Scott Josiah, Tom Molnar, Shawn Mehlenbacher, Adam Howard

HAZELNUT R&D IN THE US

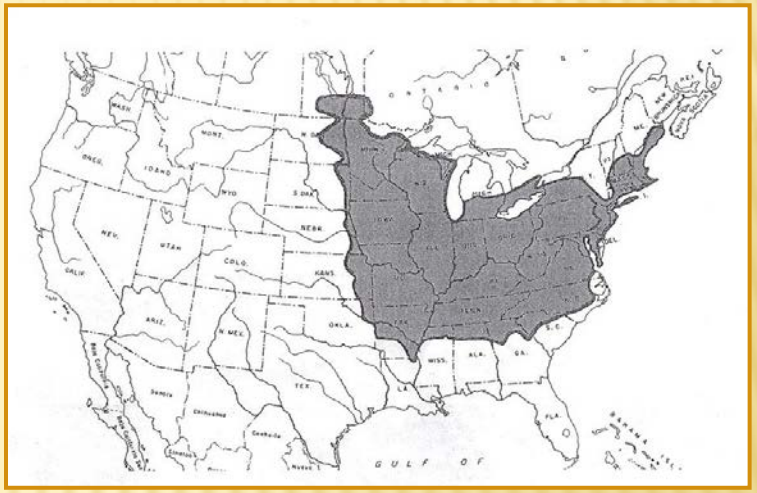
HAZELNUTS—SOME BACKGROUND

- Called hazelnut or filbert
- Hazelnuts are the 5th most important tree nut crop in the world behind cashews, almonds, walnuts, and chestnuts
  - 1,052,001 MT in 2008
- Current commercial production centers are restricted to areas with climates moderated by large bodies of water
- The U.S. produces around 3-4% of the world crop, behind Turkey (70-80%) and Italy (15-20%)
- 99% of the U.S. hazelnut crop is grown in the Willamette Valley of Oregon

Current world production regions - *Corylus avellana*

HAZELNUTS IN EASTERN NORTH AMERICA

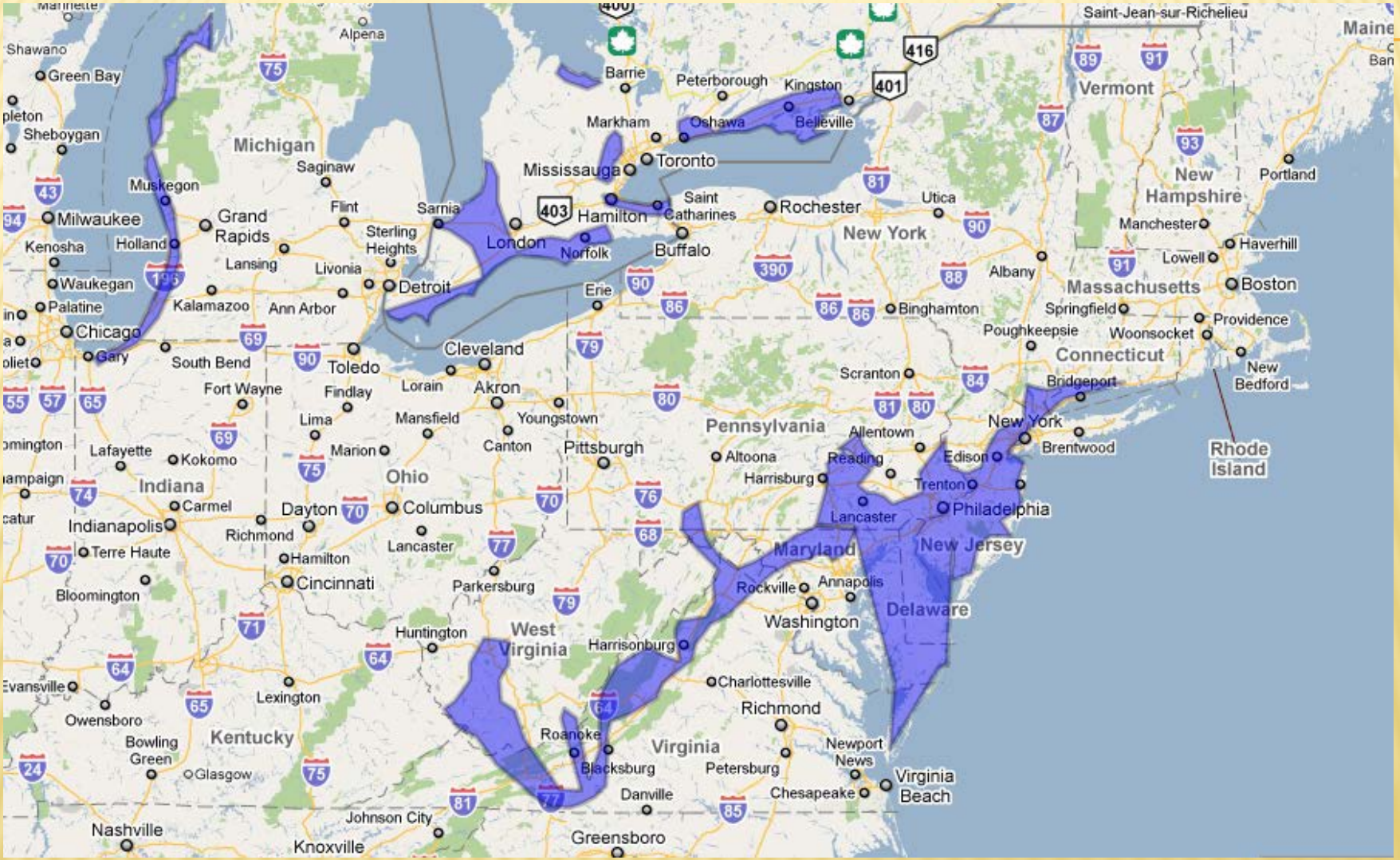
- Early colonists brought hazelnuts from Europe – very few records, no production established
- The fungal disease Eastern Filbert Blight (EFB) killed most European hazelnut trees
- EFB is naturally occurring on the wild American hazelnut, *Corylus americana*
- EFB is the primary reason there are no commercial hazelnut plantings in the east



