Fruit Notes

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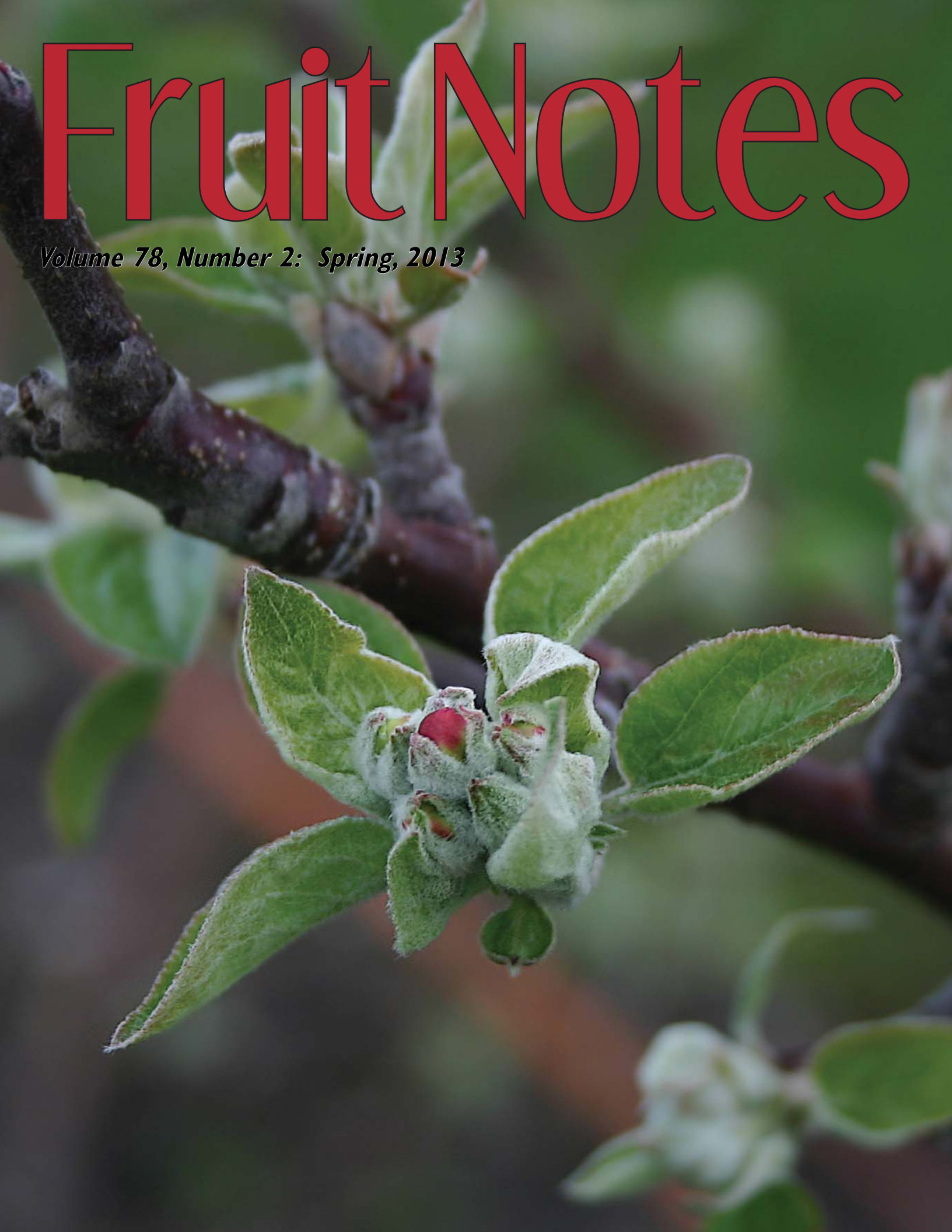

Fruit Notes

Editors: Wesley R. Autio & Winfred P. Cowgill, Jr.

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Correspondence should be sent to:

Fruit Notes
Stockbridge School of Agriculture
205 Bowditch Hall
University of Massachusetts Amherst
Amherst, MA 01003

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Cover: Apples at tight cluster. Photo by Wes Autio.

Jon Clements and Win Cowgill Received the 2013 International Fruit Tree Association's 'Extension Award'

Jon Clements and Win Cowgill were recognized at 56th Annual Conference and Intensive Workshop banquet of the IFTA in Boston, February 23--27, 2013. The theme for the conference was "Insights into Innovative Orchard Technology."

Mo Tougas, President of IFTA, made the presentation: "We have never had a tie before when selecting the recipients of this award, but this year we do. The award goes to a Rutgers University professor/area fruit agent and a University of Massachusetts extension educator, Win Cowgill and Jon Clements, respectively. These two guys have done a lot for our industry in the northeast and have worked closely together for the past twenty years to do it! They co-founded the 'Apple-Crop Listserv' (www.virtualorchard.net/applecrop.html) in 1994 and the Virtual Orchard website (www.virtualorchard.net) in 1995. They established a pruning and training website for cherry trees, (www.gielsacherry.com). Both have given their all for the growers and fruit industry in the Northeast" said Tougas.

In 2006, both Win and Jon were awarded International Fruit Tree Association's 'Outstanding Service to the Industry and Organization' for developing and maintaining the IFTA's original organization website from 1996-2005, and attending all Board meetings from 2000-2005. Win and Jon have been long-time active members of IFTA with over 53 years of combined service.

Win Cowgill, Professor and Area Fruit Agent for the New Jersey Agricultural Experiment Station,

Mo Tougas (right), president of the International Fruit Tree Association present IFTA's Annual Extension Award to Win Cowgill (left) and Jon Clements (center).

Win and Jon in the early days of the Virtual Orchard.

Rutgers Cooperative Extension, has been growing fruit and other deciduous tree fruit crops for over 34 years. Professor Cowgill, is co-editor of New Jersey Horticultural News (www.horticulturalnews.org) and Fruit Notes (www.umassfruitnotes.com). Professor Cowgill conducts extensive research and demonstration trials in all aspects of apple, peach, cherry and pear culture on 14 acres at the Rutgers Snyder Farm (snyderfarm.rutgers.edu/investigators/cowgill.html). His job at Rutgers is to serve the commercial orchardists in New Jersey and beyond. He is a sought out lecturer on apple culture worldwide and writes on his Jersey Fruit Ag Updates blog (jerseyfruitagupdates.blogspot.com).

Jon Clements has been an Extension Educator specializing in tree fruit horticulture at the University of Massachusetts Amherst since 2000 (extension.umass.edu/fruitadvisor and jmcextman.blogspot.com). Prior to that, he was the Michigan State University Berrien County Horticulture Agent from 1998-2000, and worked as a Field Research Technician with the University of Vermont apple team from 1989-1998. Clements has been progressive in bringing new technology and using innovative educational programming including video to make his audience better fruit growers. In addition to his Extension duties at the University of Massachusetts he also conducts numerous research/demonstration trials at the UMass Cold Spring Orchard Research & Education Center in Belchertown, MA.

