

The Forever Green Agriculture Initiative



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Forever Green Agriculture Initiative



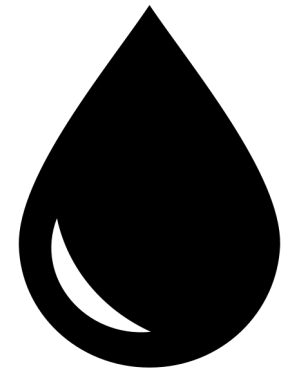
Develop **Winter Annual and Perennial Crops** for inclusion in existing cropping systems that will provide a **Continuous Living Cover and New Economic Opportunities** for farmers and rural communities, while protecting soil and water resources.



New Food/Feed/Fuel
Ingredients



New Economic Opportunities

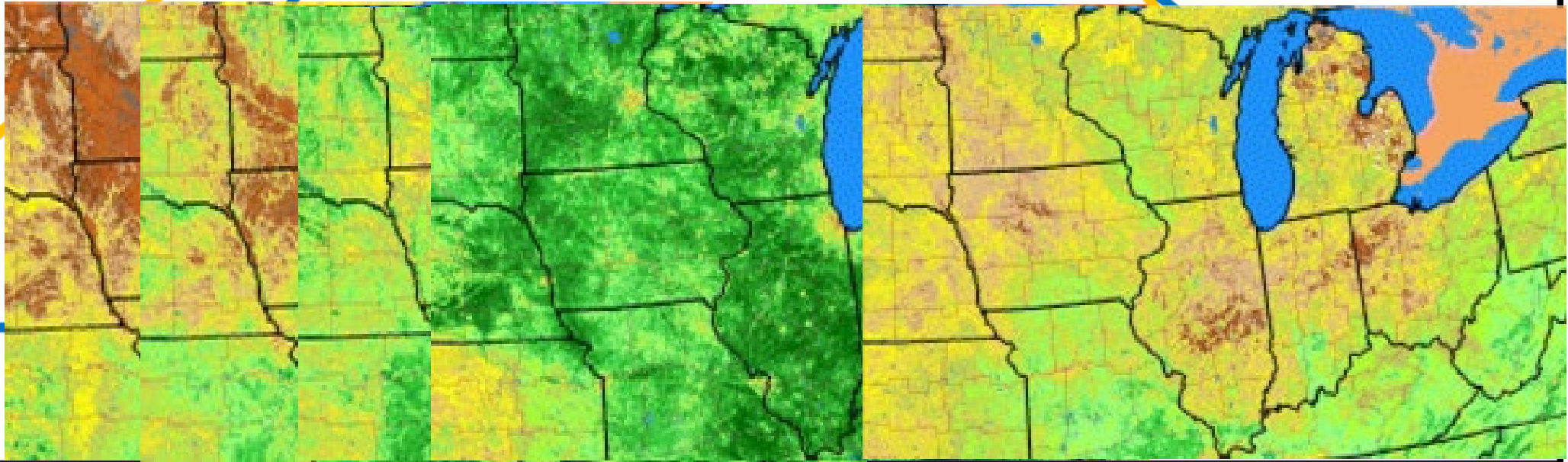
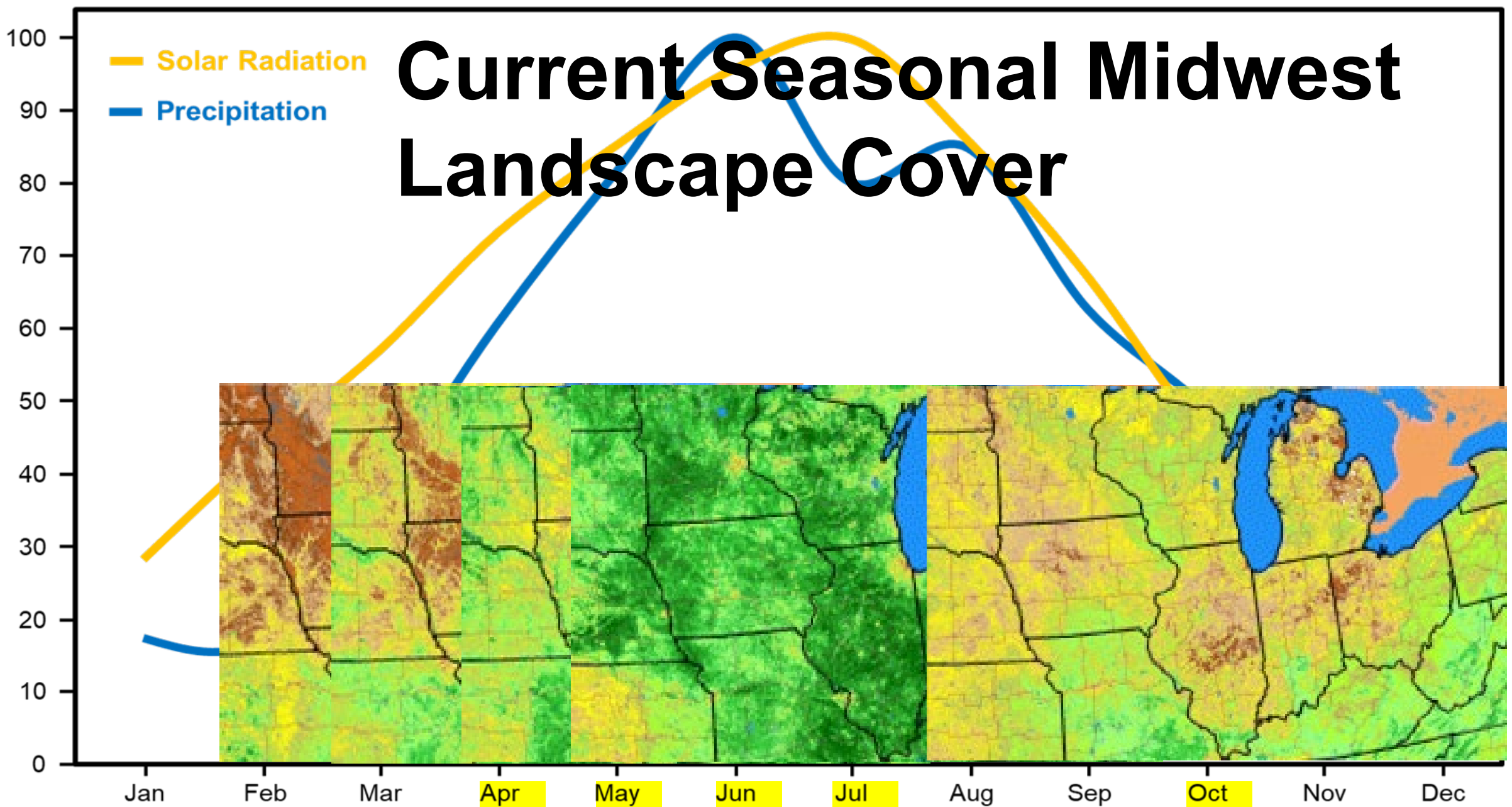


