

## FINAL PROJECT REPORT

**Project Title:** Validation of Honeycrisp and Granny Smith pollen tube growth models

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Tory Schmidt, Washington Tree Fruit Research Commission, Wenatchee, WA

**Other funding sources:** None

**Total Budget: Year 1: \$20,840**

**Other funding sources:** None

### WTFRC Collaborative expenses:

Item	2016
Salaries	4000
Benefits	1200
Wages	2000
Benefits	500
Shipping	100
Supplies	100
Travel	500
<b>Total</b>	<b>\$8,400</b>

### Budget:

**Organization Name:** Virginia Polytechnic Institute and State University (Va. Tech)  
**Contract Administrator:** Eric James Dinwiddie, Pre-Award Administrator  
**Telephone:** 540-231-9368 **Email address:** EricJD@VT.edu

Item	2016
Salaries*	8000
Benefits	4080
Supplies	360
<b>Total</b>	<b>\$12,440</b>

\*Note: Salary for Research Specialist Leon Combs.

## RECAP OF ORIGINAL OBJECTIVES

### Validation Testing of Honeycrisp and Granny Smith Pollen Tube Growth Models in Washington Orchards. (Virginia Tech & WTFRC)

Pollen tube growth model validation included criteria from three tests:

**Test 1:** Commercial use of the pollen tube growth models. In this test, grower-participants use the models made available to them through the AgWeatherNet website. These growers (beta-testers) trained in the use of the models then monitor the blocks start times and bloom thinning application timings. At the end of harvest, the beta-test participants rate their actual crop relative to their ideal expected yield. Comparing the desired yield with the actual harvested yield demonstrates that the beta-test participants understand the principles of the model and that it is working to their satisfaction. This harvest data will be cross-referenced with application timings as done with other models in previous years.

**Test 2:** Validation test 2 includes flower samples collected in Washington orchards after thinning chemicals were applied, by comparing model-predicted pollen tube growth versus actual growth in flowers. Sampling of flowers from beta-test blocks and evaluating them microscopically will determine if fertilization occurred on the segment of the flower population that was intended to be the harvested crop. Bloom thinning applications can then be re-applied to reduce unwanted additional cropping.

**Test 3:** We will request harvest data from selected Washington orchard blocks that were bloom thinned using the pollen tube growth models in the 2015 growing season. This data, if available for validating Honeycrisp and Granny Smith models, will come from selected beta-testers who had access to the beta tests models for the 2015 growing season.

Once 2015-16 research findings are complete, they will be combined with 2013-14 data and evaluated as a whole. Only after validation tests 1, 2, and 3 are completed will the Honeycrisp and Granny Smith models be endorsed for release to all growers beginning in 2017.

**Table 1.** Chronology of beta-testing and release of the pollen tube growth models.

<b>Pollen Model</b>	Began field beta-testing using Excel spreadsheet models (Year)	Began field beta-testing using AgWeatherNet website models (Year)	Released for public use (Year)
Gala	2007	2012	2014
Golden Delicious	2007	2012	2014
Fuji	2009	2012	2014
Pink Lady	2011	2012	2014
<b>Honeycrisp</b>	<b>2013</b>	<b>2013</b>	<b>2017 (projected)</b>
<b>Granny Smith</b>	<b>2014</b>	<b>2014</b>	<b>2017 (projected)</b>

## SIGNIFICANT FINDINGS

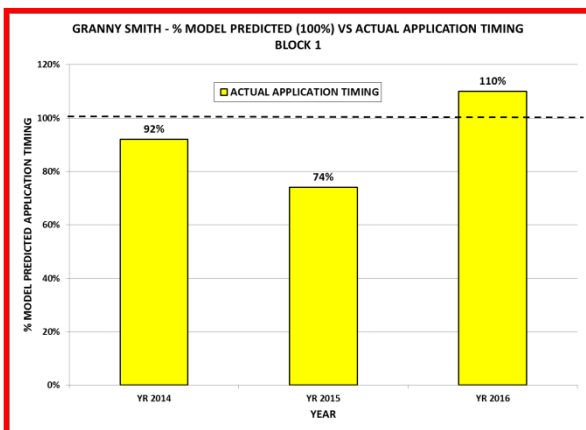
- Developed cultivar-specific equations for Honeycrisp and Granny Smith pollen tube growth and interfaced these models with real-time and forecasted weather data on the AgWeatherNet website.
- Created web-based interface to make these models user friendly and the output results easy to understand.