A Comparison Of Two Sources Of Environmental Data And Three Model Outputs For Primary Apple Scab In 2012 At The UMass Cold Spring Orchard

Jon M. Clements and Daniel R. Cooley
University of Massachusetts

In a previous *Fruit Notes* article (Cooley & Clements, 2009) we pointed out that the source of weather data, and the models used to analyze it can produce very different recommendations with regard to treatment of sooty blotch and flyspeck. In this article, we look at two important components in apple scab management, apple scab ascospore maturity and primary infection periods, and compare two different data sources and four analytical tools that produce recommendations. Ascospore maturity and primary infection periods are important because they drive fungicide spray decision-making and management during the primary apple scab season.

In 2012, weather data was collected from two sources, SkyBit (skybit.com) and an on-site weather station, a Rainwise MKIII LR (rainwise.com). SkyBit is an agro-meteorology service that provides daily reports of recorded and predicted hourly weather data via email. Longitude and latitude coordinates, and elevation for the UMass Orchard were given to SkyBit hence the data is location-specific. The Rainwise weather station is located at the UMass Orchard, is connected to the internet and sends weather data to the Network for Environment & Weather Applications (NEWA, newa.cornell.edu).

We used four different systems to analyze the data and produce recommendations. The NEWA system uses on-site data, and provides a graphic output for ascospore maturity, as well as precipitation (Figure 1) and tabular output for infection periods (Figure 2). Orchard Radar (pronewengland.org/AllModels/RadarIntro.htm) uses SkyBit weather data, and provides graphic or table output of ascospore maturity estimates and rainfall (Figure 3) and a separate graphic and table output estimating the risk of apple scab infection (Figure 4). In addition to weather data, the SkyBit service can provide recommendations for apple scab, and provides a table with estimates of ascospore maturity and risk of infection, as well as related rain, temperature and leaf wetness data (Figure 5). RIMPro uses Rainwise on-site data, and provides graphic output of ascospore maturity and the risk of infection.

The method for calculating the risk of infection during an individual wetting period varies with each model, but all are based largely on revised Mills criteria (MacHardy and Gadoury, 1989). NEWA uses the revised Mills criteria without modification. Orchard Radar uses the revised Mills model, but incorporates other factors such as relative amount of leaf area and susceptibility of the tissue (Ficke et al., 2002). SkyBit likely modifies the revised Mills model and it's methods are proprietary. … . RIMPro's capabilities are beyond the scope of this article as we have really no actual user experience, however, we are pursuing looking at it more closely in the future. For now, see the RIMpro website for more information: www.biofruitadvies.nl/rimpro/rimpro_e.htm.

All four models calculate accumulated ascospore maturity (ASM) using degree days base 32º F. starting at 50% McIntosh green tip (Gadoury and MacHardy, 1982)1982 with adjustments for prolonged dry periods (Stensvand et al., 2005). The ASM model is used to estimate when large amounts of ascospores are ready to be released, high risk periods, and when ascospores are no longer available, the end of primary season. It predicts that 99%, or for practical purposes all, of the

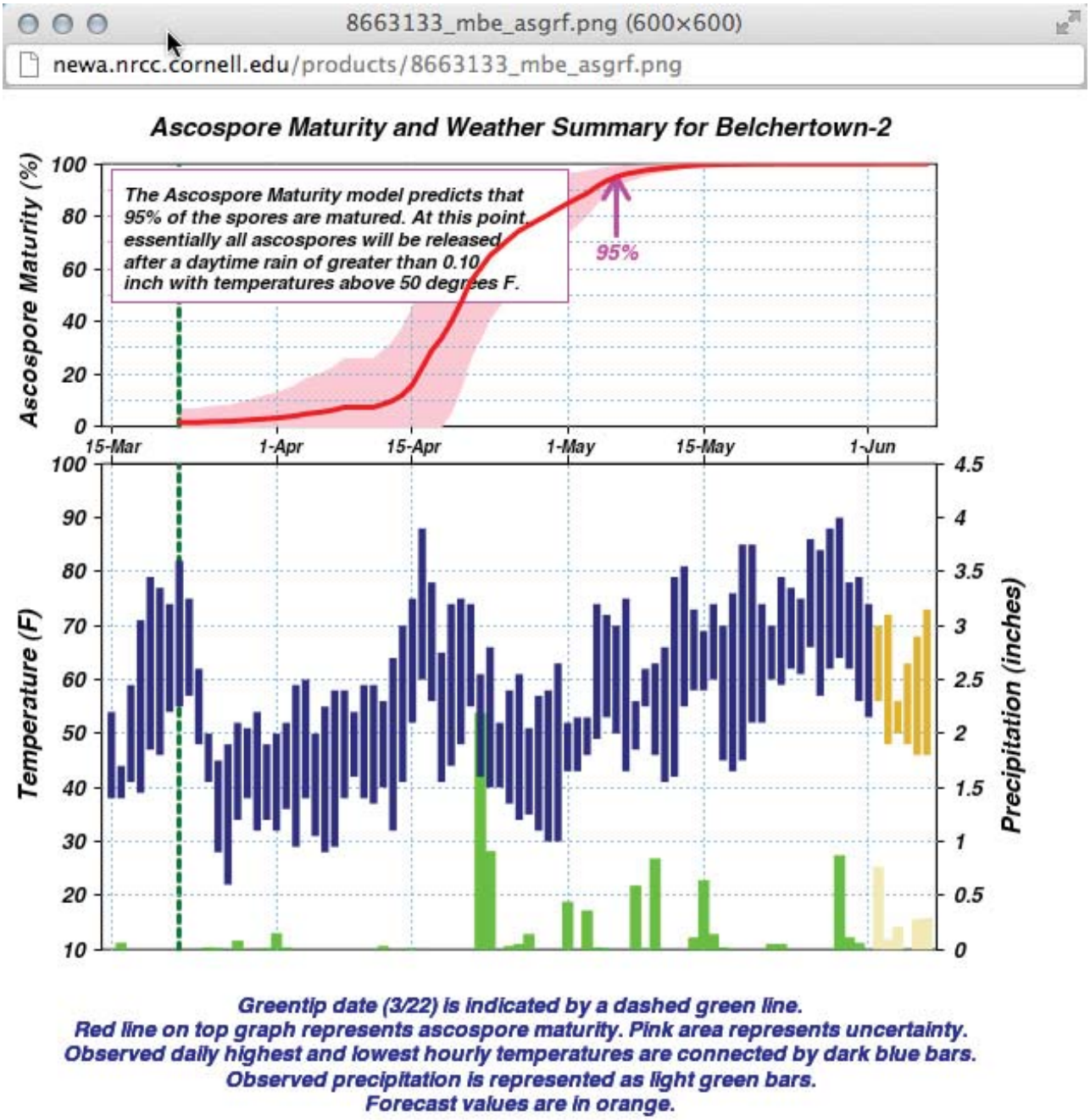

Figure 1. NEWA ascospore maturity.

ascospores for a season have matured when 900 DD (base 32º F.) have accumulated from green tip. Once this point is reached, the last primary inoculum is released with the next rain. Using the model is at least as accurate as actually observing ascospore maturity and release directly and saves significant expense in terms of skilled labor (Gadoury et al., 2004). Once all ascospores have been released from overwintering leaves, the risk of primary infection is over.