Ecosystem Services

Current Seasonal Midwest Landscape Cover

Percent of Maximum

Solar Radiation
Precipitation



Apr

May

Jun

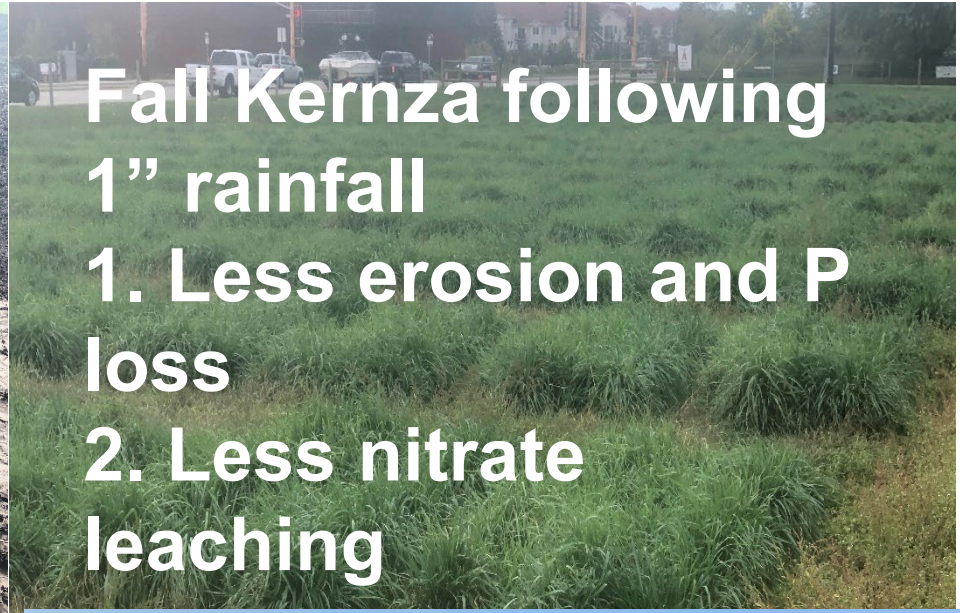
Jul

Oct

Continuous Living Cover Cropping Systems



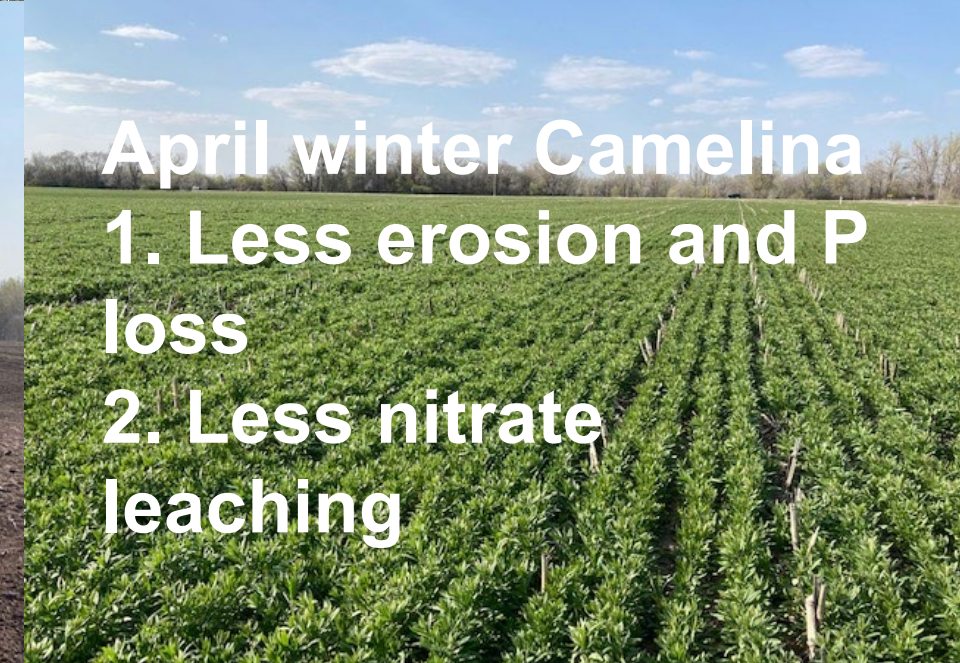
Fall tilled field following 1" rainfall



Fall Kernza following 1" rainfall
1. Less erosion and P loss
2. Less nitrate leaching



April field prep for summer annual crops



April winter Camelina
1. Less erosion and P loss
2. Less nitrate leaching

Forever Green Crops Provide: New, Unique Food, Feed and Energy Products for Commercialization



Oils



Fiber



Protein



Phytonutrients

Forever Green Crops and Cropping Systems Provide: New Economic Opportunities



High Value Food, Feed and Energy
Ingredients



Green Marketing: Ecosystem Services,
Green House Gas Reduction



Innovative Healthy Food Products



New Economic Opportunities for
Farmers and Rural Communities

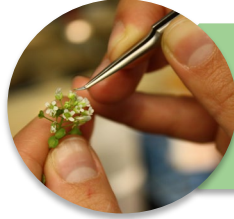
Forever Green Crops Also Provide: Environmental Services

- Soil health
- Clean water
- Nutrient management
- Pollinator habitat
- Carbon sequestration
- Soil protection
- Rural well water protection



How do we get these plants on the landscape?

Collaboration across disciplines in both public and private sectors



Plant Breeding and Genomics



Agronomics



Food Science



Commercialization



Supply Chain Development



PERENNIAL CROPS:

- **Intermediate wheatgrass “Kernza”** – grain, forage, biomass
- **Perennial sunflower** – edible seeds, oil & protein
- **Native polyculture grassland mixtures** – biomass, forage natural products
- **Perennial flax** – edible oil and protein
- **Kura clover** – N-fixing cover crop
- **Silphium** – edible oil and protein
- **Alfalfa** – food grade protein and feed
- **Perennial Cereal Rye**--food and feed grain

WINTER ANNUAL CROPS:

- **Pennycress** – edible oil & protein, biofuel
- **Camelina** – edible oil & protein, biofuel
- **Winter barley** – food, malting barley
- **Hairy vetch** – N-fixing cover crop
- **Winter and spring field pea** – food grade protein
- **Winter Hybrid rye**—food and feed grain

NATIVE WOODY CROPS:

- **Hazelnuts** – edible nut with oil/protein
- **Shrub willow** – biomass
- **Elderberry** – antioxidant-rich fruit
- **Agroforestry** – woody, herbaceous crop mixtures for feed, food, and fuel



