

Scientific and Technological Achievements of USDA Agencies and Emerging Technologies in Agriculture

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USDA's principal intramural scientific research agency

INFRASTRUCTURE:

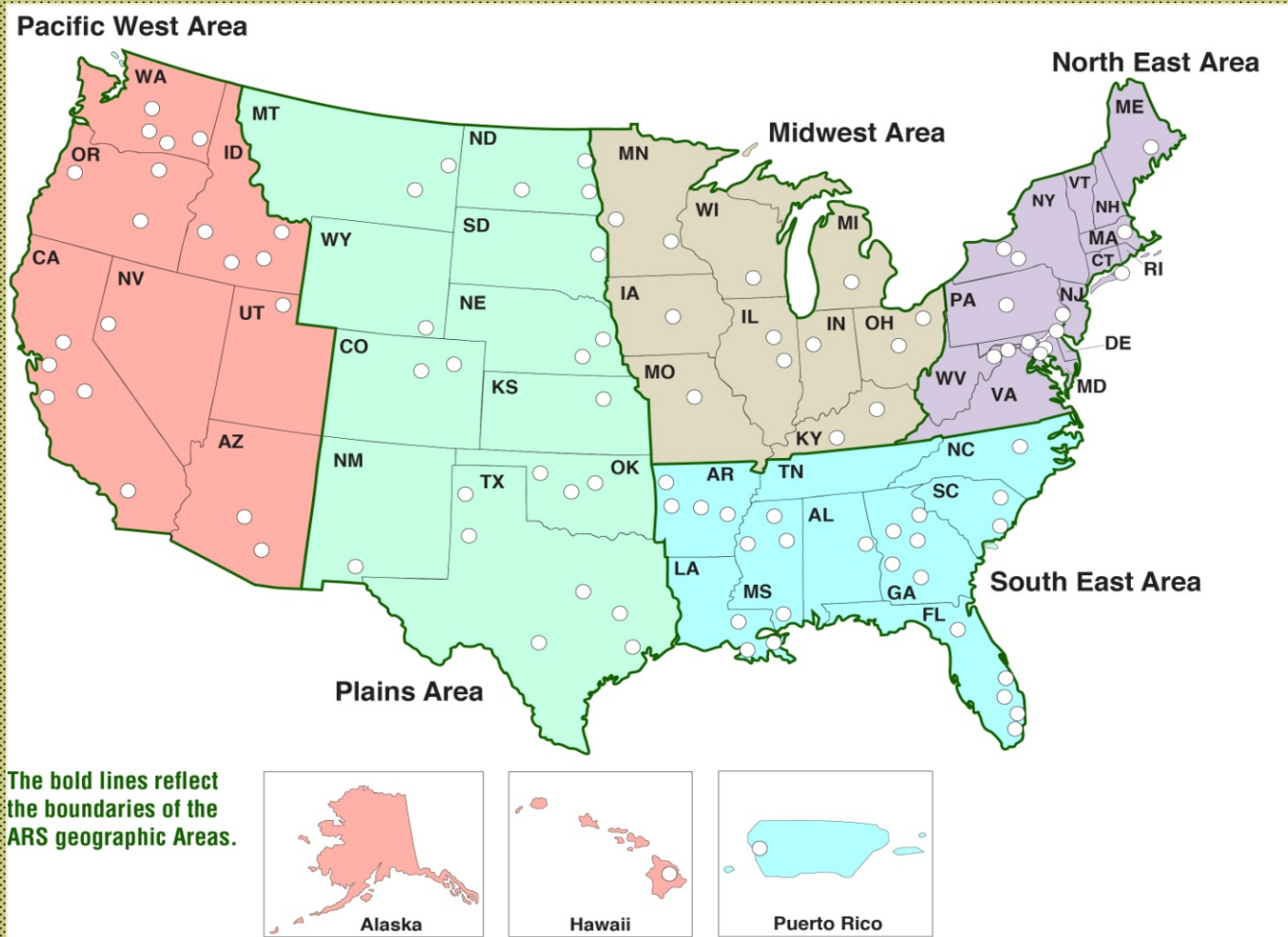
- 2,000 Ph.D. scientists
- 6,000 other employees
- 700+ research projects
- \$1.1 billion annual budget