It is worth pointing out that the researchers who developed the ASM model included confidence "belts" in it. That is, the model makes an estimate, but in reality the estimate varies. One year it might be high, the next low. Based on many years of data, however, the model

Ascospores were essentially all released on May 8. Orchards are still at risk for conidial infections. Continue to monitor scab infection events and maintain spray coverage accordingly for at least two more weeks, or until May 22. Scout orchards for primary scab infections after this time.

The Ascospore Maturity degree day model begins at 50% green tip on McIntosh flower buds. To recalculate ascospore maturity for your orchard, enter your green tip date:

Green Tip Date: 3/22/2012

Apple Scab Infection Events (March 1 - June 1)

Start Date & Time	End Date & Time	Wet Hours	Temp Avg. (F)	Rain (in.)	Days to Symptoms	Combined Event
May 29 8:01 PM	May 31 3:00 AM	21	64	1.04	9-10	Yes
May 22 3:01 AM	May 22 2:00 PM	11	63	0.05	9-10	
May 14 6:01 AM	May 17 2:00 AM	50	60	0.91	9-10	Yes
May 8 2:01 AM	May 10 10:00 AM	56	55	1.44	14	
May 3 1:01 AM	May 5 12:00 PM	42	52	0.39	15	Yes
May 1 3:01 AM	May 1 7:00 PM	16	46	0.44	17	
April 26 5:01 PM	April 27 7:00 AM	14	48	0.19	17	
April 22 1:01 AM	April 23 11:00 AM	27	45	3.09	17	Yes
Dry conditions last 44 hours at download					Download Time: 6/1/2012 23:00	

Figure 2. NEWA infection periods.

estimates that there's a 90% chance (9 out of 10) that all spores will have matured between 765 DD and 1080 DD, or a range of 315 DD. That corresponds to about 10 to 14 days in early June, the time when ascospore maturation generally ends. The take home message is that ASM estimates are approximations, not precise to within a day, or even few days. The four models here, however, give a date when 100% ascospore maturity occurs, and only Orchard Radar includes the 90% confidence range.

Add to this variability the fact that measuring temperatures can also vary. In these four models, SkyBit estimates temperature remotely, and Orchard Radar uses the SkyBit estimates. NEWA uses temperatures measured with on-site weather equipment, and that data was also used in the RIMPro model.

Table 1 depicts the end date (i.e., 100% ASM) for the four models. The model estimates of 100% ASM spanned about a week. NEWA was the earliest, while RIMpro was the latest. Another way of looking at this is that on 15-May, Orchard Radar estimated approximately 10% of the seasons scab inoculum had not yet matured and been released, while NEWA estimated that it all had.

Table 1. Date of 100% ASM of four models.

Model	Date of 100% ASM
NEWA (Fig. 1)	15-May (app.)
SkyBit (Fig. 5)	17-May (100% ASM)
Orchard Radar (Fig. 3)	22-May (app.)
RIMpro (Fig. 6)	23-May (app.)

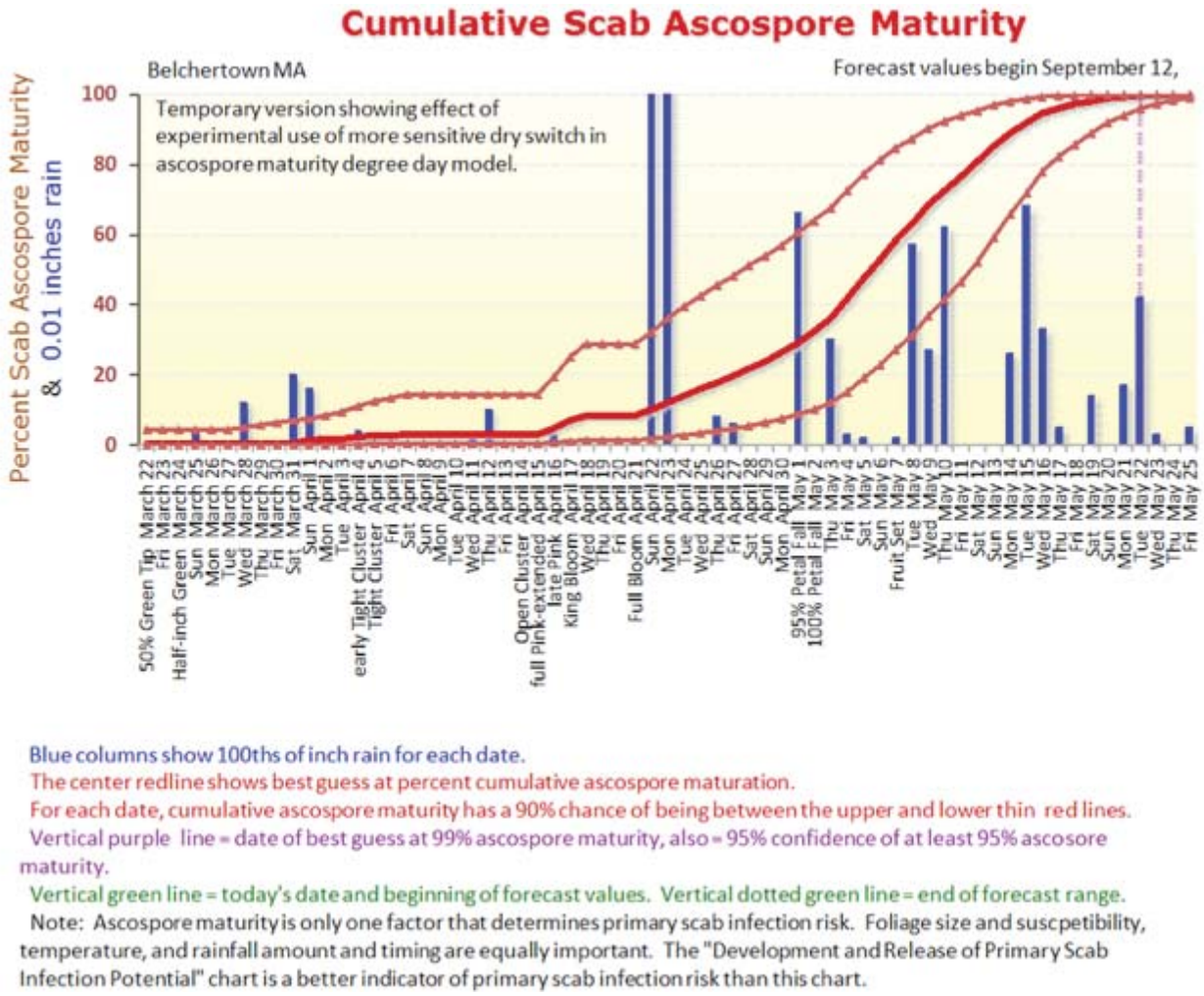

Figure 3. Orchard Radar ascospore maturity.

During most years, the average end of primary scab season in Massachusetts is around May 31. Growers typically maintain fungicide coverage into the first week of June. In 2012, the models estimated the end of to be one to two weeks earlier than that. And the season started 2-3 weeks early based on phenology and degree-days. But, based on actual observation of spore release in the region, it was suspected the primary season was really not over until sometime around June 1. Despite the early spring, dry weather at the onset likely delayed maturity, despite the degree-day accumulation, hence the delayed maturity. In most years the degree-day based maturity model is reliable, but in early, dry springs it may declare the risk of primary infection over when in fact it is not. Further research and refinement on this bugaboo is necessary.