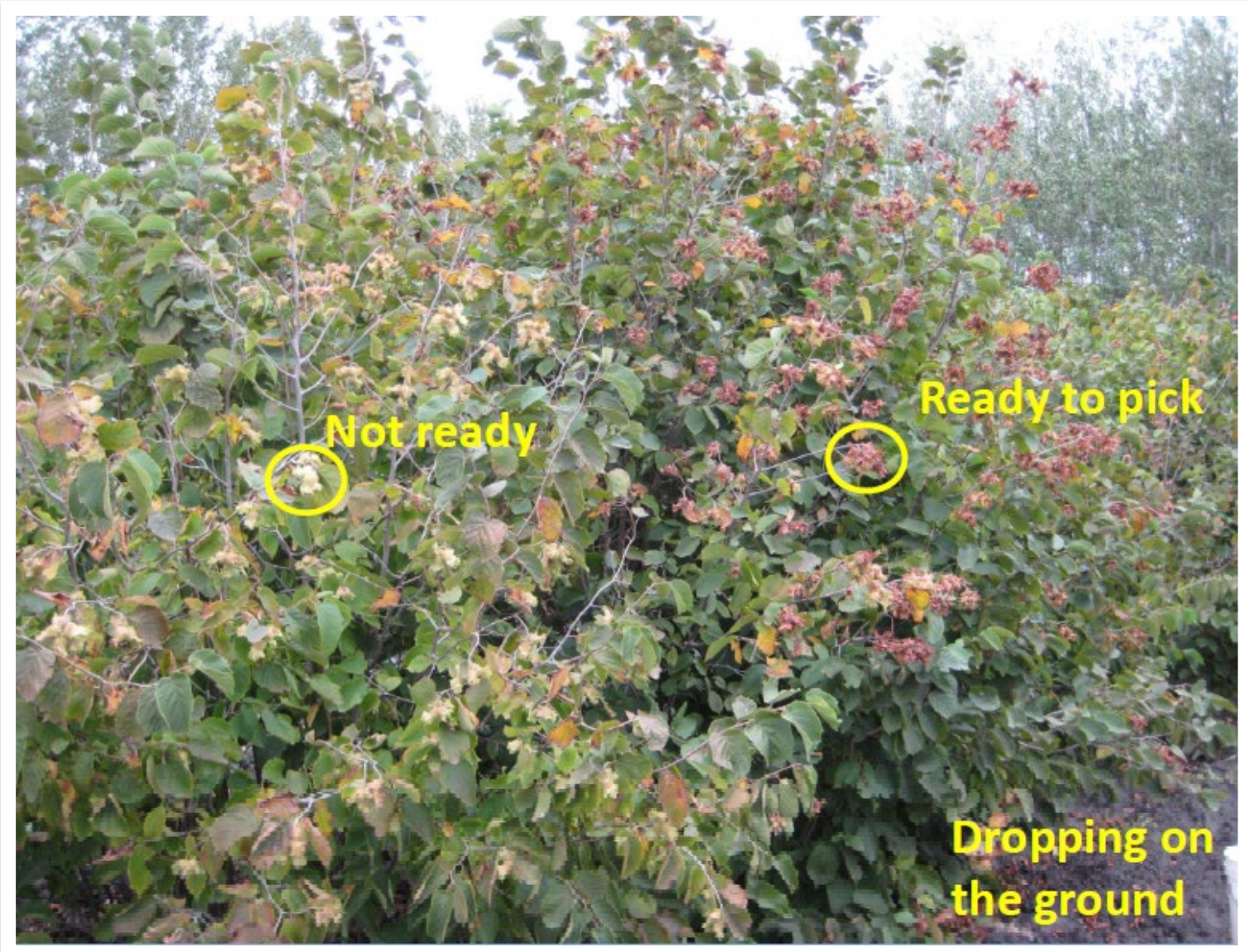
Forever Green Crops From Research To Field To Table



Mette Nielsen

The long road to a hybrid hazelnut industry:

People,
Plants,
Technology,
Finance,
and Time



Supplementary
PRICE LIST

Fall - 1927

J. F. JONES

Nut Tree Specialist

Box 527

LANCASTER, PA.

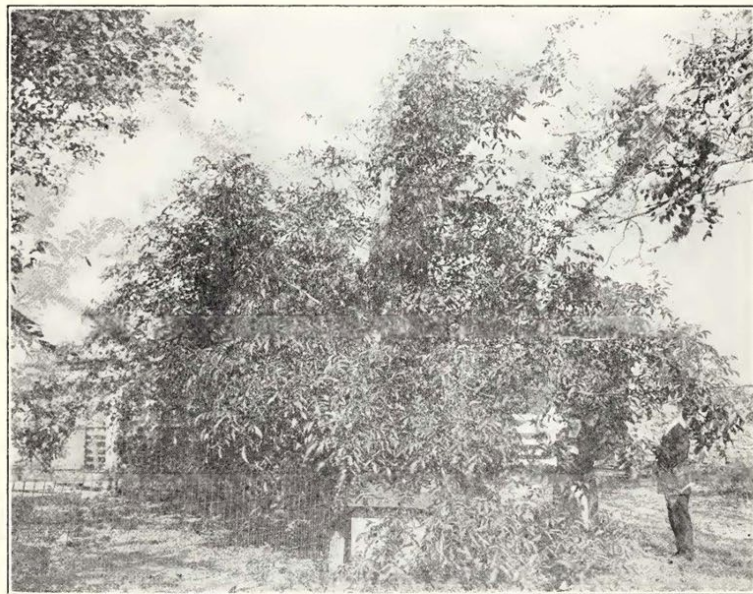


Photo of a young Wiltz Mayette tree here six years old. Dr. W. C. Deming, Pres., N. Nut Growers Ass'n taking notes on the tree Sept. 1926. This tree bore a half bushel of extra fine nuts.

Hybrid hazelnuts go back a long way - the earliest efforts

-**J.F. Jones**, Lancaster, PA

-1919-1928

-Performed the **first** recorded successful hybridization of American and European hazelnut, almost exactly **105** years ago

-*C. americana* 'Rush' x various European varieties

-Seedlings and clones from his work sold to the public



- C.A. Reed**, Bureau of Plant Industry, USDA, Beltsville, MD
- 1928-1950s
- Hybridized *C. americana* 'Rush,' 'Winkler,' and 'Littlepage' with various *avellana* varieties.
- Heavy emphasis on 'Rush'
- Also provided material to George Slate at Cornell

Photo credit: <https://www.gutenberg.org/files/24559/24559-h/24559-h.htm>



Department - Geneva Experi
row : Bob Lamb, Roger Way,
row : Walt Kender, George Slate

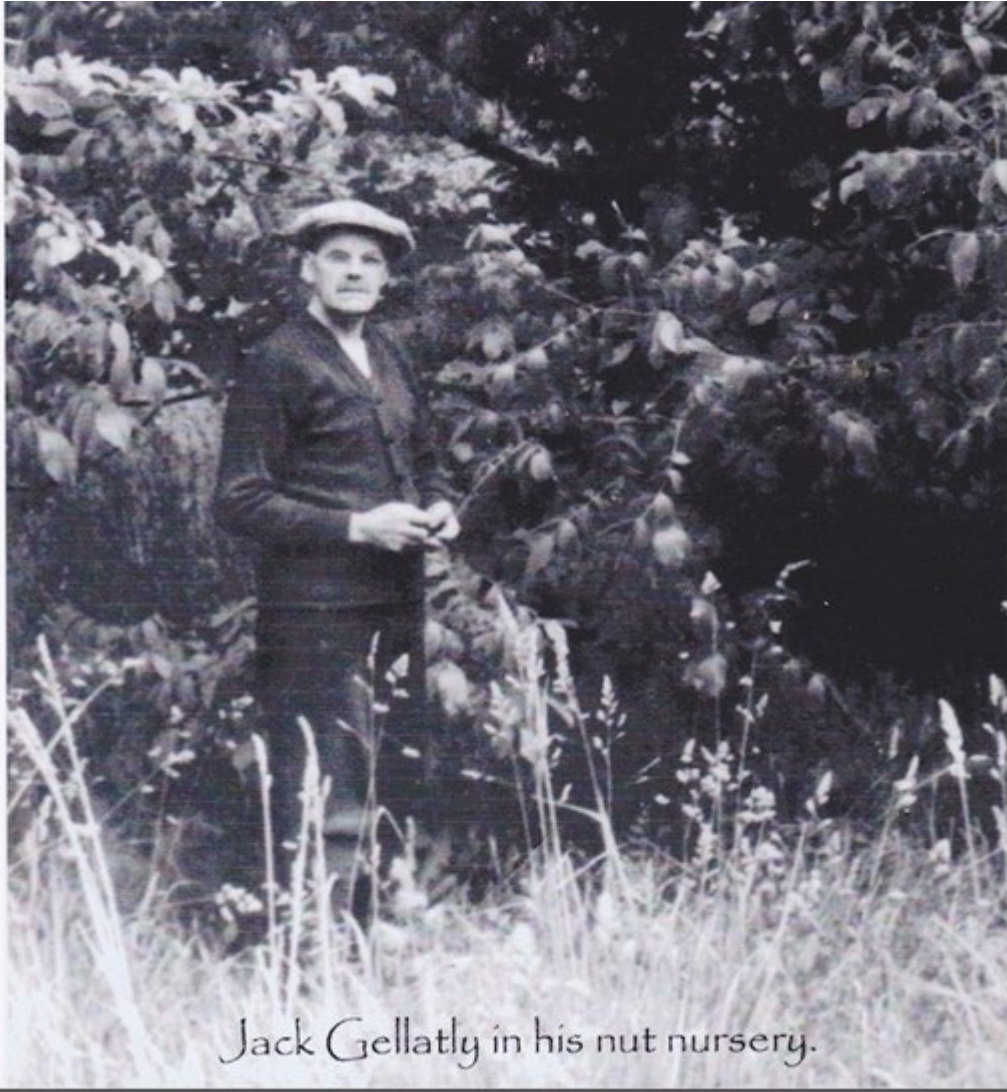
- S.H. Graham**, Ithaca, NY, 1930s-1950s
- grew seedlings of J.F. Jones' first-generation hybrids
- made his own crosses with *C. americana* 'Winkler' and 'Rush', and other hybrids
- sold seedlings to the public

