


March 2021

Agricultural Research Partnerships (ARP) Network NOTES

Welcome to ARP Network Quarterly Notes! Our goal is to keep you informed about ARP Network and Agricultural Research Service's current information. We hope that the notes build networking opportunities for businesses to connect with ARP Network Members.

Please help us spread the word by sharing ARP Network Notes with your company contacts, colleagues, other organizations, etc. Thank you!

ARP Network

The ARP Network enlists the help of partners to spark economic development, entrepreneurship and community development. USDA ARS founded the ARP Network to expand the impact of ARS research and provide resources to help companies grow. By combining ARS research expertise with complementary capabilities and talents of partnering organizations, the ARP Network helps stimulate economic growth through technological advancements. The ARP Network matches business needs with ARS innovations and research capabilities and provides business assistant services to help companies and startups solve agricultural problems, develop products and create new jobs. Learn more by visiting us on LinkedIn: https://www.linkedin.com/in/agricultural-research-partnerships-arp-network-3863a8147

ARS Office of Technology Website

Check out our website: https://www.ars.usda.gov/ott

Office of Technology Transfer

The Office of Technology Transfer (OTT) helps move Agricultural Research Service (ARS) research discoveries to market to solve agricultural problems and expand the economic impact of ARS research and development.

ARS Partnership and/or Licensing Opportunities

ARS is looking for industry partners interested in commercializing these technologies and/or evaluating them for potential commercial applications through a Cooperative Research and Development Agreement (CRADA). Many of these technologies are also available for licensing

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Immunogenic Composition to Prevent *Francisella* Infections in Fish

Increasingly, tilapia and other fish species have become the focus of healthy and sustainable farming methods. However, disease agents are a major threat to increased fish production. Piscine francisellosis, caused by *Francisella orientalis* (also known as *Francisella noatunensis* subsp. *orientalis (Fo), Francisella asiatica),* is a highly infectious disease that affects a wide range of fish species. There are currently no commercial vaccines to prevent francisellosis - and treatment options are extremely limited.

This invention is a recombinant vaccine that is effective at immunizing fish against *Francisella*-related infections. The vaccine is based on immunoproteomic approaches to identify immuno-dominant proteins in proteome of *Francisella orientalis* - from which a specific gene was found to stimulate a protective immune response (initially demonstrated in tilapia). In a trial testing the recombinant vaccine, immunized fish were shown to have a survival rate of over 80% after a 15-day exposure.

Benefits

- Could prevent economic losses in tilapia and other farmed fish species
- This vaccine does not have the risks associated with live-attenuated vaccines

Applications

- Prevent *Francisella*-related infections in fish

Docket No: 70.20. Please contact Tanaga Boozer: tanaga.boozer@usda.gov

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Process for Producing Hydrocarbons Useful for Jet Fuel

The synthesis of renewable jet fuel is a high-profile objective. Catalysts that perform a decarboxylation reaction needed for this process have been developed. However, the amount of aromatic molecules they form in the product fuel is low, so low that those products cannot be used at many blend ratios. ARS developed a new decarboxylation technology that produces fuel aromatic contents greater than prior technologies. This new renewable fuel can be blended with conventional jet fuel in any proportion

and still leave sufficient aromatic molecules in the fuel. The new technology has been studied under a variety of conditions and compares well with a previously invented method.

Benefits

- Can turn oleic acid into a suitable jet fuel hydrocarbon
- Can be used in combination with other ARS technologies
- Has been studied with High Oleic soybean oil

Applications

- A catalytic process for producing a biobased fuel product that can be used in applications which require significant aromatic content in the fuel, such as jet fuel

Docket No: 40.19. Please contact Renee Wagner: renee.wagner@usda.gov

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Synergistic Anti-browning-Antimicrobial Composition

A synergistic antibrowning-antimicrobial solution to kill foodborne bacterial pathogens on produce surfaces and inhibits browning of fresh-cut apples. The solution consists of several compounds generally regarded as safe (GRAS), and would not pose any food safety hazards.

Benefits

- Kills bacterial pathogens and slows browning in fresh-cut fruits
- A single solution with dual purpose (sanitizer and anti-browning activity)
- Can also be sprayed on fresh-cut fruits instead of submersion
- Safety GRAS ingredients as a minimal processing aid for fruits and vegetables
- Solution is stable at room or refrigeration temperature

Applications

- Provides microbial safety of fresh-cut fruits

Docket No: 52.19. Please contact Jim Poulos: jim.poulos@usda.gov

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A Hexaploid *Schedonorus Arundinaceus* Plant That Possesses a *Lolium Multiflorum* Cytoplasm Useful for Producing Rhizomatous Hybrids

A tall fescue DH66OP possessing a *L. multiflorum* cytoplasm that can enhance or induce rhizome formation across various genotypes. DH66OP may allow for the transfer the *L. multiflorum* cytoplasm to additional tall fescue genotypes for the recovery of genotypes expressing rhizomes.