Infection Periods

Infection periods are triggered by a combination of temperature, precipitation, and leaf wetness based on the Mills Table. Table 2 depicts the incidence of infection periods declared by the four models.

All four models were largely in alignment when declaring infection periods and would have predicted a grower would need to have applied 5-7 preventive sprays to control primary scab infection risk. These protectant sprays, for a total of 5-7 depending on model

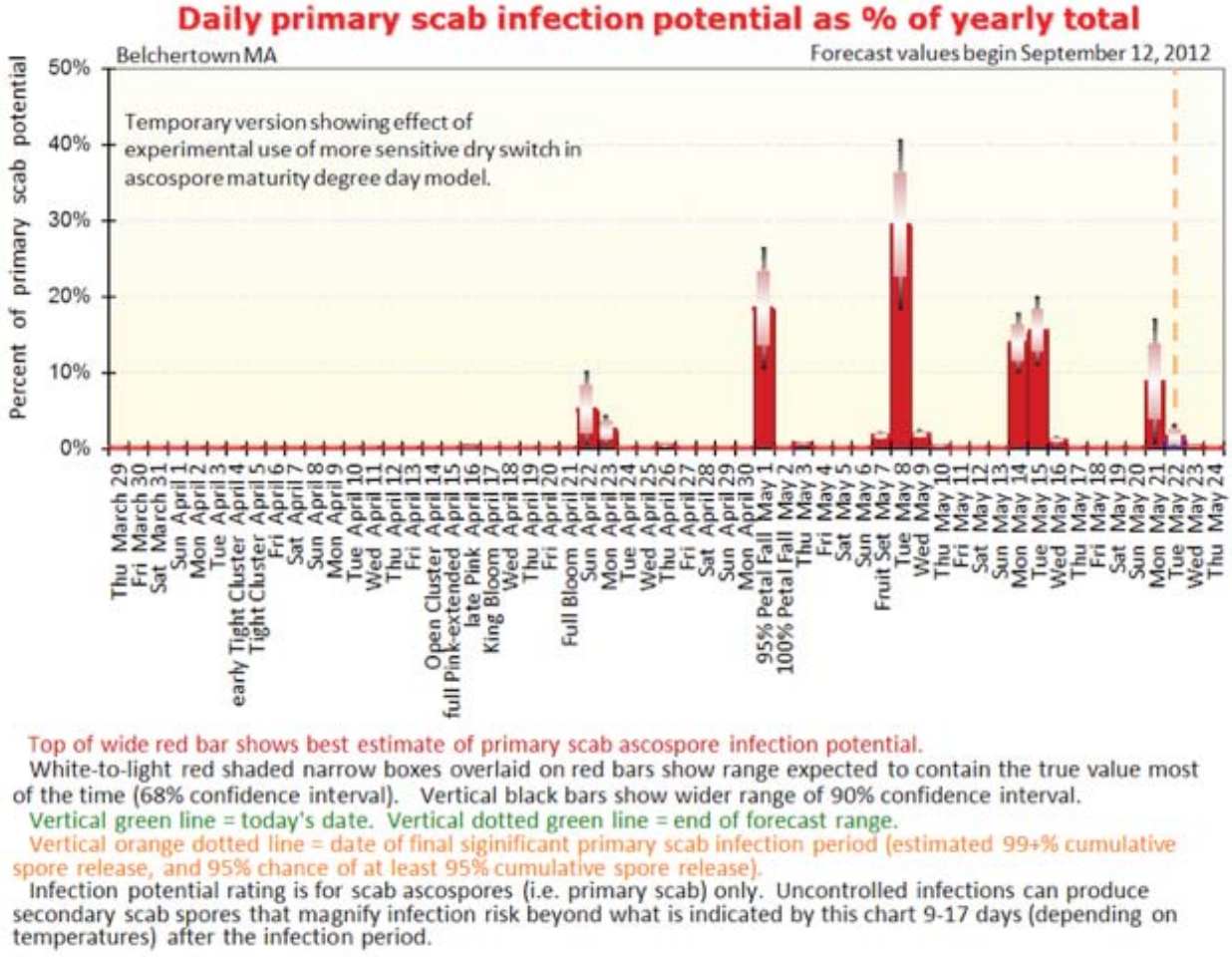

Figure 4. Orchard Radar infection periods/risk.

would have been applied at a minimum:

1. 21-22 April
2. 25-26 April (SkyBit and NEWA only)
3. 30-April to 5-May
4. 7-8 May
5. 13-17 May
6. 20-23 May (21-26 May for SkyBit)
7. 30-31 May (SkyBit and NEWA only)

In addition, infection events beginning on 1-May and continuing on-and-off through 10-May were extended and occurred when the risk of infection was particularly high. Hence, one or two spray(s) with kickback would have been advised. Therefore, based on the models, the primary apple scab season should have been controlled by no more than 7-9 fungicide sprays at the UMass Orchard.

One caveat was the fact that green tip was very early (March 22) and the degree-day maturity model started ticking but it was very dry, hence there were no infection periods/risk of scab infection recorded hence, no sprays. Unfortunately powdery mildew was infecting developing growth during this period and it turned out to be a bad powdery mildew year which was exacerbated by the fact no fungicide sprays were being applied to control scab.

Comments & Conclusions

It appears all four models based on two sources of weather data were pretty much in agreement and would be useful information in managing primary scab. So, choice of model is not as important as *actually using* a model to help manage primary scab and determine

E-WEATHER SERVICE
For: MA-BELCHERTOWN-HORTRESCENTER

	WEATHER					APPLE SCAB 120321			
	TMX	TMN	PREC	ARH	LW	ASM	AW	TW	PW
Date	F	F	in	%	hr	%	hr	F	
BASED ON OBSERVATIONS									
0323	72	55	0.00	49	0	0	0	-	+
0324	57	47	0.00	36	0	0	0	-	+
0325	47	43	0.03	73	9	0	2	46	+
0326	45	30	0.00	49	0	0	0	-	+
0327	47	25	0.00	23	0	0	0	-	+
0328	52	35	0.12	60	11	1	11	48	+
0329	48	39	0.00	65	0	1	0	-	+
0330	50	34	0.00	37	0	1	0	-	+
0331	44	33	0.20	70	13	1	13	39	+
0401	48	32	0.17	77	15	1	9	42	+
0402	52	34	0.00	51	9	1	18	41	+
0403	57	29	0.00	31	0	1	0	-	+
0404	60	38	0.04	39	8	1	8	46	+
0405	49	34	0.00	51	1	1	9	45	+
0406	52	28	0.00	44	0	1	0	-	+
0407	54	30	0.00	40	0	2	0	-	+
0408	55	39	0.00	42	0	2	0	-	+
0409	54	43	0.00	47	0	2	0	-	+
0410	57	40	0.00	41	0	3	0	-	+
0411	54	37	0.04	56	3	3	3	43	+
0412	52	38	0.08	67	20	3	4	52	+
0413	62	32	0.00	48	6	4	14	39	+
0414	68	38	0.00	37	0	5	0	-	+
0415	74	51	0.03	58	1	7	1	63	+
0416	85	56	0.00	58	9	10	10	61	++
0417	77	54	0.00	37	0	14	0	-	+
0418	59	45	0.00	45	0	17	0	-	+
0419	68	41	0.00	55	0	21	0	-	+
0420	74	45	0.00	57	0	26	0	-	+
0421	73	55	0.03	70	1	34	1	56	+
0422	55	43	1.54	88	24	38	25	48	++
0423	60	43	0.93	83	22	43	47	50	++
0424	53	43	0.00	58	0	48	0	-	+
0425	56	37	0.00	57	0	52	0	-	+
0426	59	33	0.10	67	8	55	8	53	+
0427	51	38	0.04	56	7	59	15	50	++
0428	56	34	0.00	35	0	62	0	-	+
0429	57	33	0.00	30	0	65	0	-	+
0430	61	31	0.00	38	0	69	0	-	+