AGRICULTURAL RESEARCH SERVICE

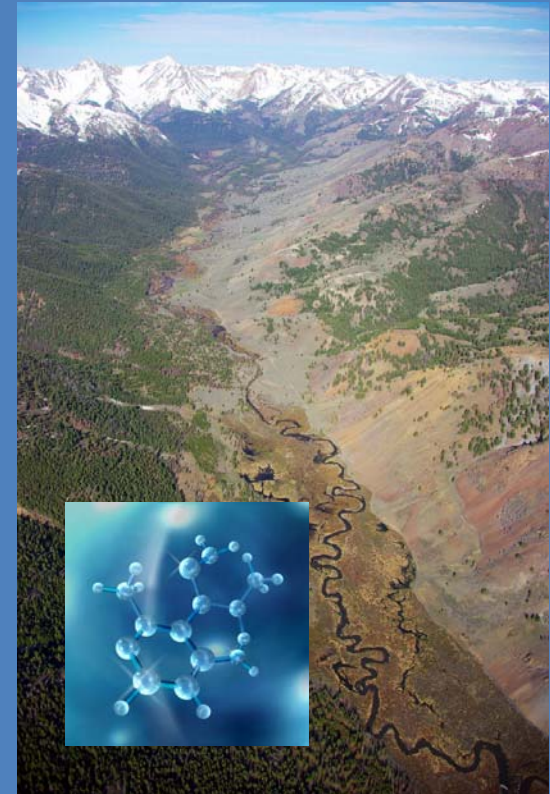
ARS Labs

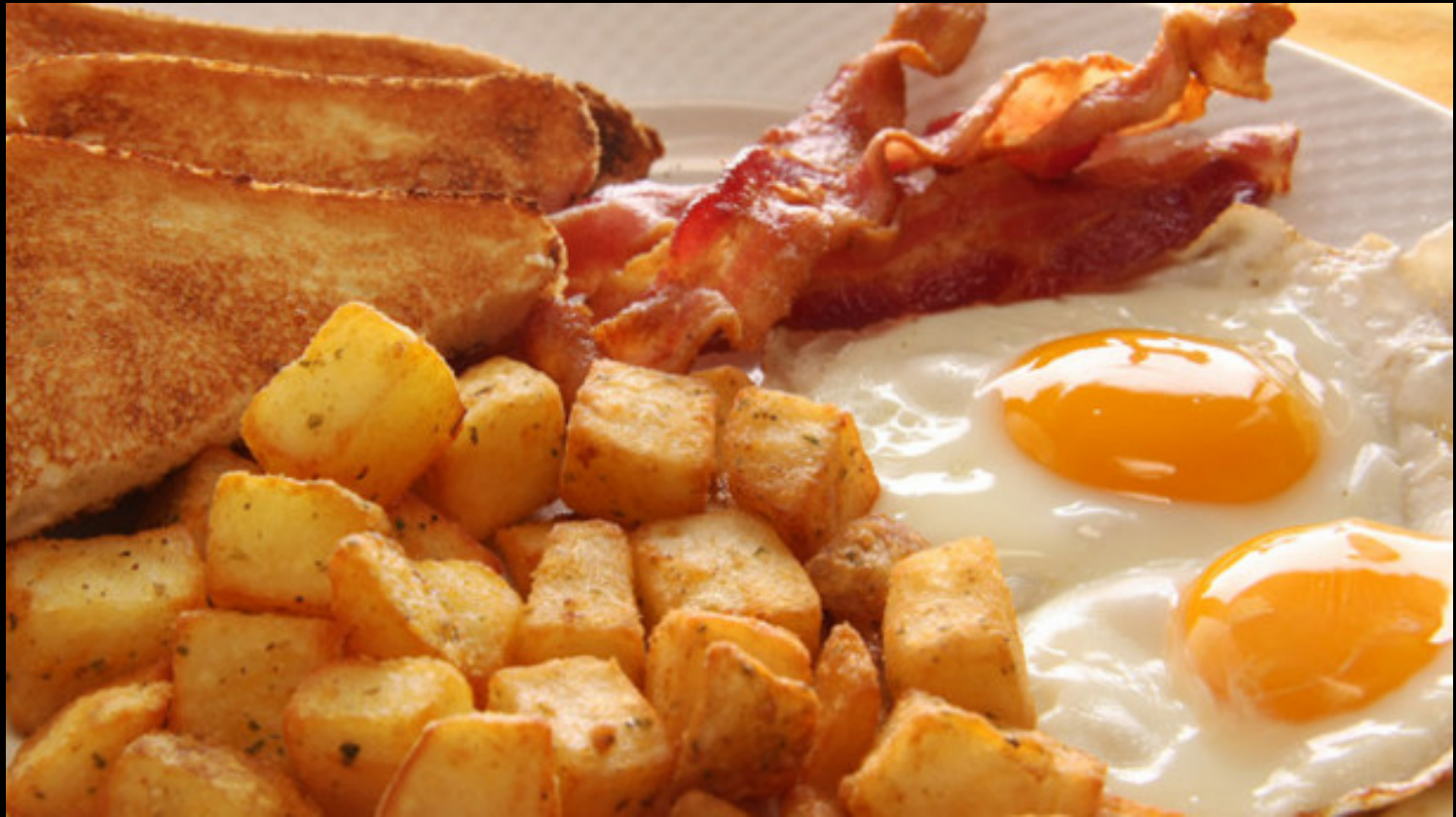
ARS research facilities are in about 90 U.S. locations and in Argentina, Australia, China, and France.