Native range of American hazelnut *Corylus americana* and associated pathogen *Anisogramma anomala*

EFB on Harry Lauder's Walking stick

LIKELY GROWING REGIONS OF *C. AVELLANA*



More cold-hardy germplasm should open up a much wider range

BARRIERS TO LARGE-SCALE EXPANSION OF EUROPEAN HAZELNUT CULTIVATION

- Susceptibility to Eastern Filbert Blight
- Lack of cold tolerance
- Phenology mismatched to climate
- Big Bud Mite susceptibility

HYBRID HAZELNUT R&D CONSORTIUM

Oregon State University

Dr. Shawn A. Mehlenbacher: Lead Hazelnut Researcher/Plant Breeder

-DNA Markers, Plant Breeding, World's Largest Germplasm

University of Nebraska Lincoln

Dr. Scott J. Josiah: Director, Nebraska Forest Service

-Replicated field trials, outreach

Dr. Milford A. Hanna: Director, Industrial Agricultural Products Center and Professor of Biological Systems Engineering & Food Science & Technology

-Oil Research, New Product Development

RUTGERS

Dr. Thomas Molnar: Lead Hazelnut Researcher/Plant Breeder

-EFB Resistance, Plant Breeding, Germplasm

Dr. Bradley Hillman: Plant Pathology/Molecular biology

-EFB Disease Research

Dr. Margaret Brennan: Agricultural Economist

-Economic Analysis

Arbor Day Foundation Team:

-Outreach/disseminate information

-Organization/Management

GOALS OF THE CONSORTIUM

- To commercialize hybrid hazelnut production within 10 years
- develop high yielding, insect and disease resistant, cold hardy, heat tolerant hybrid hazelnuts of commercial size, taste and appearance
- Develop multiple selections adapted to broad climatic zones

ACTIVITIES OF THE CONSORTIUM

- Plant breeding (crossing American with European species)
- Identifying sources of EFB resistance
- Mapping of *C. avellana, C. americana* and EFB genomes
- Determining location of EFB resistance markers
- Creating rapid diagnostic tools for identifying EFG resistance
- Rangewide collection of *Corylus americana*
- Field testing in multiple locations
- Developing enterprise budgets
- Education and outreach

Hazelnut Breeding

Hazelnut Breeding Objectives

A. Blanched kernel market (for chocolate, baked goods)
   1. Bud mite resistance
   2. Round nut shape
   3. High percent kernel
   4. Precocity
   5. High yield
   6. Easy pellicle removal
   7. Few defects
   8. Early maturity
   9. Free-falling nuts

B. Resistance to eastern filbert blight (EFB)
   1. Simply inherited resistance ('Gasaway' & others)
   2. Quantitative resistance (e.g. 'Tonda di Giffoni')