E-WEATHER SERVICE
For: MA-BELCHERTOWN-HORTRESCENTER

	WEATHER					APPLE SCAB 120321			
	TMX	TMN	PREC	ARH	LW	ASM	AW	TW	PW
Date	F	F	in	%	hr	%	hr	F	
BASED ON OBSERVATIONS									
0501	50	46	0.66	85	23	72	23	47	++
0502	53	45	0.00	81	9	76	32	47	++
0503	53	47	0.30	90	24	79	24	50	++
0504	65	50	0.03	88	21	84	42	53	++
0505	64	53	0.02	82	14	87	17	56	++
0506	64	47	0.00	68	0	90	0	-	+
0507	70	43	0.04	61	5	92	1	59	+
0508	56	50	0.55	83	24	94	26	54	++
0509	63	56	0.34	93	24	95	50	57	++
0510	61	47	0.55	72	11	96	61	56	++
0511	64	45	0.00	48	0	97	0	-	+
0512	77	39	0.00	47	0	98	0	-	+
0513	80	51	0.00	55	0	98	0	-	+
0514	69	58	0.30	80	16	99	8	62	++
0515	68	59	0.64	84	23	99	18	62	++
0516	72	59	0.35	87	20	99	29	63	++
0517	68	48	0.03	54	7	100	11	55	++
0518	71	42	0.00	56	0	100	0	-	+
0519	79	46	0.14	53	2	100	2	69	+
0520	81	51	0.00	53	0	100	0	-	+
0521	68	52	0.19	80	11	100	11	65	++
0522	66	61	0.40	90	24	100	35	64	++
0523	75	60	0.03	80	19	100	47	64	++
0524	74	61	0.00	79	12	100	13	65	++
0525	73	60	0.05	85	20	100	8	69	++
0526	82	63	0.00	73	11	100	19	69	++
0527	80	58	0.00	61	0	100	0	-	+
0528	82	63	0.00	73	0	100	0	-	+
0529	82	65	0.48	80	11	100	6	69	+
0530	75	64	0.13	79	20	100	17	68	++
0531	77	59	0.01	58	8	100	16	65	++

Figure 5. SkyBit ascospore maturity and infection risk. Abbreviations in the SkyBit table: Date = day of the month with the first two digits as month and the last two as day; TMX F = the maximum temperature for the day in degrees Fahrenheit; TMN F = the minimum temperature for the day in degrees Fahrenheit; PREC in = the inches of rain; ARH % = relative humidity; LW hr = the number of hours leaves were wet; ASM % = the accumulated percent of ascospores that have matured by the date; AW hr = the accumulated wet hours on the date; TW F = the temperature in degrees Fahrenheit during the wetting period; PW = recommendation where "-" is inactive, "+" is active but not infectious, and "++" is potential infection warning.

when fungicide sprays are appropriate and declaring the end of primary scab season. Specifically, models aligned well in infection periods, but differed more in declaring end of primary scab season based on 100% ASM. And in 2012, just because there are no apple scab infection periods called during the early part of

Table 2. Estimated apple scab infection periods (Yes) of four models.

Date	SkyBit	Orchard Radar	NEWA	RIMpro
16-Apr	Yes			
17-21 Apr				
22-Apr	Yes	Yes	Yes	Yes
23-Apr	Yes	Yes	Yes	Yes
24-25 Apr				
26-Apr			Yes	
27-Apr	Yes		Yes	
28-30 Apr				
1-May	Yes	Yes	Yes	Yes
2-May	Yes		Yes	Yes
3-May	Yes		Yes	Yes
4-May	Yes		Yes	Yes
5-May	Yes		Yes	Yes
6-May				
7-May		Yes		Yes
8-May	Yes	Yes	Yes	Yes
9-May	Yes	Yes	Yes	Yes
10-May	Yes		Yes	Yes
11-13 May				
14-May	Yes	Yes	Yes	Yes
15-May	Yes	Yes	Yes	Yes
16-May	Yes	Yes	Yes	
17-May	Yes		Yes	
18-20 May				
21-May	Yes	Yes		
22-May	Yes	Yes	Yes	Yes
23-May	Yes			Yes
24-May	Yes			
25-May	Yes			
26-May	Yes			
27-28 May				
29-May			Yes	
30-May	Yes		Yes	
31-May	Yes		Yes	
Total inf. periods	8	5	7	5

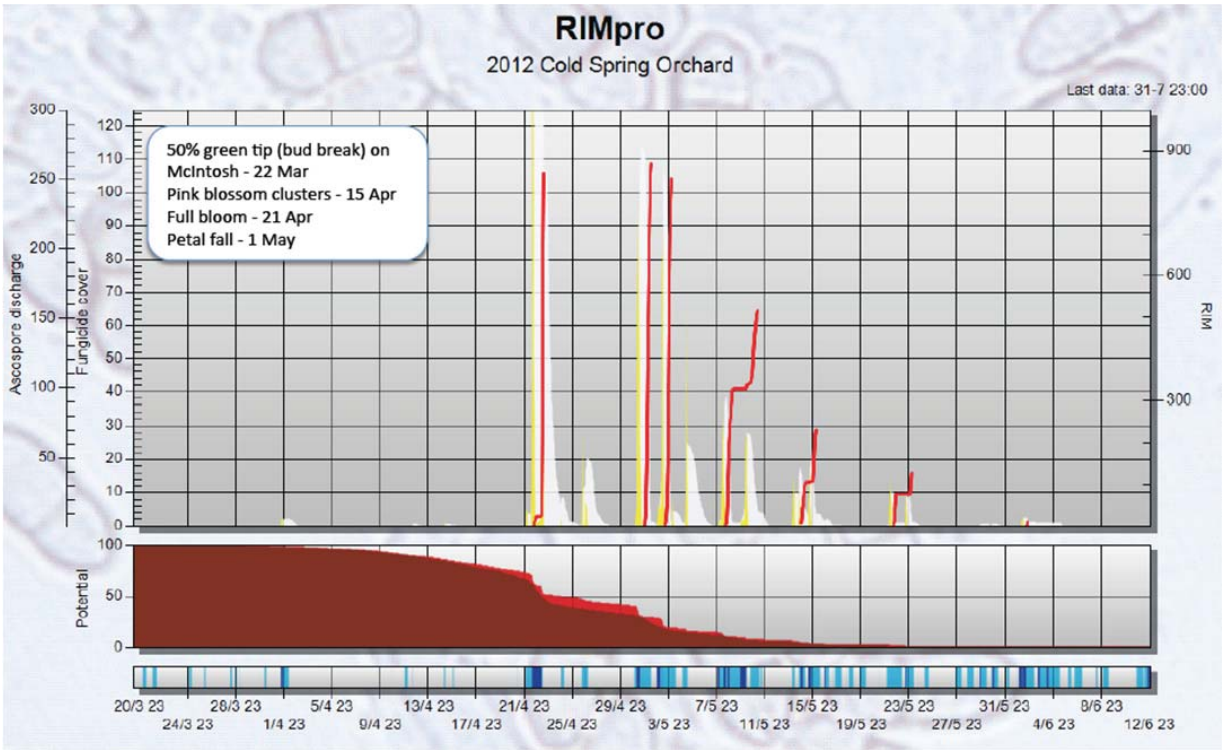

Figure 6. RIMpro ascospore maturity and infection risk.