- George Slate**, 1930s-1960s
- NYSAES, Geneva, NY
- Department of Pomology, Cornell
- americana* X *avellana* hybrids, some sourced from C.A. Reed
- Heavy emphasis (overuse) of the *americana* selection 'Rush'

**-Jack Gellatly, Kelowna, BC,
Canada, 1920s-1960s**

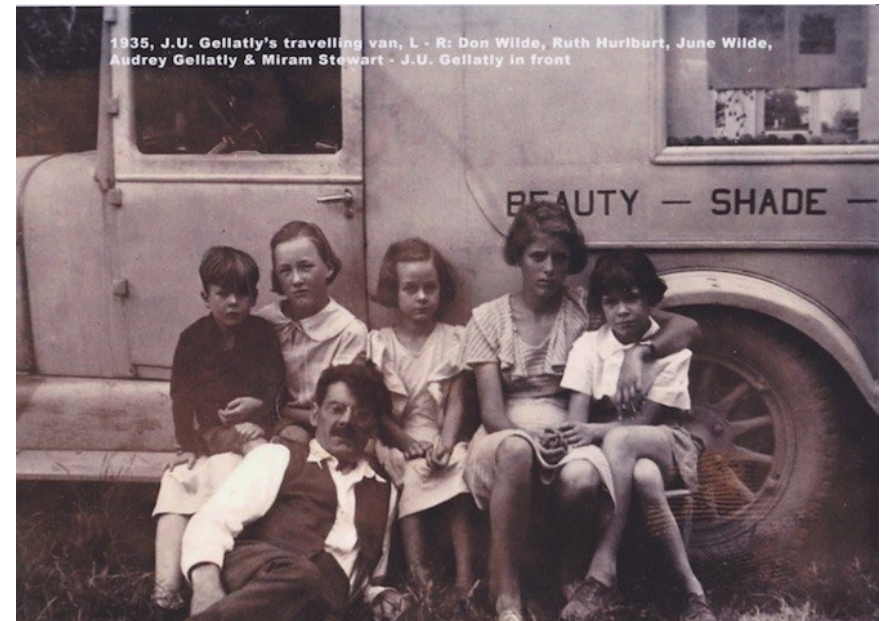
**-pure *avellana*, *columna* x *avellana*
hybrids and *cornuta* x *avellana*
hybrids**

**-seedlings of *cornuta* x *avellana*
'Filazel #45' utilized in Badgersett's
breeding program, by way of Cecil
Farris.**



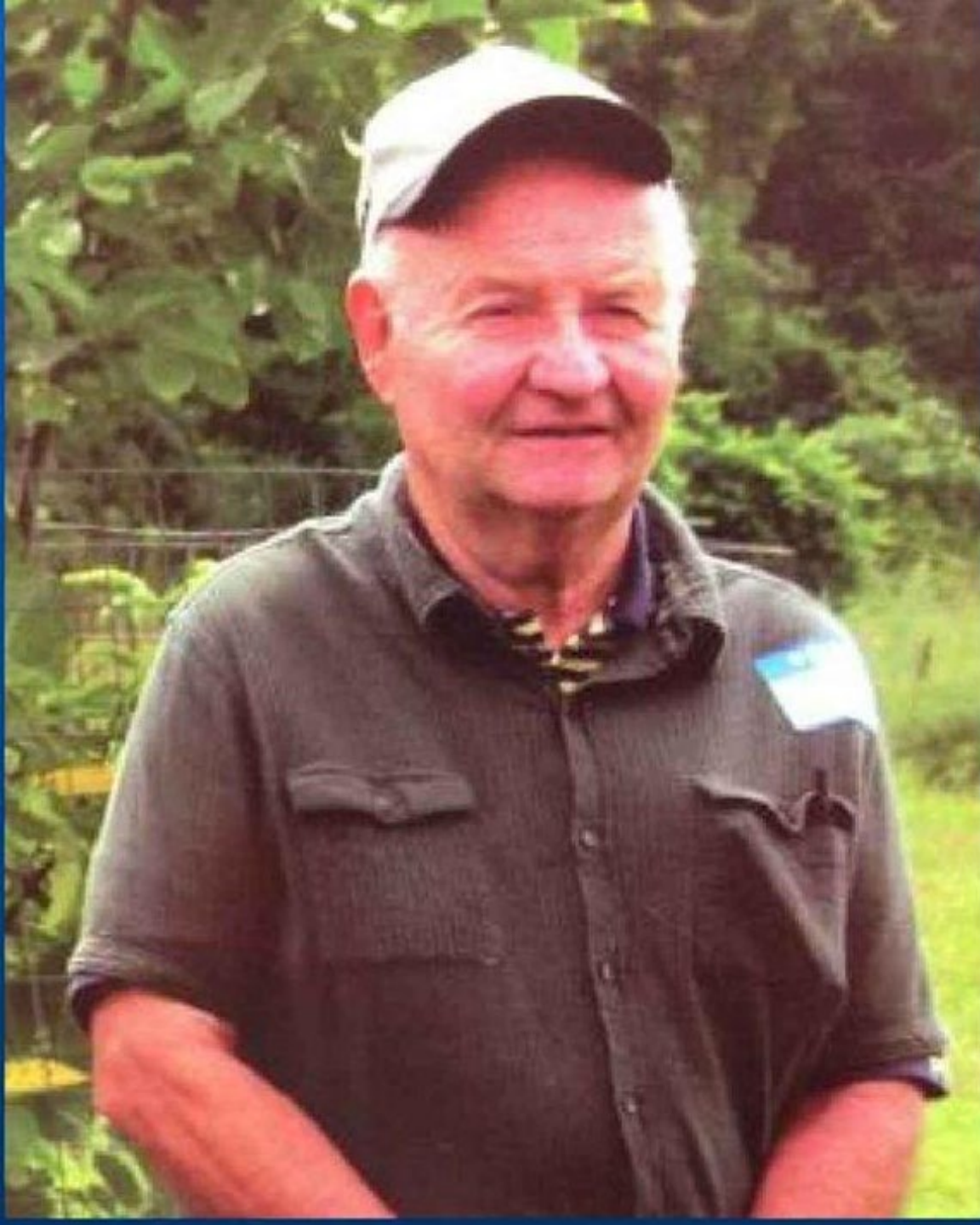
Jack Gellatly in his nut nursery.

