruit set (%)
Control	42	58
NAA 8	84	16

Table 2. Effects of NAA on fruit set and the prediction of final fruit set based on fruit growth rates taken from 4 to 7 days after NAA application.

Treatment	Bloom	Actual fruit set		Predicted fruit set	
(mg.L $^{-1}$)	BC/cm limb x-sect area	Fruit/cm limb x-sect area	Fruit set (%)	Fruit/cm limb x-sect area	Fruit set (%)
Control	8.3a*	5.4a	61a	4.8	58
NAA 8	10.1a	1.9b	16b	1.6	16

*Significant at P=0.05, Duncan’s multiple range test if numbers in a column are followed by different letters.

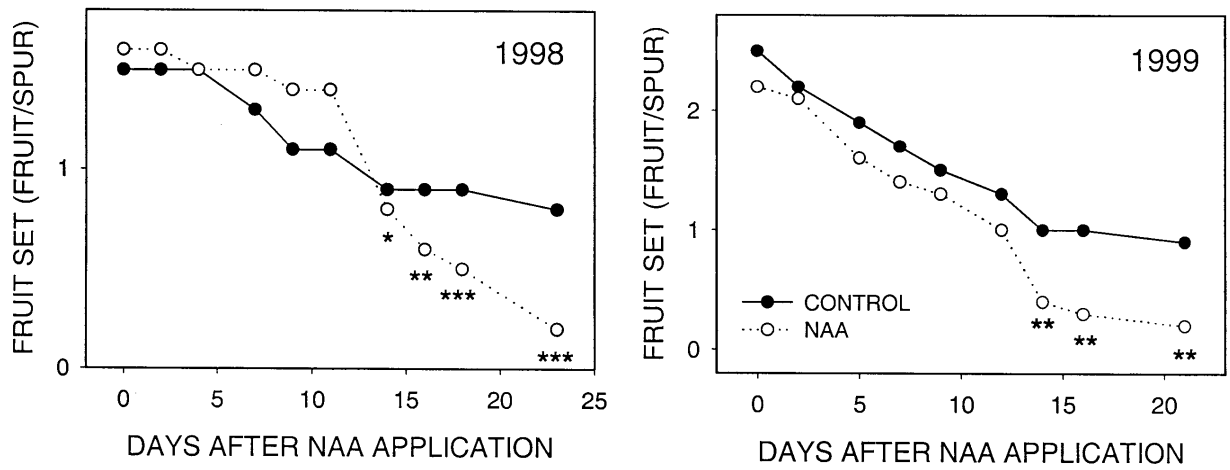

Figure 1. Kinetics of fruit set of McIntosh apples on untreated spurs and those that were treated with 8 ppm NAA when fruit size averaged 8 to 9 mm.

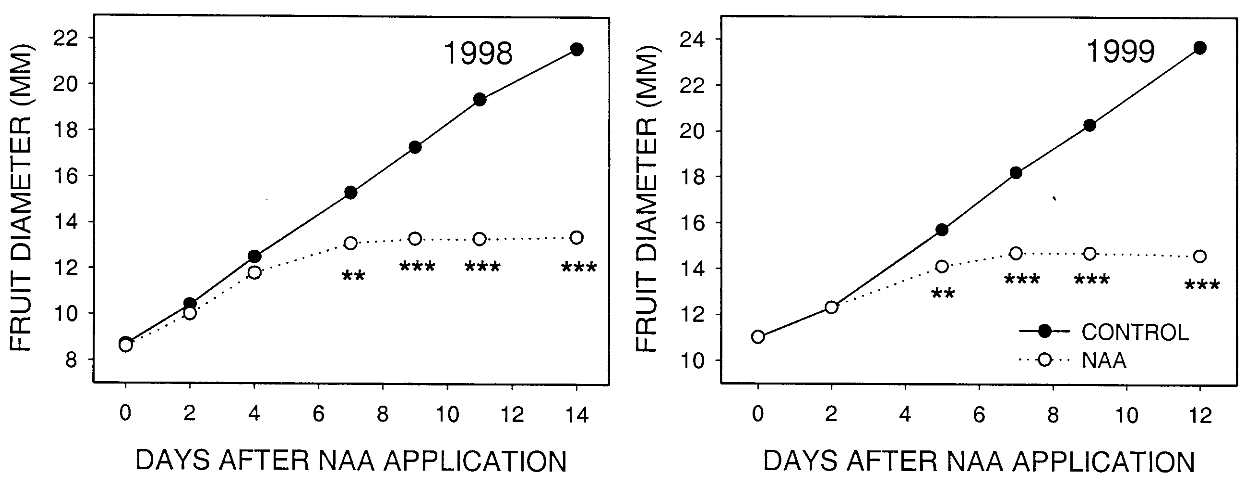

Figure 2. Fruit growth rates of McIntosh apples treated with 8 ppm NAA that abscised during June drop, and of control fruit that persisted to harvests.