- The AgWeatherNet interface allows for site and cultivar specific information to be generated.
- By using forecast data through the AgWeatherNet site, pollen tube growth is projected 48 hours into the future, which allows growers to more easily schedule bloom thinning sprays in advance.
- Microscopic evaluation of the model in the laboratory included sampling flowers from the field to determine the percent of flowers that had been fertilized helps to verify predicted fertilization by the models.
- Comparing average style length determined in the field and in the laboratory is an integral part of evaluating and refining the models to actual field conditions. These comparisons confirm that grower averages of style lengths measured in the field were comparable to those of samples in the microscopic evaluation.
- Results to date have shown that, overall, the pollen tube growth models are helping growers achieve their targeted crop load by better timing of applications of bloom thinning sprays.
- Beta-testers using the models say biennial bearing can be reduced when model applications are properly applied.

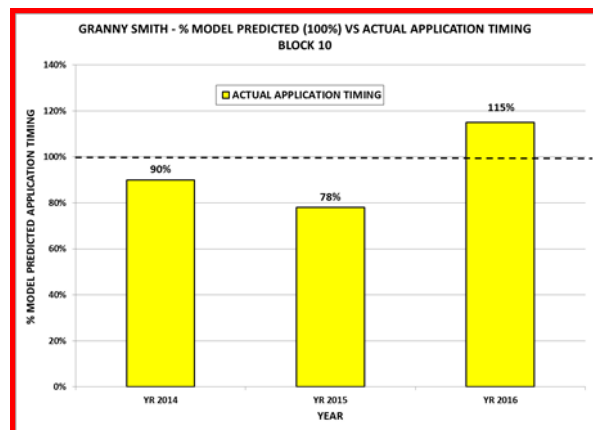
## RESULTS AND DISCUSSION

In developing new models, there will always be issues with how best to adapt new models to circumstances that arise on any given day at any specific site. If all things were equal and there were no variables to consider, then all application timings would be at 100% of model predicted fertilization of desired crop-load, resulting in a perfect crop load. As shown below in Graphics 1-8 applications go on at various stages and timings are generally due to factors that the grower/ orchard manager or someone else in charge at that specific site deems relevant to change or adjust spray timings which is exactly the way it should be. The application timing in the same blocks over a 3-year period can vary greatly as shown in these graphics.

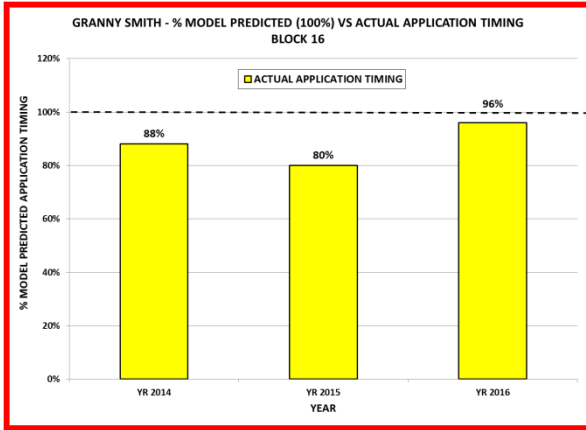
The models are tools to help reduce crop load at bloom, but are not the only tool that will be needed to help with crop load management. Judgment and working knowledge of the orchard blocks will help maximize the effects of the pollen models you are using to bloom-thin your crop.