Photo credit: <https://infotel.ca/newsitem/west-kelownas-nutty-roots-are-unique-to-the-okanagan-and-due-to-the-gellatly-family/it74378>



1935, J.U. Gellatly's travelling van, L - R: Don Wilde, Ruth Hurlburt, June Wilde, Audrey Gellatly & Miram Stewart - J.U. Gellatly in front

Direct sources of Badgersett's gene pool



-John Gordon, Amherst, NY

-1960s-2000s

-Active member of Northern Nut Growers Association, worked on a number of other nut trees besides hazelnuts

-Grew OP seedlings of Slate and Gellatly selections.

-Provided OP seed from his planting to Badgersett in early 1980s

-One or two of UMHDI's commercial selections descend from Badgersett plants originally sourced as seed from Gordon

photo credit:

[https://www.midwesthazelnuts.org/uploads/3/8/3/5/38359971/eastern_filbert_blight_the_search_for_resistance_\[compatibility_mode\].pdf](https://www.midwesthazelnuts.org/uploads/3/8/3/5/38359971/eastern_filbert_blight_the_search_for_resistance_[compatibility_mode].pdf)

The Hazel Tree



Cecil W. Farris



Photo credit: <https://nutgrowing.org/order-hazel-book/>

- Cecil Farris**, Lansing, MI, 1960s-2000s
- Self-taught breeder and nut tree enthusiast. Active with Northern Nut Growers Association
- Assembled and bred a small but highly diverse collection, including *C. heterophylla*, *C. americana*, *C. colurna*, *C. avellana*, and some of Gellatly's *colurna x avellana* and *cornuta x avellana* hybrids.
- Also known for breeding the *colurna x avellana* hybrid 'Grand Traverse'
- Supplied open-pollinated seeds of his clone of Gellatly's *cornuta x avellana* F1 'Filazel #45' to Badgersett in the early 1980s

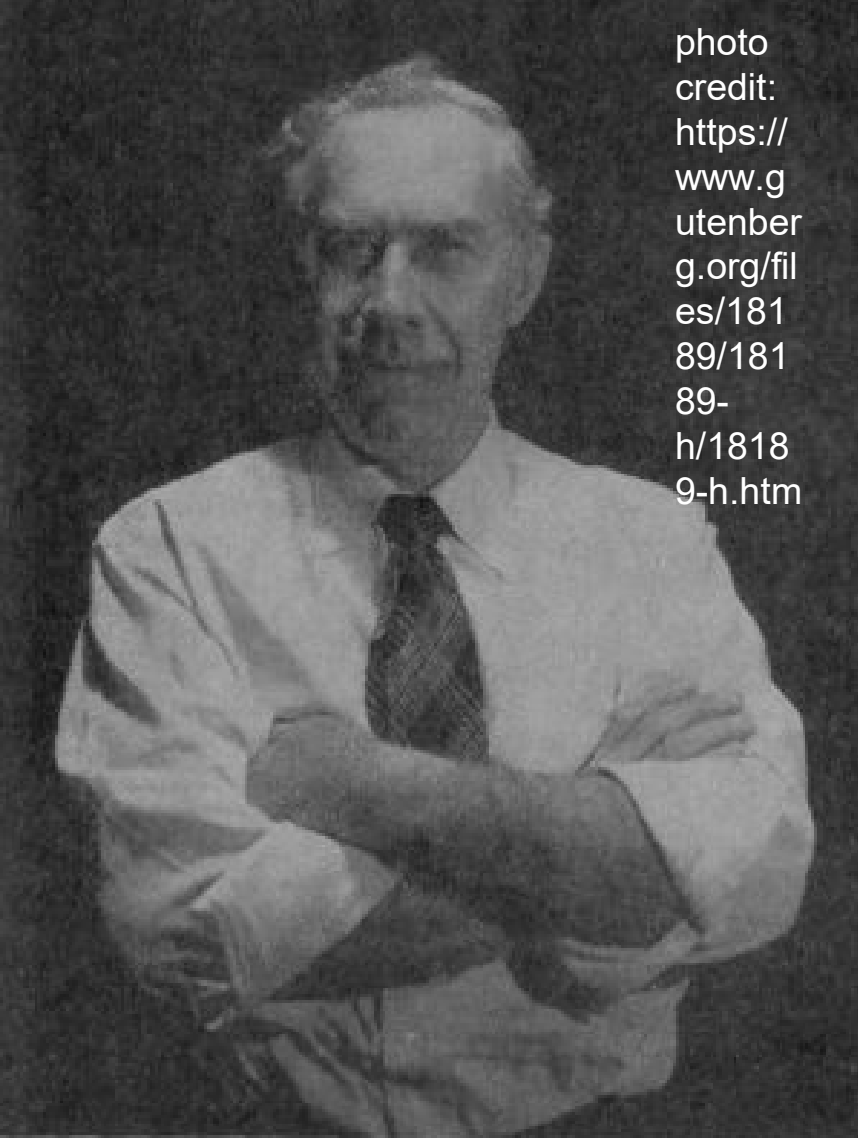


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Eat more nuts
Carl Weschcke
author

-Carl Weschcke, River Falls, WI, 1920s-1960s

-Largest, most important source of Badgersett's gene pool

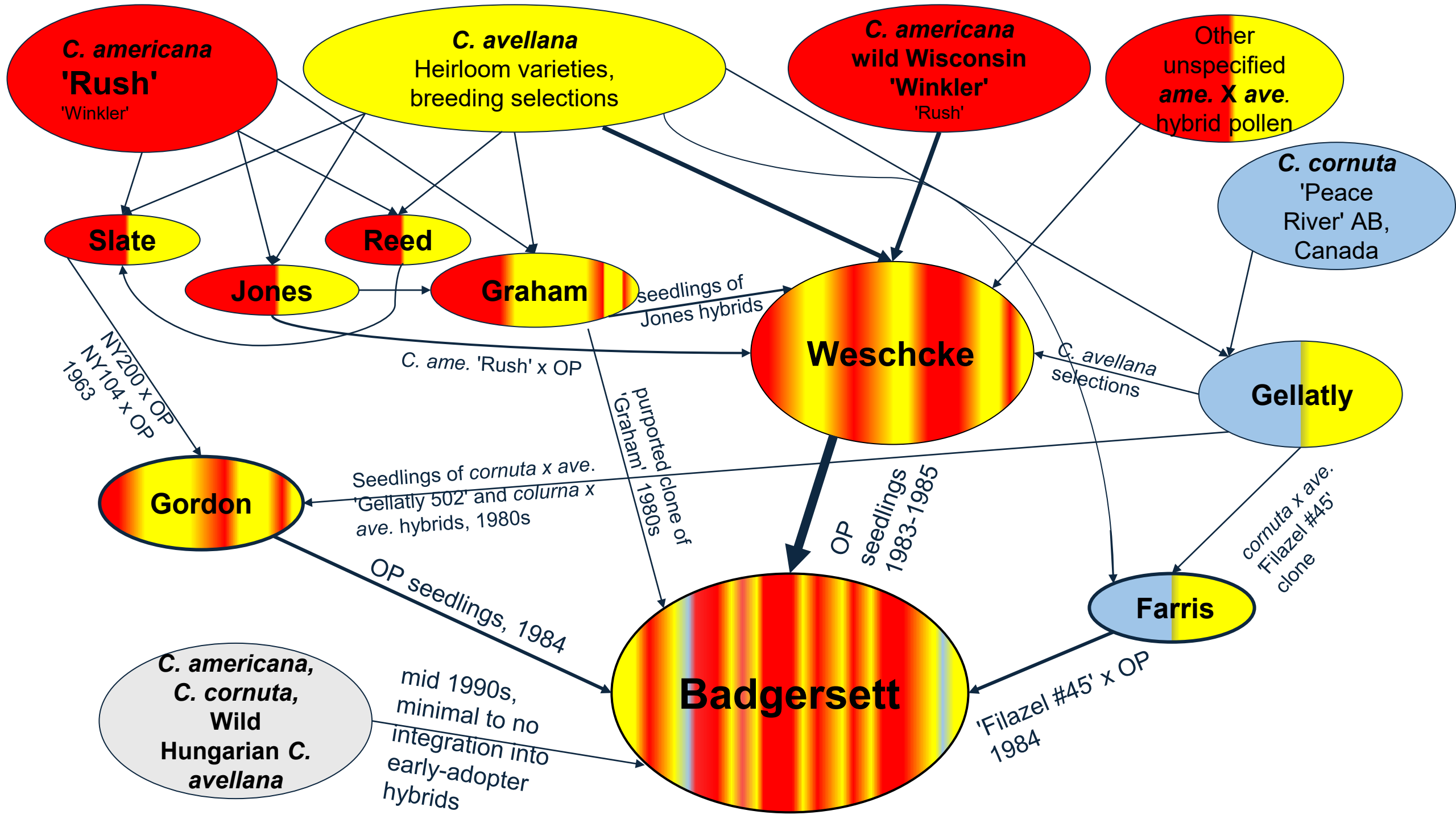
-Very active nurseryman, breeder, and member and former President of NNGA

