

From the gene to the field: A retrospective
summary of alfalfa research by the USDA-ARS-Plant
Science Research Unit
1958-2026

Deborah A. Samac
2026 NAAIC



Agricultural Research Service

“In-house” research agency of USDA

ARS delivers scientific solutions to national and global agricultural challenges.

We seek ways to:

- produce more and better food and fiber
- control insect pests and weeds safely
- get food to consumers in better condition
- improve human nutrition and well-being
- help protect soil, water, and air
- improve animal health
- find new uses for agricultural commodities



ARS research has...

- ▶ Established and maintained seed banks for all US crops
- ▶ Worked on all foods found in your shopping cart: apples to zucchini
- ▶ Helped to triple milk production in the past 50 years
- ▶ Developed new uses for crops: soy ink, diaper absorbent, lactose free-milk
- ▶ Improved health and safety across the US
 - ▶ DEET insect repellant
 - ▶ Mass production of penicillin

See: Science in Your Shopping Cart

www.ars.usda/is/np/shopcart/shopcartintro.html



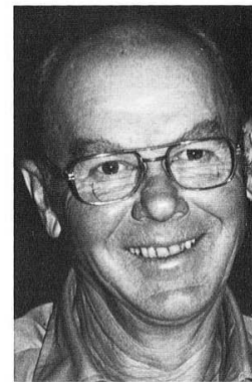
Alfalfa in Minnesota

- ▶ Grimm alfalfa: The first winter hardy alfalfa, 1850s



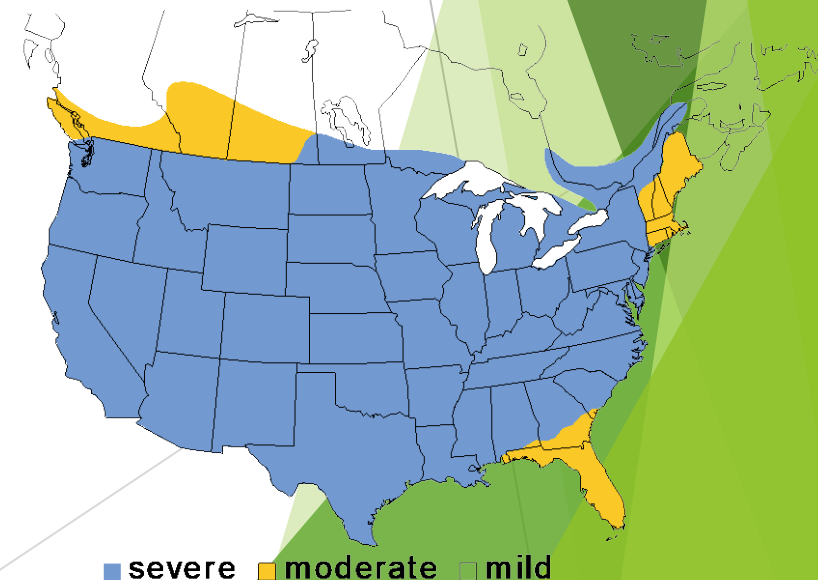
Early years (1958-1970s)

Disease resistance breeding



- ▶ Fred Frosheiser, Plant Pathologist
- ▶ Robert Stucker, Plant Breeder
- ▶ Donald Barnes, Plant Geneticist

Phytophthora root rot



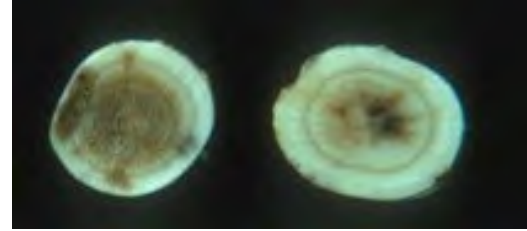


Agate: The first PRR resistant variety

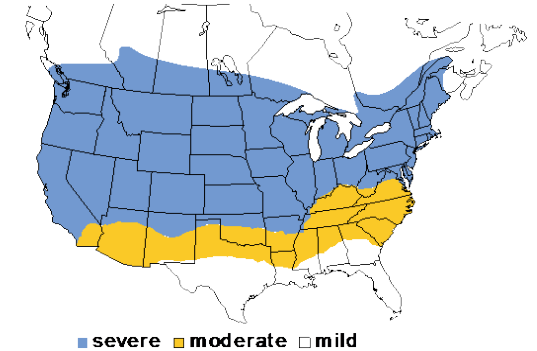


Developing standard tests

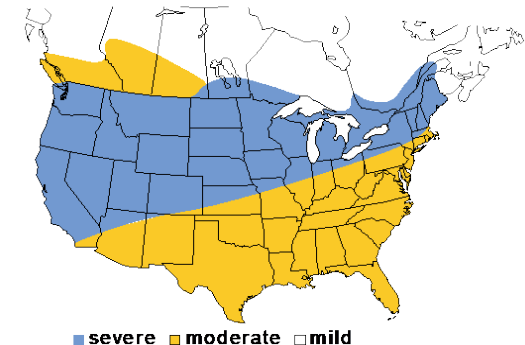
- ▶ Pathogen ID, culture, inoculation, scoring schemes
- ▶ Disease nursery tests for industry and academics
 - ▶ Digging parties
- ▶ Germplasm characterization and improvement
- ▶ Genetics of resistance
- ▶ Training of alfalfa breeders and pathologists