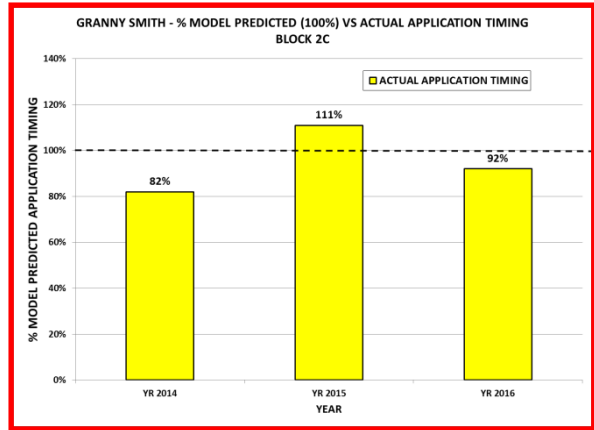
Graph 1



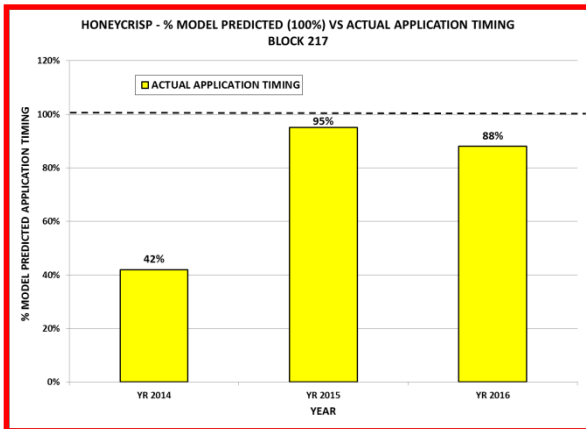
Graph 2



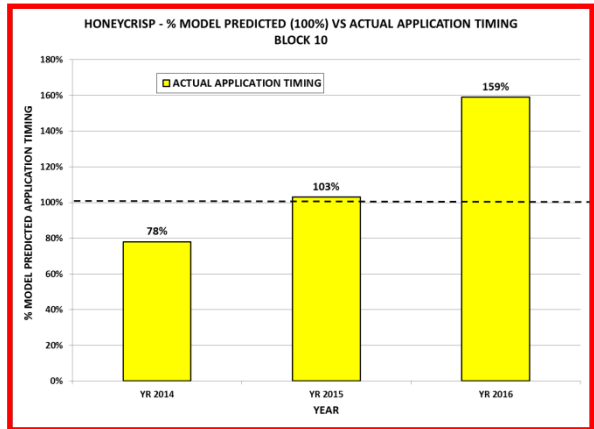
**Graph 3**



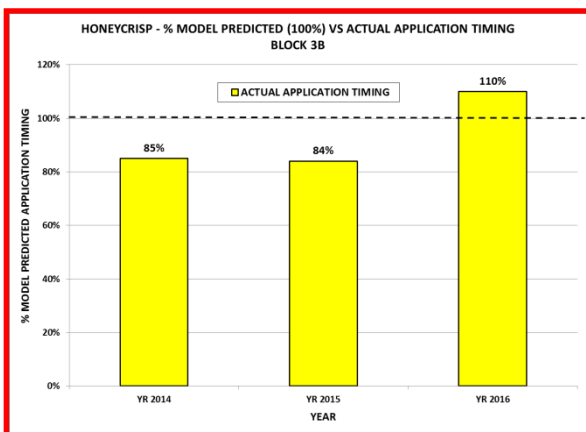
**Graph 4**



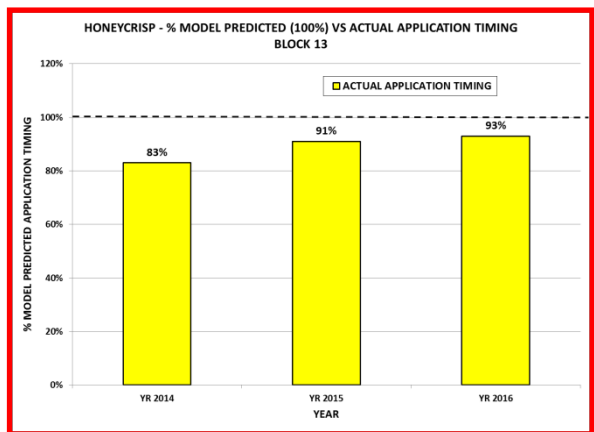
**Graph 5**



**Graph 6**



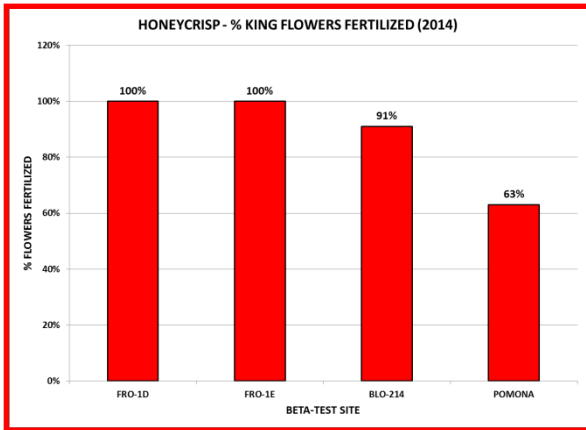
**Graph 7**



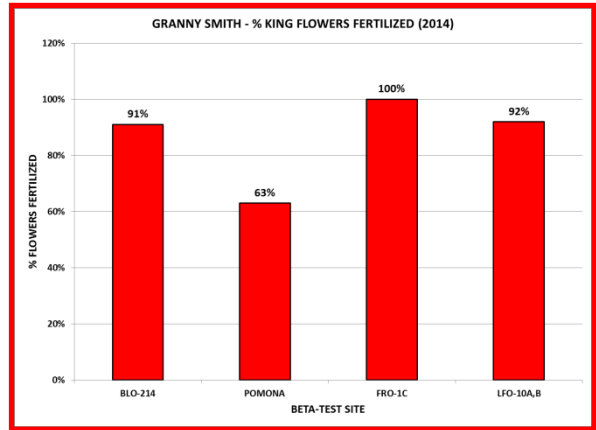
**Graph 8**

By microscopic examination of flowers sampled at beta-test sites for fertilization, we can best track how well the models are predicting fertilization. Flower samples taken from test sites are sent

for evaluation of percent of flowers fertilized as predicted by models. Graphs 9 and 10 show results of tests from flowers evaluated at 8 different orchard sites in the Washington apple growing regions in 2014.