-Planted thousands of hybrid hazelnut seedlings during his life

-Plant material included hybrid seedlings from Jones and Graham, pure *avellana* from Gellatly, F1 hybrids of wild Wisconsin *C. americana* and *C. americana* 'Winkler' with pollen from numerous *C. avellana* varieties, other unspecified hybrids, and crossing within the above mixture.

Carl Weschcke, continued

- EFB began to seriously infect his plantings towards the end of his life
- Many plants died, but thousands survived. Had mostly lost hope for his hazels by the time he passed away in 1973.
- Philip Rutter harvested open-pollinated seeds from high-yielding, climate-adapted, and disease resistant plants (3 years of observation) in the early 1980s to form the core of the Badgersett breeding program; credited Weschcke's material for saving decades of work.
- Rutter also made another smaller collection at Weschcke's focusing on larger nuts and unusual plants.



References

Weschcke, Carl (1953), *Growing Nuts in the North: A Personal Story of the Author's Experience of 33 Years with Nut Culture in Minnesota in Wisconsin*.

Available at : <https://www.gutenberg.org/files/18189/18189-h/18189-h.htm>

Molnar, Thomas J. (2011) *Corylus* L., p. 15–48. In: Kole, C. (ed.). Wild crop relatives: Genomic and breeding resources of forest trees. Vol. 10.

Rutter, Rutter-Daywater, and Wiegrefe (2015). *Growing Hybrid Hazelnuts: The New Resilient Crop for a Changing Climate*, Chelsea Green Publishing.

Brainard, Scott (2024). The first two chromosome-scale genome assemblies of American hazelnut enable comparative genomic analysis of the genus *Corylus*. *Plant Biotechnology Journal*, volume 22, issue 2.

<https://doi.org/10.1111/pbi.14199>

References, continued

Badgersett Research Corporation 2014 Woody Agriculture Short Course, DVD, viewed by Mark Hamann.

Rutter, Philip A. 1987. Badgersett Research Farm; Plantings, projects, and goals. *78th Annual Report of the Northern Nut Growers Association*, pp.173-186

Rutter, Mary (1991). Variation in resistance to eastern filbert blight in hybrid hazels. *82nd Annual Report of the Northern Nut Growers Association*, pp. 159-162

Muehlbauer et, el (2014). Characterization of eastern filbert blight-resistant hazelnut germplasm using microsatellite markers. *Journal of the American Society for Horticultural Science*. July. pp. 399-432.



Philip Rutter, Mary Lewis, Brandon Rutter-Daywater, Perry Rutter, Badgersett Research Farm, Canton, MN, beginning late 1970s

-direct or indirect source of almost all UMHDI First Generation plant material, including all of the potentially commercial selections

-originator of the woody agriculture concept

-recognized the value and potential of Weschcke's material, rescued it from oblivion, and combined it with material from Farris and Gordon to **form the base of a new crop for Upper Midwest**



Badgersett, continued

-recognized and developed bush-type hazelnuts' practical potential as a landscape-scale crop; the UMHDI hedgerow system - high density plantings with direct bush combine harvest - is an original Badgersett concept and model

-Decades of work to develop a large, genetically diverse breeding population adapted to EFB and the Upper Midwest climate, segregating for other important agronomic characteristics.