Innovation: New fundamental knowledge for solutions to the problems facing American Agriculture

- Farm to Table
- Apples to Zucchini's
- Molecules to Watersheds





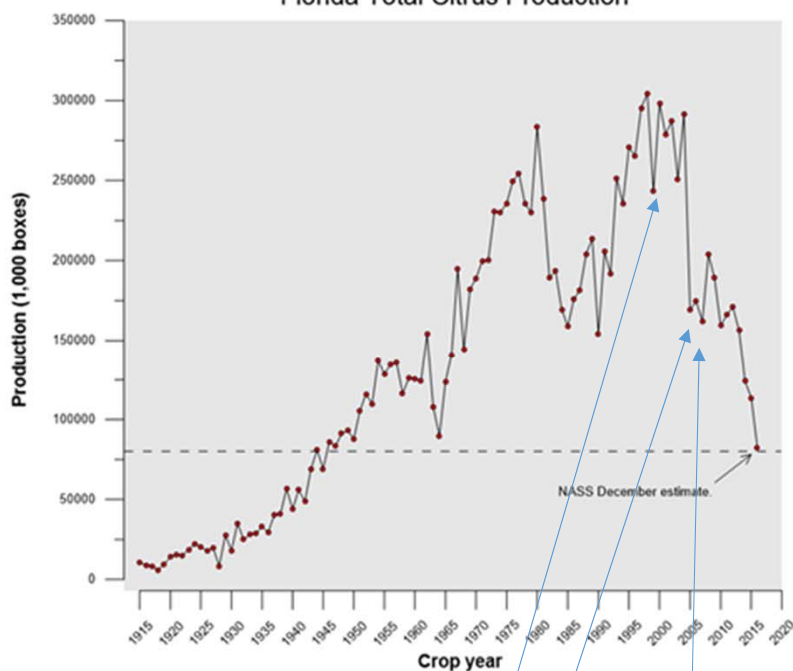




ARS Response to Citrus Greening: *All Hands on Deck*

Current situation in Florida

Florida Total Citrus Production



Insect vector (ACP) detected; 1998

Canker eradication program stopped; 2004

HLB citrus greening pathogen (*Liberibacter*) detected; 2005





'FasTrack' Revolutionizes Tree Fruit Breeding



'FasTRACK'

- One year generation time
- Can make crosses and produce fruit year-round
- Avoids winter and spring injury in the field
- Fewer insects and diseases in greenhouse



NASA evaluating FASTRACK for future missions



CONVENTIONAL

- 4-6 year generation time
- One pollination/fruiting per year
- Subject to seasonal climate extremes
- Disease, insect, and weed pressures





Antibiotics are used widely in the poultry industry

- Fight diseases
- Promote growth
- Over time, can select for microbes that can resist antibiotics