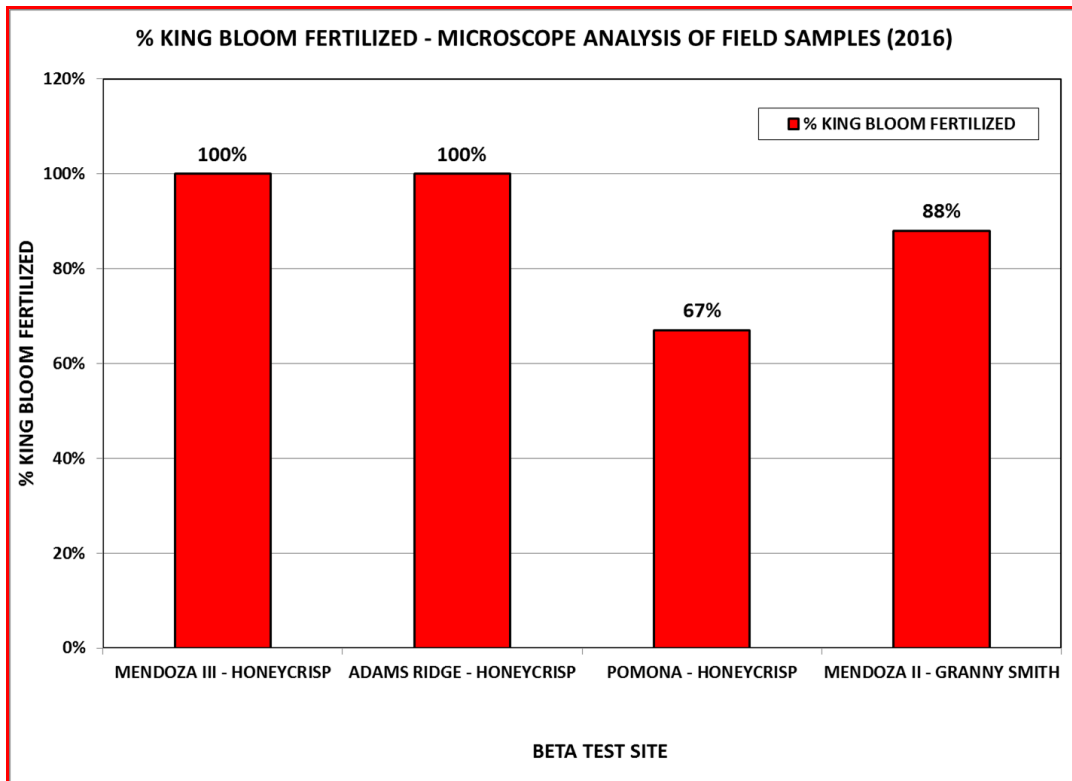


**Graph 9**

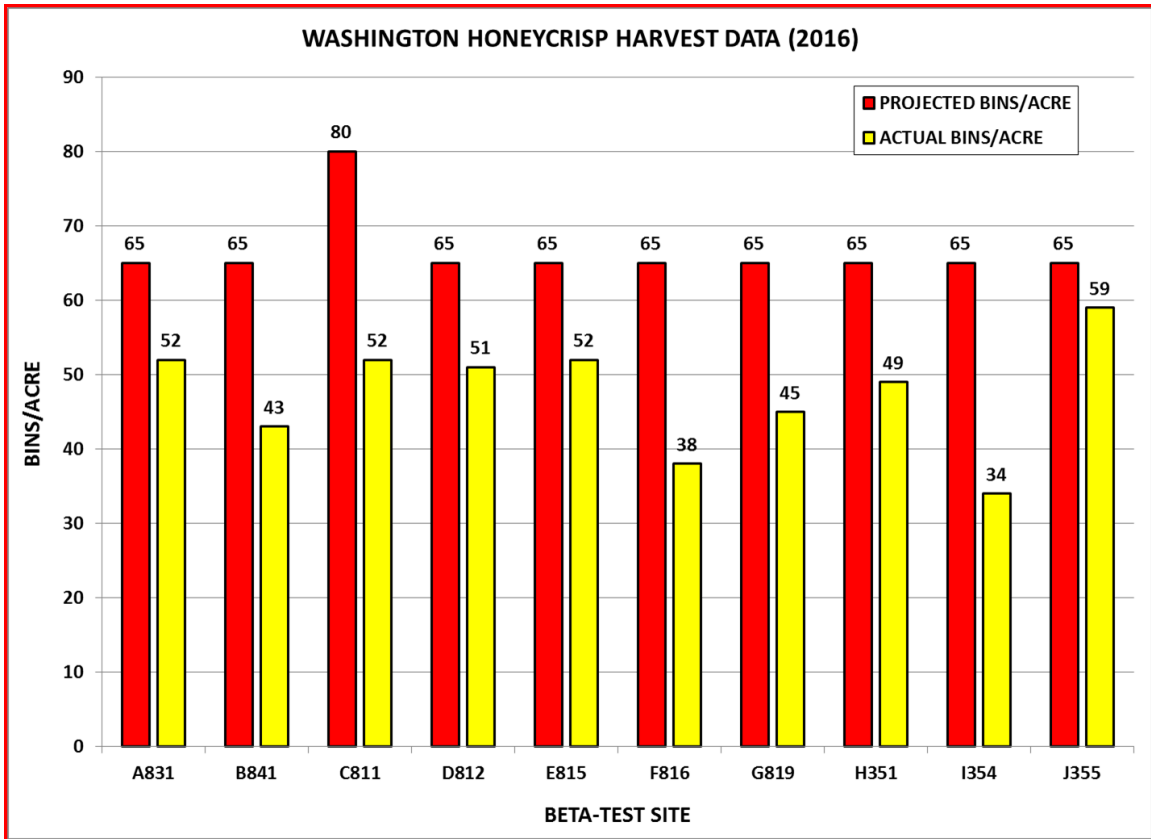


**Graph 10**

Graph 11 shows results of flower fertilization testing carried out in 2016. Graph 12 shows Honeycrisp crop load data (Projected Bins/Acre vs Actual Bins/Acre) at harvest. Table 1 shows 2016 crop load data from various beta-test sites across the Washington growing region for Honeycrisp and Granny Smith.



**Graph 11**



**Graph 12**

Farm	Block	Variety	Desired Bins/Acre	Actual Bins/Acre	% Desired Yield
Frog	4, 7, 8	Honeycrisp	73	60	82%
Fox	1, 2	Honeycrisp	78	58	74%
Squirrel	12, 13, 15	Honeycrisp	75	53	73%
Squirrel	1, 5, 9	Granny	77	71	92%
Hound	11, 12, 13, 14	Granny	45	51	113%

**Table 1**

## **EXECUTIVE SUMMARY**

In summary, we tend to agree with our colleague Tory Schmidt in a statement he made recently regarding the models, “it seems clear that the model has some fans, some skeptics, and just about everything in between”. For some it is seen as a useful tool to help them better control their crop load. For others, it seems unreliable because predicted timing vs what growers are seeing in the field that do not match. What the models can do exactly versus what users expect them to do may be where the problem lies. In working with beta-testers for many years we have come to respect their opinions and recommendations for how they use the model and what they expect it to do.

The following are the opinions and insights of one of the beta-testers in regards to what he expects the models to do for him and how he adapts them to his own situations.

### **Darin Case - Dovex Fruit Company:**

“In my opinion the Pollen Tube models are an exceptional tool for the apple industry and for us as growers here in Washington State. The trend in our industry has been that we have fewer and fewer materials that work effectively, or if a material works, MRL’s or restrictions have an impact on markets, so this model helps us better use chemicals as well as timings related to blossom thinning. As I have always said, if we have models to help guide us to make better decisions, we will be better at what we do and have a better handle on bi-annual bearing habits.