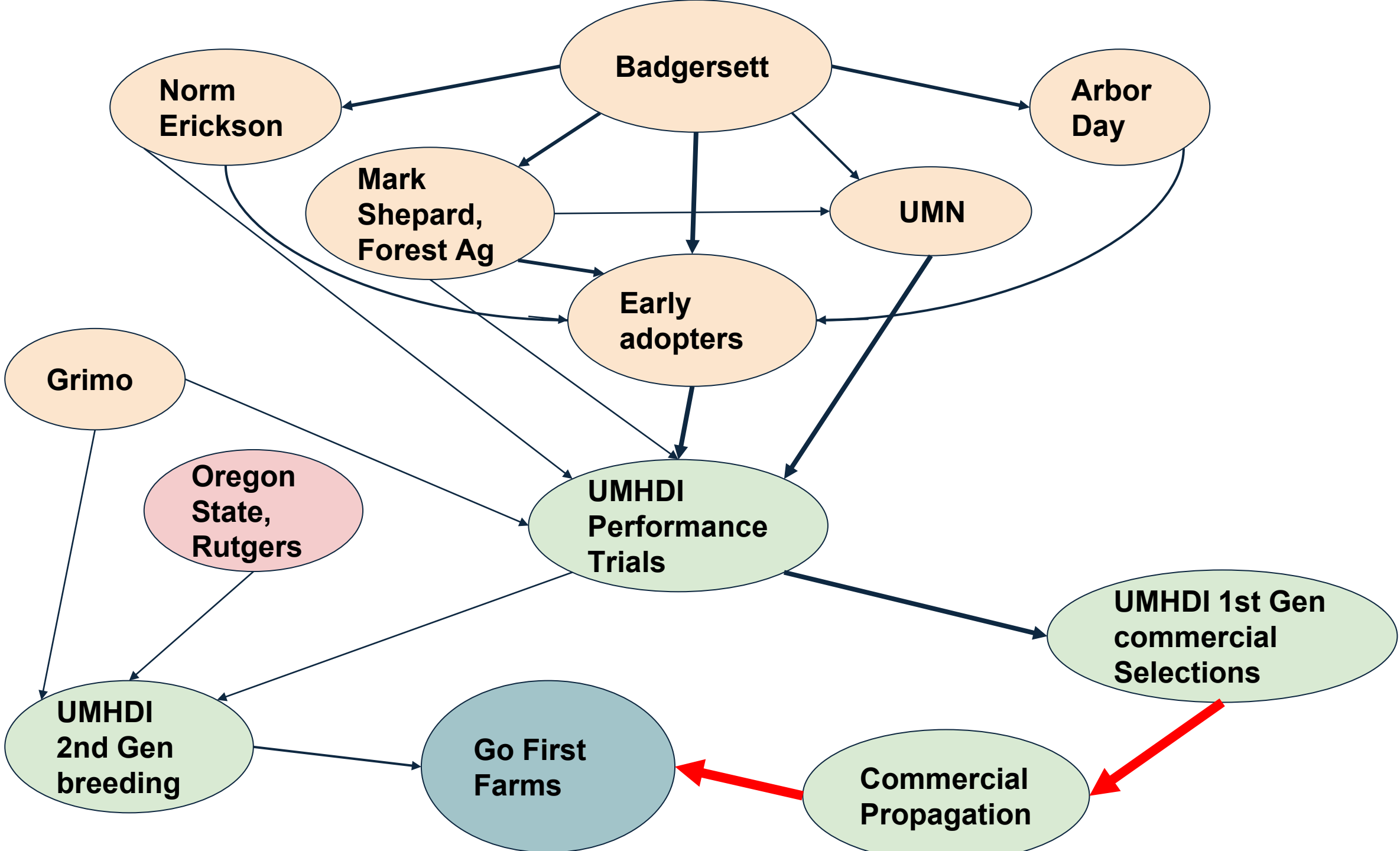
Badgersett, continued

- Long-term identification** of high-performing individual plants and promising breeding material
- Direct sales of plants to public and private growers**, 1990s-2010s, generating the initial wave of enthusiasm and adoption of hybrid hazelnuts on the landscape
- Stimulated the **first micropropagation research** with hybrid hazelnuts in late 90s-early 2000s, with Mehmet Nas and Paul Read, U. Nebraska
- First demonstrations of mechanical, direct bush harvest**, in early 2000s in cooperation with Arbor Day, and in 2011 in NW Illinois with early adopter growers
- Glad to see that Brandon is back and will continue to move the hybrid hazelnut work forward.**



photo credit: <https://www.postbulletin.com/news/a-leap-forward-for-hazelnuts>

Expansion to Public and Private Early Adopters





**Mark Shepard, New Forest
Farm/Forest Ag Nursery, Viola, WI**

-early adopter grower of Badgersett
material

-prominent promoter of hybrid
hazelnuts as a sustainable crop,
generating significant public interest
and adoption 2010s-present

-widely distributed seedlings of his
selections to the general public
through Forest Ag nursery business

Norm Erickson
Lake City, MN





Roy and
Teresa
Cerling,
Wykoff, MN

4. 2. 1999

Dave Minar
New Prague,
MN



Nancy Adams and
Joe Kempe
Le Roy, MN



Jim Mickelson
Rochester, MN



Jeff Jensen,
Fenton, IA





2008

Dennis Gibson,
Montevideo, MN

2023



Linda and Ernie Grimo, private nursery and hazelnut growers of Niagara-on-the-Lake Ontario, long time members of the Northern Nut Growers Association. Ernie, now in his 80s, started the nursery; Linda, his daughter is now running it. Different from the Badgersett gene pool, with some overlap in original source material. Contributed selections to UMHDI germplasm trials. Their selection Northern Blais looks excellent, one of the best for the Midwest.

Norm and Mary Erickson - source of Eric4-21, generous, energetic, enthusiastic, hosted multiple trials, including one of the original Germplasm Performance Trials, bought and operated (with Linda Mescke. and Jim Mickelson) the second blueberry harvester used for hazels, developed his own processing equipment

Jim Mickelson—bought a blueberry harvester with Norm and Linda, developed his own processing equipment, hosts a plant-spacing trial

Don Price - source of PriceW41, also developed his own hazelnut processing facility

Dennis and Mary Gibson – contributed plants to germplasm trials, hosts of many research trials

Roy and Teresa Cerling – contributed plants to germplasm trials, hosts of many research trials

Linda Meschke - Rural Advantage Farm in LeRoy. Partnered on the second mechanical harvester, with Norm and Jim. Driving force for promoting and funding hazelnuts at the beginning of UMHDI

John Runde – bought the first blueberry harvester and partnered with Badgersett for use of it 2011-2013; collaborated with UWI on mechanical harvesting and de-husking

Paul Ronsheim – Past president of the American Hazelnut Company, hosted many mechanical harvesting trials, developer of AHC food products

Brad Niemchek - First GM of the AHC, ran the commercial kitchen at Gays Mills.

Mike Lilja - Member of the American Hazelnut Company; hosts a plant spacing trial

Even More Early Adopters and contributors to UMHDI germplasm trials

Pam Saunders - AHC

Mary Hovel - AHC

Wayne Edgerton

Gary Smith

Dave and Florence Minar

Tom Wahl

Jim Heaser

John and Candy Cuddy

Dan and Margaret Gunthner

Richard Handeen and Audrey Arner

Bob Meyer

John Munter

Dan Johnson

Rob DeHaan

Getting Organized

Hazelnut Development Initiative Strategic Planning Meeting November 19, 2007

CINRAM

**University of Minnesota St. Paul Campus
220 Skok Hall St. Paul, MN**

Upper Midwest Hazelnut Development Initiative (UMHDI)

University of Wisconsin—Madison

University of Wisconsin –Extension

University of Wisconsin –Natural Resources

University of Minnesota--CFANS

University of Minnesota—Forever Green Initiative

List of Attendees:

Nursery Producers:

Deb McCown (Knight Hollow Nursery), Brandon Rutter (Badgersett Research Corp.), Mark Shepard (New Forest Enterprises), Gail Soens (Bailey's Nursery)

Growers:

Nancy Adams (Minnesota), Roy Cerling (Minnesota), Teresa Cerling (Minnesota), Norm Erickson (Minnesota), Michael McNeill (Iowa), Jim Mickleson (Minnesota), (also Mark Shepard, listed above, Wisc.)

Researchers:

Dean Current (U of M), Mike Demchik (UW Stevens Point), Tom Molnar (Rutgers), Scott Josiah (University of Nebraska), Brent McCown (UW Madison), Don Wyse (U of M), Jason Fischbach (UW Extension, Ashland), Jeff Jensen (Rural Advantage, Minnesota), Students Lois Braun (U of M, graduate student), Katie Cafruny (U of M, undergraduate)

Outcomes of the hazelnut planning meeting:

A 10-year strategic plan for development of a hazelnut industry in the Upper Midwest.
[Microsoft Word - Hazelnut Development Initiative.doc \(midwesthazelnuts.org\)](#)

Initiated the development of UMHDI that facilitated the second strategic planning meeting in 2018.

[UMHDI Strategic Plan draft January 18 2018.pub \(midwesthazelnuts.org\)](#)

Upper Midwest Hybrid Hazelnut Initiative-Leadership

Jason Fischbach, University of Wisconsin-Extension Division

Lois Braun, University of Minnesota-Forever Green Initiative

Hazelnut Production Potential in the Upper Midwest: A Report on Hybrid Hazelnut Yields



Jason Fischbach, UW-Extension*
Mike Demchik, UW-Stevens Point

Lois Braun, University of Minnesota
Don Wyse, University of Minnesota

Introduction

Commercial hazelnut production in the United States is currently limited to the Pacific Northwest and is based on cultivars of European hazelnut (*Corylus avellana*). United States production is approximately 2% of world production (USDA FAS, 2004). Turkey is the world's largest hazelnut exporter with 74% of production (USDA FAS 2004). Turkey exports approximately \$1.4 billion dollars worth of hazelnuts to over 100 countries (Hazelnut and Products Exporters' Association, 2010). A growing local-food economy, interest in low-input oil crops for biodiesel, and concerns about sustainability of annual row-crop agriculture is driving an interest in hazelnut production in the Upper Midwest. Existing cultivars of European hazelnut are not suitable for production in Midwestern States due to poor winter hardiness and lethal susceptibility to Eastern Filbert Blight, a fungal disease native to the region



Photo 1. Hybrid hazelnuts in the Midwest are grown as a multi-stemmed bush. High-yielding genotypes have the potential to support a thriving Midwest hazelnut industry.

and lethal susceptibility to Eastern Filbert Blight, a fungal disease native to the region