Bacterial wilt

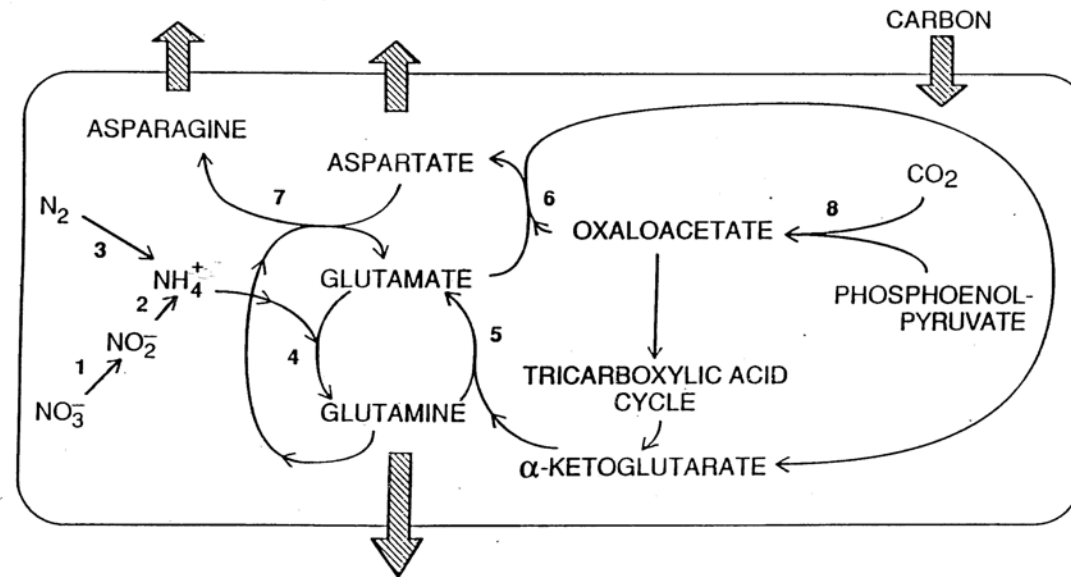


Fusarium wilt



Physiology and molecular biology of N fixation (1980s-2000)

- ▶ Carroll Vance
- ▶ Gary Heichel



Development of 'Ineffective' alfalfa

- ▶ Ideal control for measuring nitrogen fixation in lab and field sites
- ▶ Demonstrated use in phytoremediation



Development of 'Nitro' a non-dormant alfalfa for use as a green manure

- ▶ N yield: 79 lbs/ac
- ▶ Total season forage biomass 3.88 tons/ ac.



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Managing the Rotation from Alfalfa to Corn