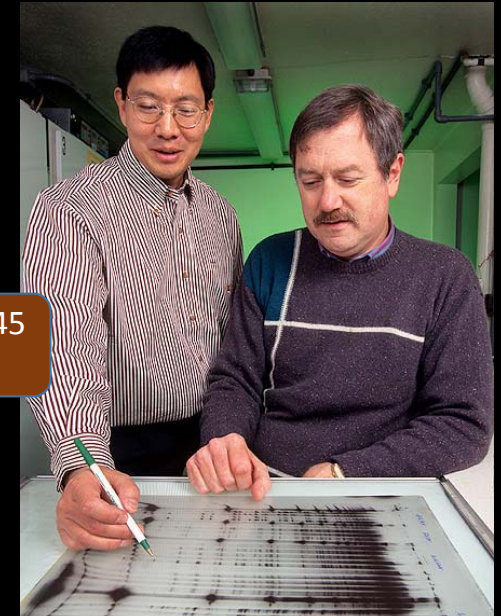
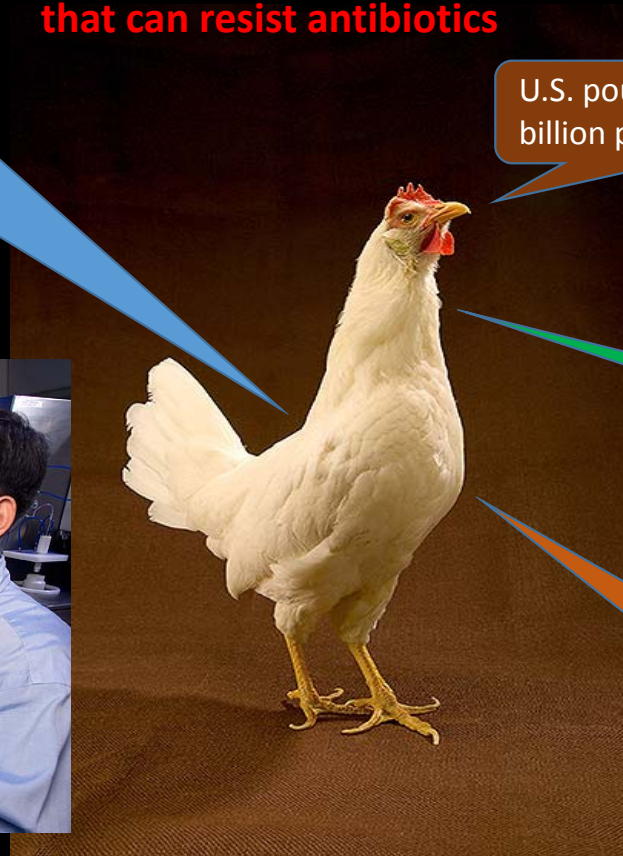
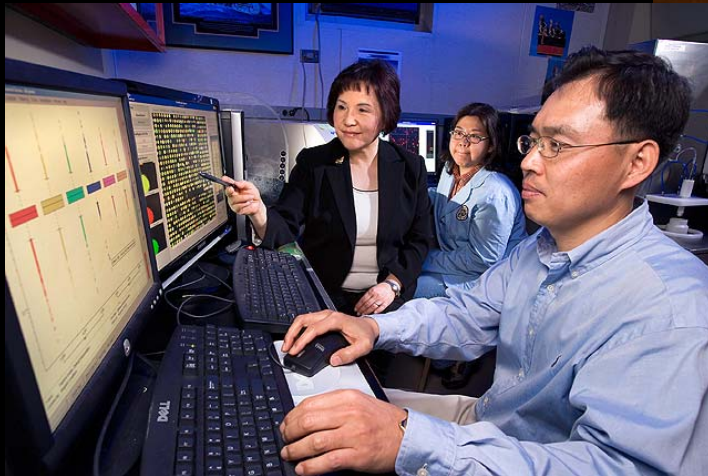
Feed young chickens with:

- A common bacterium in the environment (probiotic)
- Organic selenium
- Extracts of chili peppers, cinnamon, turmeric, garlic, aloe vera, green tea.....

U.S. poultry industry: \$45 billion per year!