the season leading up to bloom (because of unusually dry weather) that does not mean you can ignore applying fungicides to control mildew in some years. One advantage of using SkyBit (and Orchard Radar) is the predictive forecasts. (Although forecast data can be incorporated into the other two, NEWA and RIMPro to get model output and predictive risk of infection.) All four models using two sources of weather data were/are very useful in managing sprays and apple scab during the primary season and should be used by all growers/ Extension/consultants.

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International Fruit Tree Association, 56th Annual Meeting, Boston

Jon M. Clements
University of Massachusetts

Note: reprinted from jmcextman.blogspot.com

I just returned from the International Fruit Tree Association (IFTA) 56th Annual Conference held at the Boston Copley Marriott from February 23 to March 2, 2013. Hereafter, I will refer to the Conference as "#ifta2013boston" as I started tweeting from the Conference and it looks like social media (see IFTA Facebook page) has started to catch on a bit with otherwise very progressive horticulturists/fruit growers.

First, on Saturday, March 23 were two Pre-Conference Intensive Workshops. Altogether, there were about 200 attendees split between "Strategies for Improving Production Practices" and "Managing Pick Your Own Tree Fruit Operations." I spent time in both -- in the "Strategies" session Equilifruit disks were passed out and explained how to use by James Schupp of Penn State, and I won't forget Tom Chudleigh's comment in the "Managing" Workshop: "It's easier to increase revenue $10,000 than decrease expenses $1,000!" Thanks to Pre-Conference workshop organizers and moderators Mo Tougas, Phil Schwallier and Duane Greene for successfully kicking-off #ifta2013boston!

Then, on Sunday, despite the weather, the show

IFTA Annual Meeting Tour visited Brookdale Farm in Hollis, NH. Photo by Win Cowgill.

Mo Tougas (Massachusetts) and Lynn Long (Oregon State University) depate KGB cherry pruning at pre-conference pruning workshop at Tougas Family Farms, Northborough, MA. Photo by Win Cowgill.

must go on, but barely! With perseverance, an excellent Pre-Conference Demonstration by Greg Lang (Michigan State U.) and Lynn Long (Oregon State U.) in front of 100 cold, snowy-wet attendees on pruning dwarf cherry systems at Tougas Family Farm. And then Jim Schupp (Penn State U.) showed us how to prune quad-v intensive planted peaches. It's typical to have some kind of weather-related obstacle during these winter orchard visits, and we in Massachusetts did not disappoint!

Monday morning the Education Sessions commenced. Loosely titled "Innovation in Production" and "Innovation in Automation" these Monday sessions were attended by nearly 350 fruit growers and other industry representatives from at least 11 different countries. (But mostly from the United States and Canada.) I should note the overall theme of #ifta2013boston was "Insights into Innovative Orchard Technology." Dr. David Rosenberger of Cornell's Hudson Valley Lab delivered the Carlson lecture titled "Societal Changes are Creating Opportunities and Challenges for Fruit Growers." The Monday afternoon "Automation" session was organized by Tara Baugher (Penn State U.) and featured speakers working on the SCRI-funded "Comprehensive Automation for Specialty Crops."

All-day Tuesday, February 26 was the Field Learning Tour which went to three orchards in Massachusetts and one in New Hampshire. Six 50-passenger buses (thanks A Yankee Line!) were split between a North and South route, but all visiting the same orchards. On the South Route (which I was on) we stopped at (in order): Belkin Lookout Farm, Natick, MA; Tougas Family Farm, Northboro, MA; Tower Hill Botanic Garden, Boylston, MA (for lunch); Brookdale Fruit Farms, Hollis, NH; and Parlee Farms, Tyngsboro, MA. So much practical pruning, growing, and marketing information on apples, peaches, and cherries at these typically diversified New England orchards. Terence Robinson (Cornell University) was instrumental in getting discussions going between our orchard hosts and tour attendees.

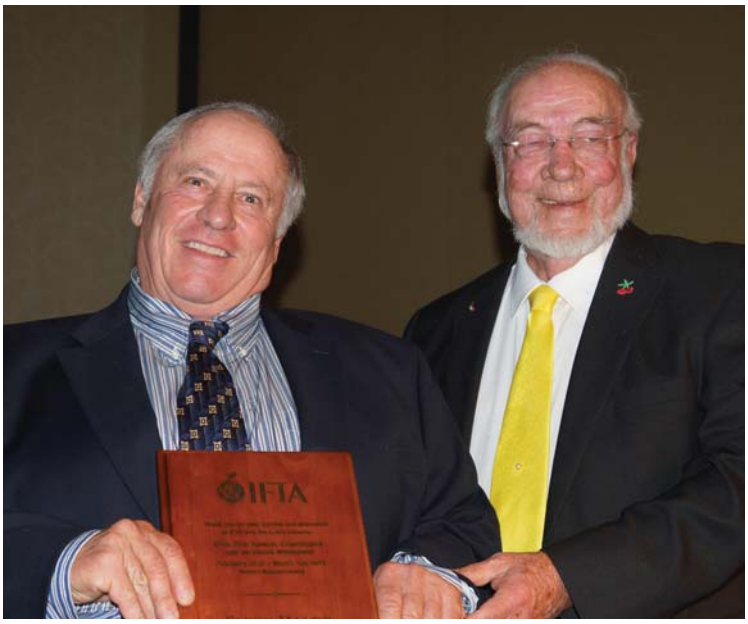
Returning to Boston Tuesday evening after a long-day in the orchards, enthusiasm for the cider silent auction to benefit the IFTA Research Foundation was still high as we enjoyed a New England boiled dinner of corned beef and cabbage during the 2013 IFTA Awards Banquet. Speaking of awards, here are the deserving recipients:

- Carlson and Outstanding Researcher Award -- Dr. David Rosenberger, Cornell University

- Outstanding Grower Award -- Tougas Family, Northboro, MA
- Outstanding Extension Award (tie) -- Win Cowgill, Rutgers U. and Jon Clements, UMass Amherst
- Hall of Fame Award -- Art Thompson (deceased), U. of Maryland
- Industry Service Award -- Elwin 'Stub' Hardee (deceased) & Family, Hollis, NH

Thanks to Banquet emcee Tim Welsh and cider silent auction organizer Ken Hall for a fun and productive banquet! Announced near the end, the cider auction raised nearly $6,000 for the IFTA Research Foundation!