C. Climatic adaptation

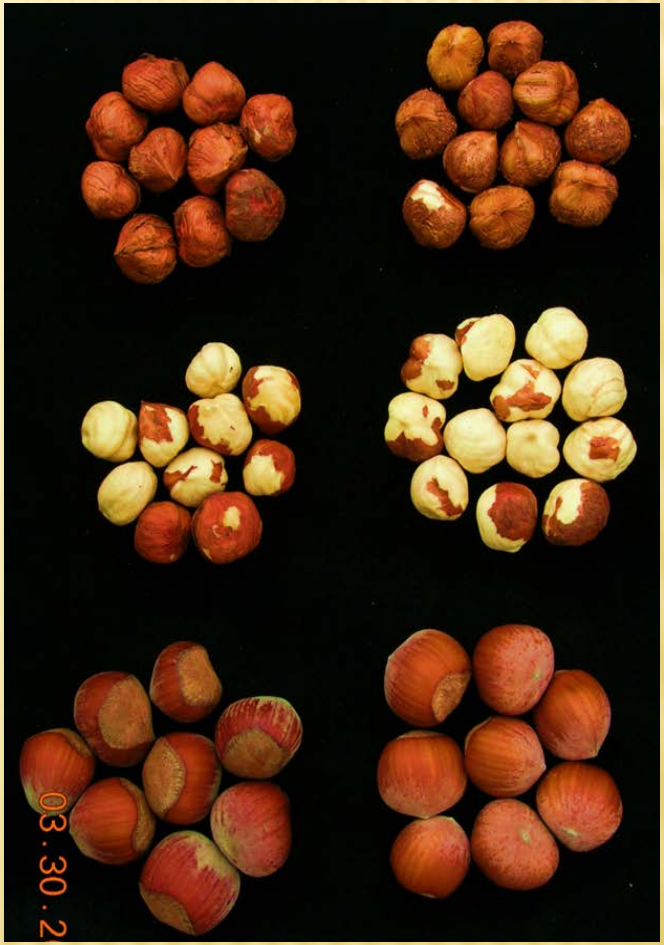
D. Horticultural applications

Eastern Filbert Blight Fungus - *Anisogramma anomala*

- Nearly all European hazelnuts are highly susceptible
- Fungus grows under bark and creates cankers that kill hazelnut plants
- Native to eastern North America
- First discovered in Washington State in 1968 and in the Willamette Valley in 1986
- More than 60 % of Oregon's hazelnut orchards are affected or in close proximity to diseased orchards

Breeding EFB Resistant Plants

- Searching for resistance to EFB began at Oregon State Univ. in the 1970s
- 'Gasaway' (the first), and later many other sources of resistance (and tolerance) have been identified
  - New EFB resistant cultivars (C. avelana) released in Oregon in 2009 & 2010 ('Yamhill' and 'Jefferson')
- Rutgers and OSU's breeding programs are building on these advances



Barcelona Susceptible

Jefferson Resistant


Hazelnut progeny at Rutgers
3 years from seed

RECENT ADVANCES

- Barcelona: kernel =1.6 g, kernel % = 44.2
- Lewis: kernel =1.1 g, kernel % =47.4
- Crosses produced at least 14 high quality EFB-resistant selections at Rutgers, others at OSU and Nebraska
  - Rutgers hybrids: avg. kernel weight ranges from 1.1g - 1.4 g
  - Rutgers hybrids: avg. kernel % ranges from 45 - 58%
  - currently undergoing further screening and testing

FUTURE DIRECTIONS

- Newly developed European hazelnut cultivars may be adapted to the Mid Atlantic and Fruit Belt Regions (northeastern US and southern Ontario)
- Hybrid hazelnut selections are being bred for much broader climatic adaptation to large areas of the US (Midwest to the east coast)
- Multiple product development [in-shell and crushed kernel, large and medium size kernel; oil applications (cooking, lubrication, biofuels), flavorings, confections, etc.]
- Breeding for horticultural applications

ACKNOWLEDGEMENTS AND THANKS!

Specialty Crops Research Initiative
Grant 2009-51181-06028

Specific Cooperative Agreement with
USDA for Eastern Filbert Blight research

Oregon Hazelnut Commission

Nebraska Specialty Crop Program

NONTRADITIONAL USES OF HAZELNUTS

Human Foods

90% of the world crop is used as kernels in candy, baked-goods, and other products

HYBRID HAZELNUT OIL

- Kernel is between 51-75% oil by weight
- Oil applications
  - cooking oil
    - high in oleic and linoleic acids
  - biodiesel & oleochemicals
    - superior to soybean oil
    - better oxidative stability
    - lower cloud point (better flowability at low temps)
    - 2x yield/acre of soybean oil
    - 88% of energy of diesel fuel
  - mechanical lubricant

HAZELNUT MEAL (AFTER OIL REMOVAL)

- Meal remaining after pressing high quality, high protein human and animal feed
- emerging market: substitute for those with wheat allergies

MISCELLANEOUS HAZELNUT PRODUCTS

EFB-RESISTANT ORNAMENTAL HAZELNUTS

Interspecific hybrids between purple-leaf *C. avellana* (European) and *C. americana*: EFB-resistance, cold hardiness, smaller plants with better leaf quality

Fall color in *Corylus* hybrids

Several have purple spring and summer color with pink-red fall color!

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