Mapping the chicken genome

Egg yolk powder from hyperimmunized chickens



Pepper

Genetic Resources & Breeding

- *Specialty sweet bells*
- *Fresh-cut applications*
- *High-value ornamentals*
- *Flavor & color genetics*
- *Disease resistance*





A New Vaccine for Foot-and-Mouth Disease

- **Problem:**

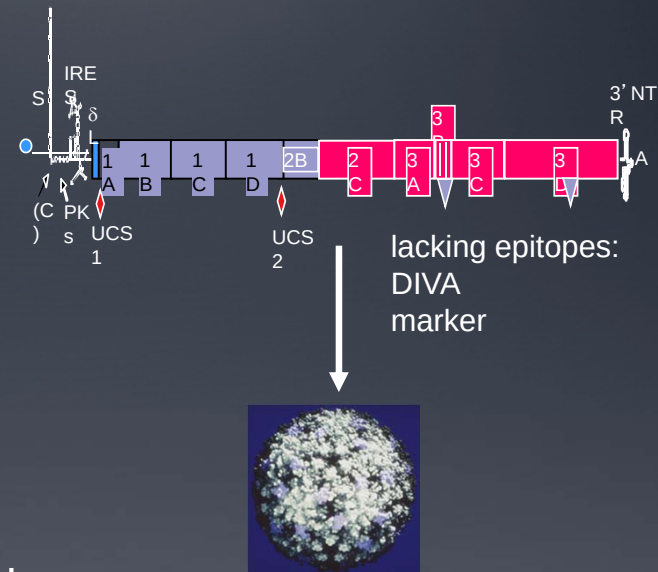
- Potential impact of FMD in the US up to \$140B
- Current vaccine is made with highly virulent virus
- US vaccine bank is solely dependent on overseas manufacturers

- **Solution:**

- ARS developed a vaccine that is effective, safe for US manufacturing, and low cost

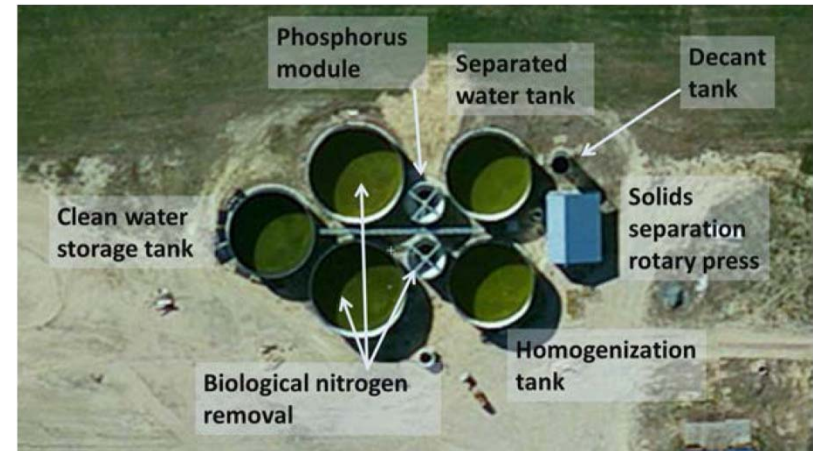
- **Safe production:**

- Built-in markers allow differentiating infected from vaccinated animals
- Lower doses than current vaccine
- Allows rapid response
- Commercial partner: Zoetis
- Awaiting regulatory approval to allow full development



Technology to recover nutrients and more from swine manure

- Use bacteria to remove nitrogen that would be lost as ammonia to the air
- Use alkaline chemical reactions to recover phosphorus that would be lost to water
- In a full-size demonstration, the system handled 75,000 gallons of manure per day.
- Highly efficient:
 - ✓ 99% of suspended solids
 - ✓ 100% of ammonia
 - ✓ 92% of phosphorus
 - ✓ 95% or more of copper and zinc
 - ✓ 99.98 of fecal coliform bacteria
 - ✓ 100% of odor causing compounds
- Recovered nitrogen, phosphorus, and solids can be marketed for cost recovery.
- Effluent meets state environmental standards.
- Applications for dairy and municipal wastewater.