#### In regards to the Honeycrisp and Granny Smith models;

1. Honeycrisp – Can be a difficult variety to thin and have return bloom. Use the model as a guide, but be aware of the amount and type of cross pollinizers you have. If you have heavy cross pollination, go on the early side, if you are weak on cross pollination, go on the later side. I did use on some blocks, the 2016 model, especially on younger blocks with low cross pollination and the model worked very well. One also has to take into account if they are blossom thinning by hand as well, and what they really want out of their bloom thinning programs.

2. Granny Smith – Again, as in all the pollen tube growth models, really understand what your cross pollination is like. To me, Grannies can be easy to thin so watch temperature trends and use the model accordingly. I used both models in 2016, but mostly stayed with the older model that was first developed.

As far as using the 2016 models versus the older model, I don’t think it will make too much of a difference. One has to remember this is a great tool and you have to understand what you are wanting out of the blossom thinner you are applying along with the variety and cross pollination percentage one has, bee activity and number of hives per acre used. By looking at style lengths each year, one gets a greater feel for if you have winter injury, frost damage, difference in style length between cultivars, or locations in the orchard. The more one grasps this model, the better they can use it as a decision aided tool and can set trends in your own farm related to how early or later you are vs. the nearest Ag Weather Net Weather site, how easy or difficult your varieties are to thin”.

This is the final report for the work completed on the Honeycrisp and Granny Smith models that was funded for one year.