On Wednesday, Education Sessions resumed. For the morning, the topics were "Innovation in Technology and Varieties" and during the afternoon "Innovation in Climate Change Strategies & Production" were featured. A featured speaker during "Technology and Varieties" was Neal Carter of Okanagan Specialty Fruits who are trying to introduce non-browning Arctic Apples to the USA. His talk "Apples and Biotech -- Why They Fit" was followed by Nancy Foster with USApple's "View from the Hill." One of the best talks of the afternoon was Jeff Andresen's (Michigan State U.) "Climate Change 101 for Fruit Growers." Andresen painted a challenging picture ahead for fruit growers with increased likelihood of seeing earlier springs and more frost/freeze events like those that occurred during 2012. (Update: we're certainly not seeing an early spring 2013 as I write this!)



Elwin "Stub" Hardy was granted the Industry Service award. Stub passed away in January. His son Chip Hardy (left) accepted the award on behalf of his father from Evan Milburn (right). Photo by Win Cowgill.

Dave Rosenberger (left), with his wife Carol (center), accepts the IFTA Outstanding Research Award from Terence Robinson (right). Dave also gave the Carlson Memorial Lecture where he discussed the challenges facing growers in the next 10 years, including reliable labor, climate change, and maximizing the benefits of new technology. Dave will be retiring at the end of the year. He has always been known for his problem solving and applied research of tree-fruit diseases and postharvest problems. Photo by Win Cowgill.

On Thursday morning two buses (100 attendees) left Boston for the Hudson Valley of New York for the Post-Conference Study Tour. First stop before leaving Massachusetts, however, was the UMass Cold Spring Orchard where Redhaven peach and Honeycrisp apple NC-140 rootstock plantings were visited. Then onto Thursday PM stops in the Hudson Valley:

- Yonder Fruit Farms in Valatie and

Hudson, NY for tall spindle apple planting established in 2012 and Delicious Pruning/Rootstock trial respectively

- Golden Harvest Farm and Distillery, Kinderhook, NY for Applejack and other spirits sampling
- Fix Brothers Farm, Germantown, NY for Orsi platform demo and older "tall spindle" apple pruning discussion
- Mead Orchards, Tivoli, NY for diversified fruit and vegetable farm marketing discussion

And then overnight at Poughkeepsie Grand Hotel for dinner on our own. (I heard the Bull and Buddha is pretty good!)

Friday early morning we departed Poughkeepsie across the Mid-Hudson Bridge for Cornell's Hudson Valley Lab in Highland. At the HVL we were treated to indoor laboratory and outdoor field research being done by the HVL's scientists – David Rosenberger, who is also Director, on pathology; Peter Jentsch on entomology; and Steve Hoying on horticulture. It was all very informative and these researchers (and Extension educator Mike Fargione) at the HVL provide essential support for Hudson Valley fruit growers who maintain open space and provide locally grown food and economic development to the region.

After departing HVL continuing Post-Conference Study Tour stops included:

- Porpiglia Fruit Farms, Marlboro -- packing line, storage, and plantings
- Crist Bros. Coy Farm, Clintondale -- tall spindle apple plantings and hedging
- Wrights Farm Market & Bakery, Gardiner -- gourmet box lunch, cider donuts
- Dressel Farms, New Paltz -- modern storage and Cider Week, but no sampling, and we did not go look at one of the oldest tall spindle apple plantings in eastern new york :-(
- Crist Bros. Home Farm, Walden -- brand new Greefa pre-sorting line
- Fishkill Farms, Fishkill -- Eco Apples and year-round farm market (some crops organic), and more cider donuts!

Larry, Mo, and Curly (no Phil). Mo Tougas (center) is recognized for his service as IFTA president by Larry Lutz (left, immediate past president) and Phil Schwallier (right, incoming president) at the IFTA Banquet and Awards Ceremony. Photo by Win Cowgill.

After the day of orchard visits and a brief return to the hotel we had a short ride to Locust Grove Estate and Samuel Morse Historic Site for an authentic Dutch-Colonial dinner hosted by Hudson Valley entertainers and cooks John and Cynthia Vergilii. It was really great and a fitting end to the Post-Conference Study Tour. Kudos to Steve Hoying and the Hudson Valley Young Growers for an informative and entertaining IFTA event no one will soon forget. Finally, on Saturday morning back to Boston for eventual travel home.

Of course I want to thank very much all the people who worked particularly hard and/or significantly contributed to make #ifta2013boston a success. They include: Mo Tougas, Phil Schwallier, and the IFTA Board of Directors; Tara Baugher for putting together the automation session; Rick, Glen, and Teresa who are IFTA›s management team with AMR Management Services; Tim Welsh and Ken Hall for hosting the banquet program and cider auction; all our Pre-Conference Workshop and Conference speakers; all our Pre-, Post-, and Conference tour stop hosts; and Steve Hoying and the Hudson Valley Young Growers for arranging the Post-Conference Tour.

Hazelnuts: An Emerging Crop for the Northeast

Megan Muehlbauer, John Capik, and Thomas Molnar
Department of Plant Biology and Pathology, Rutgers University

Hazelnuts have recently gained popularity in the United States food market for their use in various products, the majority of which are produced by the Italian company Ferrero. Ferrero uses very large quantities of the nuts in candies and other confections, including the chocolate-hazelnut spread Nutella. The recent increase in demand for these products in the United States has resulted in a corresponding increase in demand for hazelnuts. Currently, less than 5% of the world's hazelnuts are grown in the United States, with over 70% produced in Turkey. Of the hazelnuts grown in the United States, 99% are grown in the Willamette Valley region of Oregon.

Hazelnuts are small to large deciduous shrubs native to temperate regions of Europe, North America, and Asia. The European species, Corylus avellana, has the largest nuts and is grown commercially in production orchards in Oregon, where it is pruned to grow as a single-trunk-tree. Hazelnuts have catkins and small female flowers that are wind pollinated. The trees bloom in the late

A young hazelnut orchard in Chile. Photo by Tom Molnar.

Developing hazelnuts in a New Jersey planting. Photo by Tom Molnar.

winter or early spring before the leaves begin to show. Hazelnuts are self-incompatible and cross incompatible between certain cultivars. Similar to apples, pollinator trees are required in hazelnut orchards. They must be chosen carefully to ensure compatibility with commercially desirable hazelnut species. Hazelnuts generally grow in clusters of 3-5 nuts, and the nuts are encapsulated within husks. Nuts are harvested in late August-September.

The primary reason that hazelnut production has not flourished in the northeastern United States is due to the disease eastern filbert blight (EFB). EFB is a fungal disease caused by Anisogramma anomala that causes branch dieback and girdling of the stems, which will typically kill the trees 5-6 years after becoming infected. EFB is native to the eastern half of the United States, where our tolerant native Corylus americana (American hazelnut) acts as a host to the disease and is very tolerant to its effects. Conversely, the European species, which is grown for commercial hazelnut production, is highly susceptible. The other primary factor for the lack of hazelnut production outside of the Willamette Valley (which has a Mediterranean-like climate), is because existing

Developing fruits are surrounded by green or red bracts. Photo by Tom Molnar.

cultivars originated in Europe and were not selected for production in cold climates. However, very cold hardy hazelnut plants exist, as the native range of the wild American hazelnut reaches north of Minnesota. The European species can be found north of Moscow, Russia.