Some of UMHDI's Major Activities:

Developed successful federal grants:

Developing Native and Native-European Hybrid Hazelnut Germplasm and Agronomics for the Upper Midwest.
Wyse, D., L. Braun, B. McCowen, T. Kern, M. Demchik, J. Fischbach, L. Godsey, M. Bell, M. Miller. 2011-2015
\$946,000

2018 Updated Hazelnut Strategic Action Plan and Developed Second Federal Grant

Overcoming obstacles to hazelnut production in the Upper Midwest.
D. L Wyse, et.al. USDA-Specialty Crop research initiative \$6,600,000
2019-2023

Supporting hazelnut growers

-Outreach education, on farm support, field days, conferences, website information

Identifying select first generation hazelnut hybrids

-worked with growers to identify their best plants

Developing second generation hybrid hazelnuts

-made controlled crosses between 1st Gen selections and between 1st Gen x *avellana* from OSU and Rutgers
-10,000 new seedlings planted in breeding plots since 2013

UMHDI 1st Generation Selections

Rose 9-2

Upper Midwest
Hazelnut
Development Initiative

Why It Was Selected

This is our best all-around plant with consistently high yields and excellent percent kernel. The only negative is the thick fiber layer around the kernel, but it is easily removed with roasting.

Origin/Parentage

Rose 9-2 is a hybrid seedling selected from a University of Minnesota research planting in Rosemount, MN.

In-Shell Nut and Kernel

Both the kernel and nut are slightly long. The kernel has a thick fiber layer, but roasting is effective in removing the fiber and pellicle and flavor is excellent. The shell is thin with an average kernel percentage around 45%.

Plant Form





<https://www.midwesthazelnuts.org/processing-equipment.html>



Photo: Jason Fischbach

UMHDI Major Activities (continued)

Developing hazelnut propagation protocols

- mound layering
- stem cutting
- Micro-propagation (tissue culture)

Facilitating Commercialization Infrastructure Development

- harvesting
- de-husking
- shelling
- product development

American Hazelnut Company formed 2014

Establishing Hazelnut Production Best Management Practices

- plant establishment
- fertilization
- pest management

Evaluating the potential of American hazelnut

- developed regional *C. americana* germplasm collection

Research teams and people involved:

Hazelnut flavor profiles

Devin Peterson, OSU

Entomology

Hailey Shanovich UMN

Brian Aukema UMN

Commercialization team

Colin Cureton UMN

Jason Fischbach UWI

Propagation and Micropropagation

Jerry Cohen UMN

Renata Pincelli-Souza UMN

Molly Krieser-Tillman UMN

Senay Uger UWI

Amaya Atucha UWI

Brent McCown UWI

Steve Unverzagt Gertens

Agriculture engineering

Dave Bohnhoff, UWI

Scott Sanford, UWI

Breeding and Genetics

Les Everett UMN

Lois Braun UMN

Mark Hamann UMN

Julie Dawson UWI

Scott Brainard UWI

Mike Demchick UWI

Agronomy and Field Propagation

Lois Braun UMN

Mark Hamann UMN

Outreach Team

Greg Schweser UMN

Connie Carlson UMN

Michelle Miller UWI

Pam Porter UWI

Savanna Institute

Scott Brainard (breeding), Nate Lawrence (carbon sequestration), Erik Hagan (pilot demonstration), Zach Loken (digital imaging), David Bruce (outreach), Keefe Keely and Fred Lutzi

Major outcomes of UMHDI

Identification of high-performing hazelnut varieties through replicated trials.

Further selection for varieties that also have commercial propagation potential.

The 'Fab 4':

Arb7-1

PriceW41

Rose9-2

StapN7-6

UMHDI 1st Generation Selections

Price W41

Upper Midwest
Hazelnut
Development Initiative

Why It Was Selected

This is another all-around good plant with a growth form that is slightly more compact than Rose 9-2.

Origin/Parentage

Price W41 is a hybrid seedling selected from a private planting near Northfield, MN.

In-Shell Nut and Kernel

The in-shell nut is round and the kernel is slightly long with a pointed tip typical of hazelnut kernels. Kernel size and weight is average for the Badgercott material. There is some fiber around the kernel, but it is easily



Hopefully also including 'Northern Blais' from the Grimo's breeding program.

Recent Advances:

Early-stage commercial propagation and scale-up at Gertens with leadership provided by Steve Unverzagt. Vastly better stem cutting propagation results with select varieties than we've ever had, testament to Gertens' expertise.

American Hazelnut Company is aggregating, processing, and selling out of excellent products. Supply limited, demand infinite; grow more nuts!

Prototype commercial-scale processing line

Ashland, WI – A fantastic achievement by Jason, AHC, and the UWI engineering team. Ability to process smaller Midwest nuts no longer a question (10 mm!). System is ready to be adopted for larger commercial scale-up.

Hazelnut combine harvester on the drawing board, shooting for prototype 2024 harvest.



Go-First Farms:

**New model for commercialization of
new UMHDI hazelnut varieties:**

Multi-Purpose Go-First Farms

- De-risked early production of UMHDI 1st Gen Selections
- Collaborative evaluation of advanced UMHDI breeding material
- Demonstration and agronomic research
- Create local partnerships to develop scaled and efficient supply chains
- Led by Jason Fischback and Colin Cureton



Five of target 10 Go-First Farms underway



Farmington, MN



Finley, WI



Spooner, WI



Ashland, WI



Spring Green, WI

UMHDI Considerations for the future of the Midwestern Hazelnut Enterprise

Cheap, massive propagation capacity

- Stoolbeds and stem cuttings are near-to-medium term solutions
- Manhattan Project for tissue culture/somatic embryogenesis

Economic Success for Growers, Paired with Environmental Outcomes

- Grower innovation and entrepreneurship
- Public and private innovation and cooperation

Continuously improving new plant material

- Public and private sector
- Important role for growers - identifying promising new material in their plantings, testing new releases

Upper Midwest Hybrid Hazelnut Industry is on the Verge of Becoming a Reality

The future looks very bright

- Collaborations are now in place
- Public and private sector organizations are committed
- High quality germplasm has been identified
- Effective propagation techniques have been identified
- Models to capitalize the production, processing, supply chain development, and marketing are being explored.

Thank you



Linda Meschke

President and Founder Rural Advantage- 2003

BERBI Executive Director-1996

Farm Partner 1980 –25 years

Agriculture Inspector Water Planning, Martin County-1988

Farmers Home Administration-1985

**University of Wisconsin-River Falls, BS, Agricultural Education
1978**

**University of Minnesota-Crookston, Associate of Applied
Science**

Degree, Meat and Poultry Science-1976

Rural Advantage:

Rural Advantage's mission is to promote the connections between agriculture, the environment, and rural communities, in order to improve ecological health, economic viability, and rural vitality.

Rural Advantage Third Crop Initiative is Linda's Major Focus, Designed to:

- Support working lands
- Economic returns to family farms
- Ecological services to society
- Local processing and markets
- Stronger rural communities



Initiative focused on adding perennial crops, and cropping systems that provided a continuous living landscape cover.

- Grass lands—grazing and biofuels
- Agroforestry-hybrid hazelnuts and willows
- Wind energy
- Eco-tourism
- Bioenergy
- Recreation



Some of Linda's other Initiatives:

**Establishing and then Developing Markets for 3rd
Crops:**

**Local food, local energy and ecological services
payment.**

ECoPay Pack

The Madelia Model

Farm2Cafeteria Net Work

On behalf of everyone in the hybrid hazelnut community, we want to thank Linda Meschke for all of the dedication, hard work, leadership and friendship that she provided to the community over many years.