Matt A. Yost, Jeffrey A. Coulter, and Michael P. Russelle

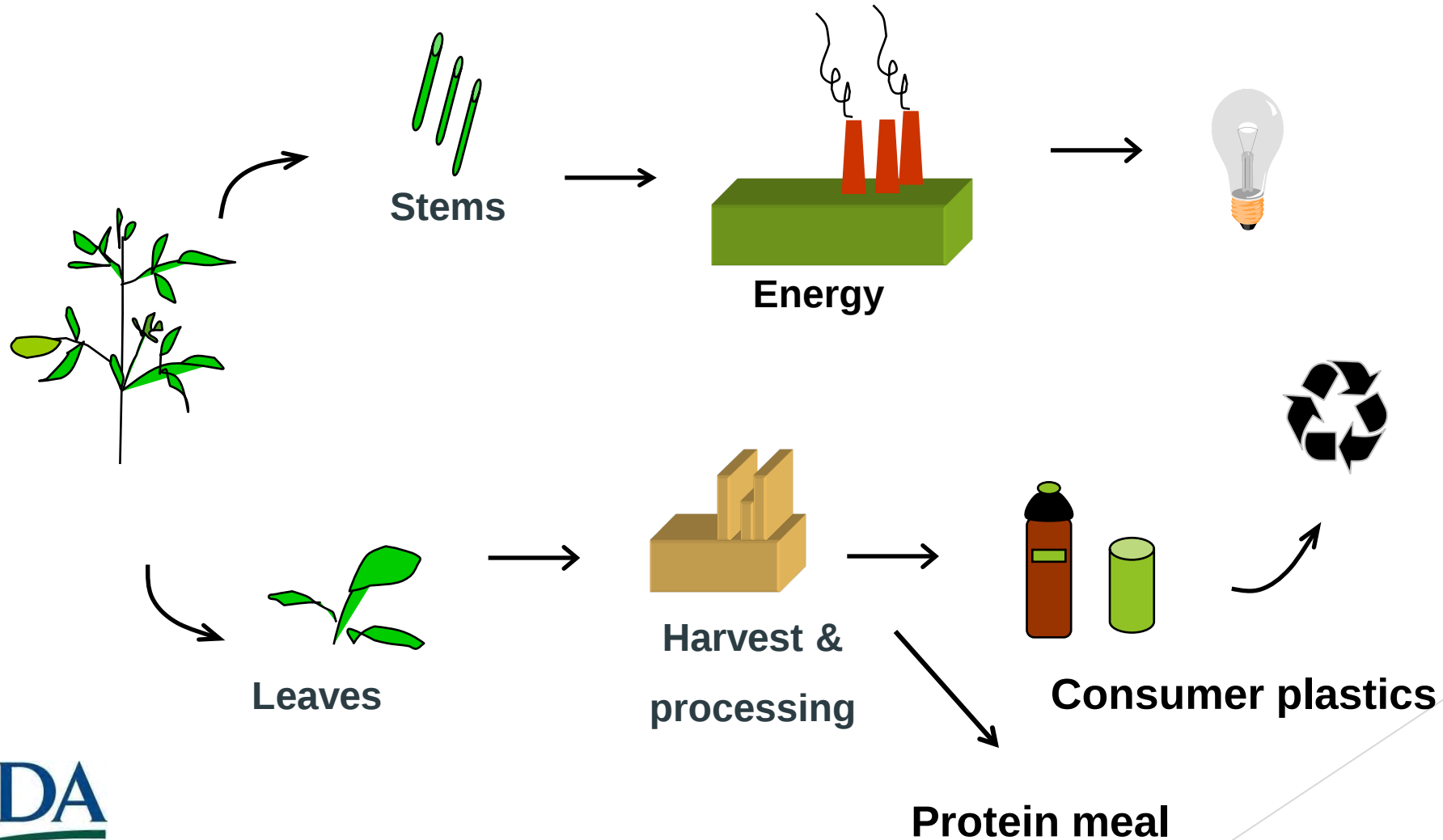


Development and evaluation of core collections (1980-1990)

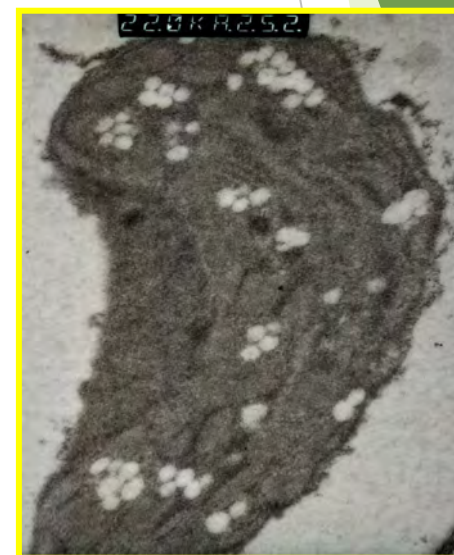
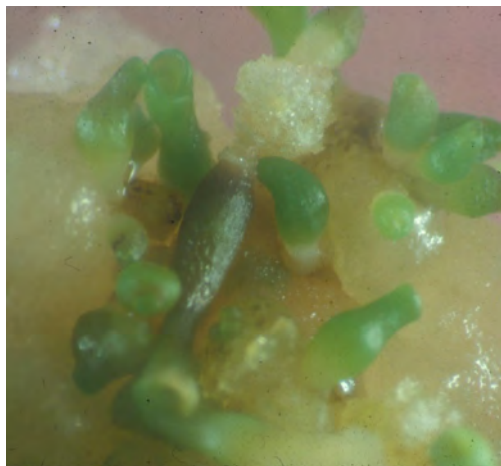
- ▶ Alfalfa
- ▶ Annual medics



Forage quality and bioenergy (2000-2010)



Biotechnology



Transgenic

Wild-type

5 μ g/ml atrazine

Breeding for root and stem traits (2000-present)



Genomics and molecular breeding

- ▶ Development of 3K SNP panel with Breeding Insight
- ▶ Genomic selection for
 - ▶ Fiber digestibility
 - ▶ Root system architecture
 - ▶ Winter survival
 - ▶ Crude protein and other nutrients
- ▶ QTL mapping of disease resistance genes
- ▶ Reference genome sequences of North American alfalfas





Thank you!