1934-1942
Stanley Marsden

Beltville Small White

- ✓ Fit home ovens & refrigerators
- ✓ More white meat
- ✓ White pin feathers





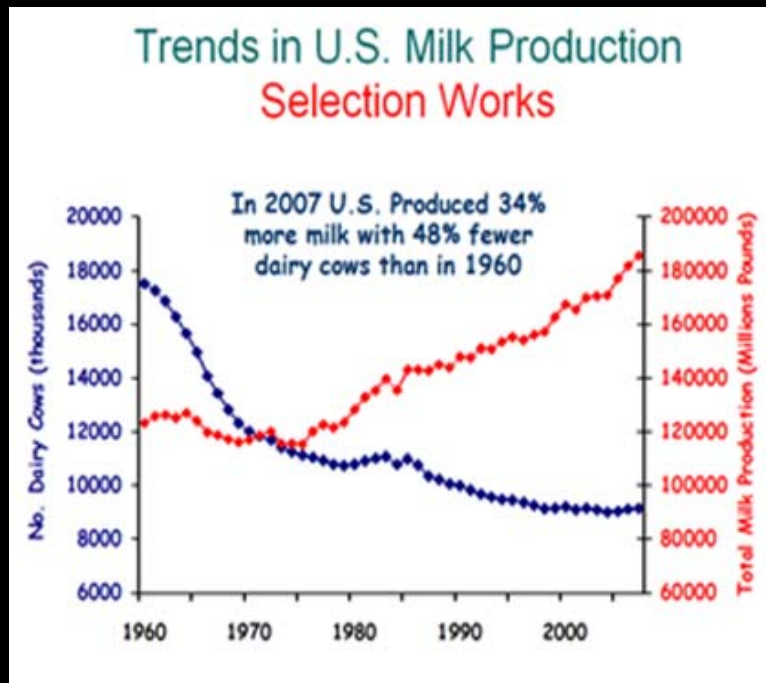
Decision support tool integrates research: The Potato Systems Planner

What crop rotations in Maine will lead to the best potato production?

- Different crops in the rotation
- Management inputs
- Yields of each crop
- Level of nitrogen recycling
- Soil microorganism activity
- Disease incidence
- Economic feasibility







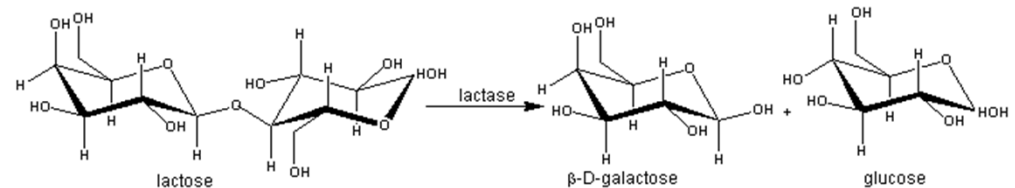
ARS and industry partners have increased milk production while reducing the number of dairy cows.

- An increasing number of traits is considered in the merit index.
 - Pre 1994: milk, fat, protein
 - Now: milk, fat, protein, longevity, mastitis resistance, conformation traits, fertility, calving ease, stillbirths
 - More traits to be added
- Use genomics markers rather than pedigree analysis
 - Rapid identification of animals for breeding
 - Selection for traits that have low heritability



Reduced lactose in dairy foods

Microbial enzyme and processing research that resulted in lactose-reduced and lactose-free dairy products being made available to the 30-50 million American consumers who have problems digesting lactose. New products helped increase milk consumption by 2%.





Emerging diseases can threaten crops that feed the world: Ug99 Wheat Stem Rust

USDA-ARS accomplishments

- Sequenced the Ug99 stem rust pathogen
- Yearly screening of new US varieties in Kenya
- Identified several new sources of resistance
- Sequenced wheat resistance gene to Ug99
- Breeding for resistance with University breeders
- Identified additional new races of stem rust





ARS Bee Research

Presidential Pollinator Plan

Parasites



Pathogens



Electron micrograph of a purified (left) preparation and of clarified crude sap from infected bee hemolymph (right). TNV (117,000 nm) was added to the right micrograph as a size marker. The bars in the left micrograph represent 100 nm.