These two limitations to hazelnut production are being overcome now because of the research and breeding efforts of several universities, including Oregon State University, under the direction of Shawn Mehlenbacher, and Rutgers University, under the direction of Thomas Molnar. The focus of the work at Rutgers has been to develop hazelnuts with better cold tolerance and resistance to EFB, while maintaining the characteristics that are in demand by the hazelnut markets. These characteristics include medium to large nuts with a high kernel percentage, round kernels that blanch well, and excellent flavor. A significant portion of the breeding plan consists of crossing disease resistant American hazelnuts with commercially desirable European cultivars. More recently, work has been done to investigate the oil content of hazelnut kernels, which has been found to consist of 60-75% oil. When coupled with the current breeding efforts, this focus on oil production could lead to an alternate

Developing hazelnut fruit. Photo by Tom Molnar.

Hazelnut orchard of Rutgers seedlings in New Jersey. Photo by Tom Molnar.

market for hazelnuts as a high-value oil crop.

Over the past 40 years, great strides have been made in breeding disease resistance into commercially valuable hazelnut plants. In the 1970s, a gene for resistance to EFB was discovered in a hazelnut named 'Gasaway'. This gene was used in systematic breeding, which led to the development and recent release of several productive, disease-resistant cultivars. These include Jefferson and Yamhill, along with pollinators Theta, Eta, Gamma, and Epsilon. The 'Gasaway' gene has been shown to be insufficient under the intense disease pressure in New Jersey, and work has been done to find new sources of resistance

Nut harvester in operation in Chile. Photo by Tom Molnar.

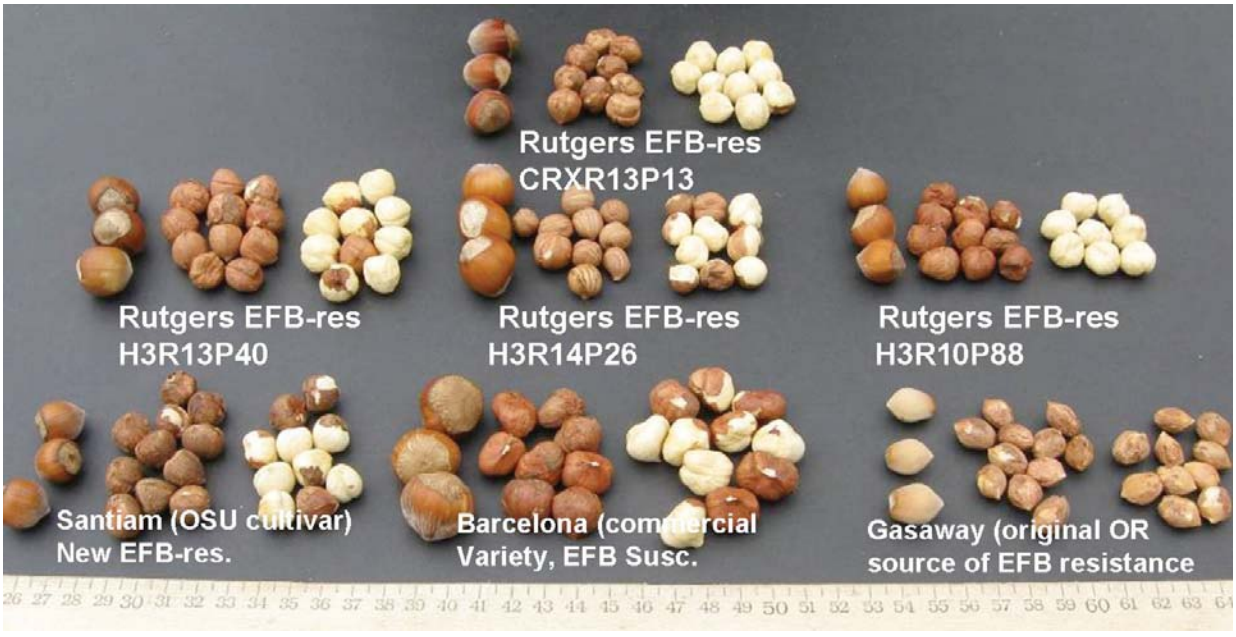
and introgress them into commercially desirable, cold hardy cultivars. Germplasm collection trips for hazelnuts have been made into northern and Eastern Europe and the Caucuses (Poland, Ukraine, Russia, Georgia,and Estonia). Thousands of resulting plants have been grown and a small portion were found to be resistant to EFB. This germplasm also has excellent nut quality and traits and is being used in crosses in the breeding program.

One of the things that makes growing hazelnuts so economically appealing is the minimum amount of inputs required to grow them. They have been shown to need little to no irrigation after establishment, and aside from EFB, there are few diseases or pests requiring chemical control. Of course, this could change as the hazelnut industry is scaled up in the United States, and research is currently being done to combat future potential pest outbreaks. However, in Oregon, pest and disease control is minimal compared to most other horticultural crops. Ideally, they should be grown on well-drained soils with high organic matter, similar to many other tree fruit crops. Hazelnuts are easier to maintain than other tree crops in respect to their pruning requirements.

Young orchard of Rutgers hazelnut seedlings in New Jersey.

They need to be pruned to a single leader and 3-5 scaffolds after the first year. Following that, each tree only needs to be pruned every 5 years (1/5 of the orchard per year), unlike other fruit trees, to allow for optimal light penetration to ensure consistently good nut crops.

Harvesting of hazelnuts also requires little hand labor, unlike many other tree fruit crops. Several methods have been developed to optimize the nut



Diversity in kernel characteristics in Rutgers hazelnut seedlings. Photo by Tom Molnar.

harvest. Nuts typically fall out of the trees on to the ground at maturity and are then swept into wind rows. After sweeping the nuts into wind rows, they are collected by a variety of harvesting machines that separate the nuts from the sticks, twigs, and other debris.

Hazelnuts can be sold as kernels or in-shell (whole nuts). Ferrero, the world's largest buyer of whole nut hazelnuts has recently opened up a processing facility in Brantford, Ontario, Canada, to supply the North American market for Nutella. This presents an excellent opportunity for northeastern United States growers. Currently, the in-shell market is the most common market for hazelnuts grown in the United States, where the largest sized nut varieties are considered the most desirable. Hazelnuts can be sold for $1.00 per pound on the wholesale market. Orchards are generally planted with 100 trees per acre. At that density, yields can be upwards of 1 Ton of nuts per acre at maturity (7 years). It has been shown that the planting density can be doubled to increase initial yields per acre, and then later be thinned out to accommodate the growing orchard.

Hazelnuts are a promising new crop for the Northeast. They require very little inputs and can easily be added to existing orchards. With the close proximity of large gourmet farmer's markets, it is a unique crop that is ideal for direct-to-consumer marketing in the Northeast. There may also be significant opportunity for nut sales to processing companies in New Jersey.

Although there are excellent disease-resistant, high-yielding trees on the market now, they are primarily bred for use in the Oregon hazelnut industry. Rutgers University now has breeding selections being tested in yield trials in NJ, NY, PA, NE, and Ontario. At Rutgers we hope to release our best performing plants to farmers within 4 years.

Fruit Notes
University of Massachusetts Amherst
Stockbridge School of Agriculture
205 Bowditch Hall
Amherst, MA 01003-9294

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