Pests



Pesticides



Poor Nutrition



“Integrated Bee Management”





Coffee Berry Borer in Hawaii and Puerto Rico Initiated an Areawide Pest Control Program in 2013

A multi-prong attack on this beetle:

- Remove berries left in the field after harvest
- Repellents to ward them off
- Plant treatments to starve the beetles between harvests
- Spray only when necessary.
- Use effective native biological control agents

Current research:

- GIS system to predict invasions
- Gut microbes – caffeine detox and digestion (allows beetle to reproduce)





Food safety

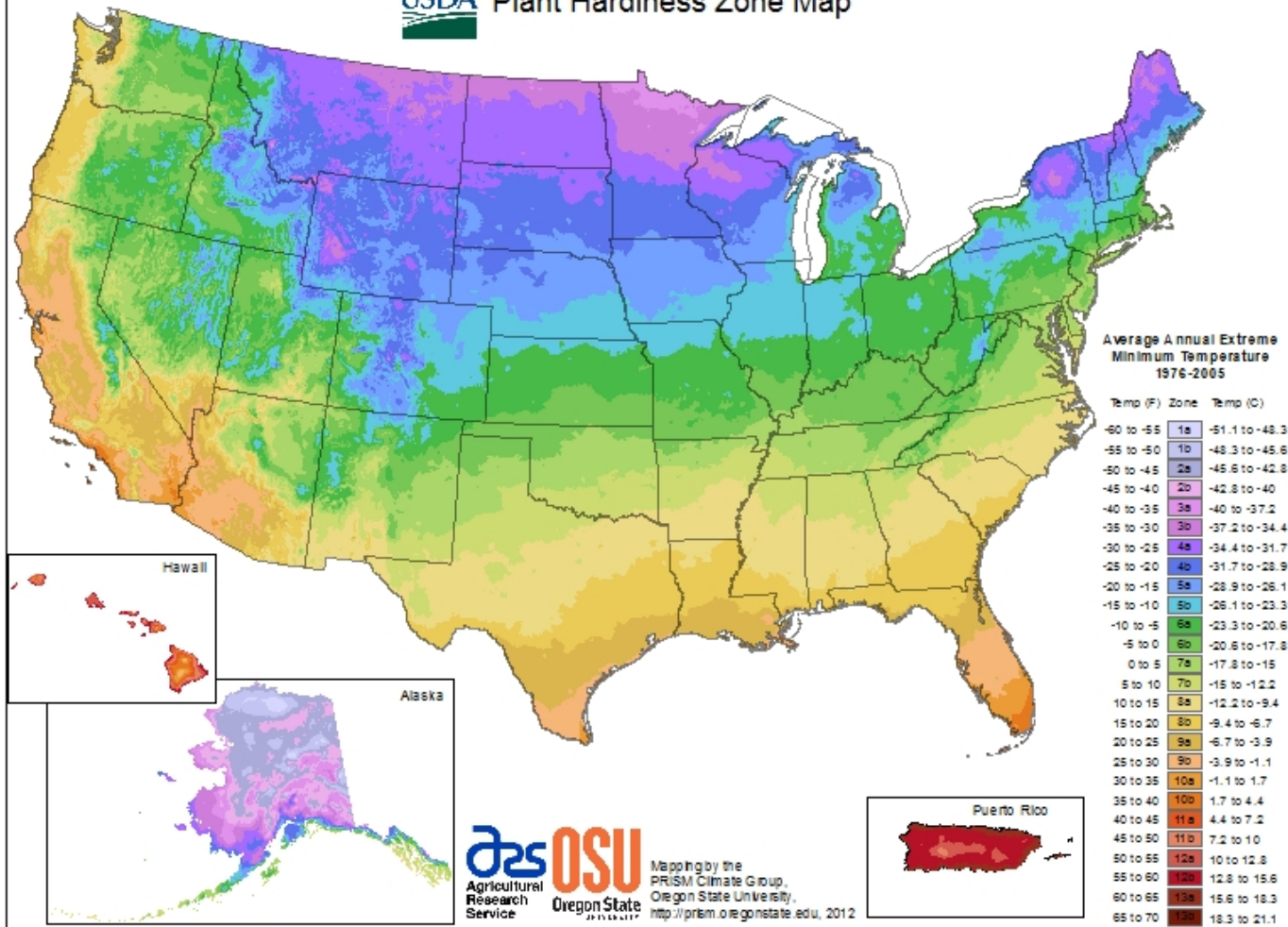
Cold plasma is generated by passing high-voltage electricity through air.

The plasma can eliminate microbes on the surface of foods like fruits and nuts without damaging it.



Multispectral imaging detects contamination on poultry.

USDA Plant Hardiness Zone Map



*Leading America towards a better future through
agricultural research and information.*