Benefits

- Rhizomatous forms of any grass turf or forage are highly desirable since the rhizomes represent rapidly spreading tillers that can fill voids in turf or pastures without the need for reseeding

Applications

- DH66OP may be used as the maternal parent in a hybridization with another plant, such as a *Fescue sp.* or *Lolium sp*. Plant to produce rhizomatous plant materials or hybrids

ARS Docket No. 99.18. *Please contact Jeff Walenta:* jeffrey.walenta@usda.gov

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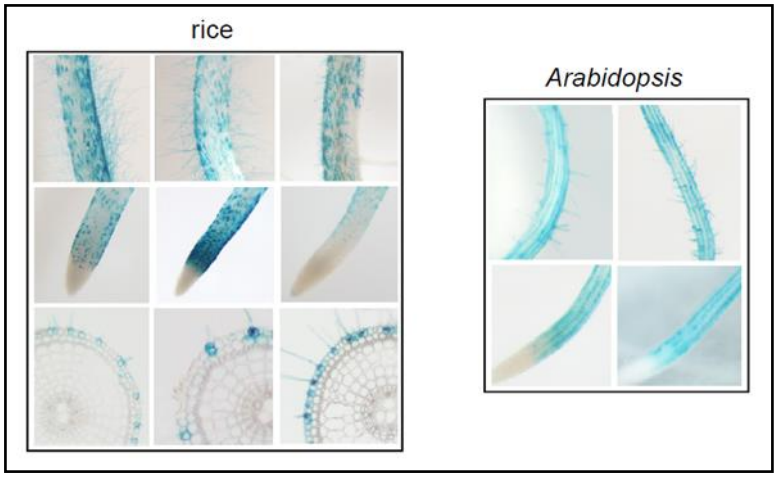
Highly Active, Root Hair Cell-Specific Gene Regulatory Sequences



Root hair cells comprise approximately 70% of the surface area of plant root systems and represent a critical interface between plants and the surrounding soil environment. Highly active root hair-specific gene promoters are therefore of significant value to projects aimed towards expressing proteins or regulatory RNAs at the plant-soil interface. Using a genomics-based approach, ARS identified root-hair specific regulatory elements (promoters and terminators) in Sorghum bicolor. These regulatory elements have been tested in both monocot (rice) and dicot (Arabidopsis) transgenic plants, and in both cases conferred strong, root hair-specific expression to a test reporter gene (beta-glucuronidase). These regulatory elements can be used to drive expression of sorgoleone biosynthetic genes. Sorgoleone is a major component of sorghum root exudates and inhibits weed growth. (see U.S. patents 7,732,666; 8,383,890; 9,248,145; 9,284,537; and 9,926,539; USDA dockets 20.04, 109.06, 145.06, 145.12, and 41.16).

Benefits

- The promoters and 3' sequences are capable of directing precise root hair-specific gene expression in both monocot and dicot transgenic plants
- Because the regulatory sequences were selected based on the extremely high expression levels of their native genes, transgenes utilizing them may also be expressed at very high levels

Applications

- Highly active root hair-specific gene regulatory elements are of value to researchers working in a variety of biotechnology fields, including nitrogen fixation, nutrient uptake, plant-pest interactions and bioremediation

- Use of root hair promoters to express gene products capable of synthesizing pesticidal compounds, which when secreted in soil, could reduce the need for synthetic pesticide treatments (e.g., sorgoleone)

ARS Docket no. 77.18 + 183.07. Please Contact Tanaga Boozer: tanaga.boozer@usda.gov

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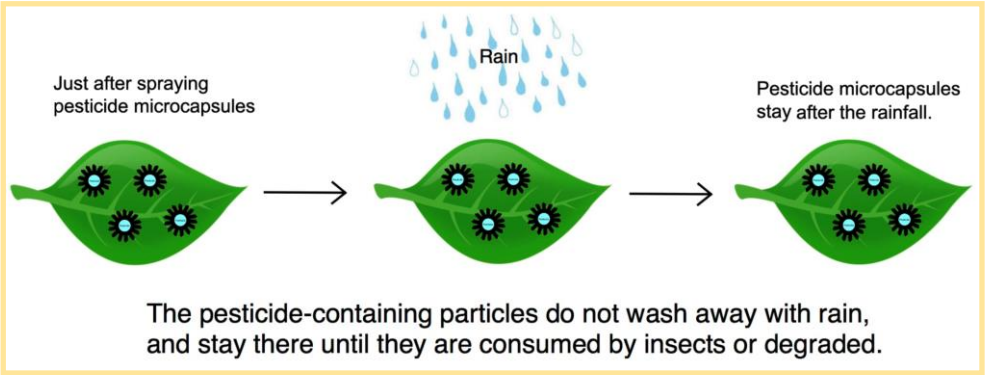
Pesticides That Do Not Wash Away with Rain



Existing pesticides wash away with rain or morning dew after spraying. A novel procedure that can be used for the encapsulation of pesticides into microparticles was developed. These microcapsules adhere to the surface of plant leaves and are not washed away with rain. They stay on the leaves until they are consumed by insects or degraded. Therefore, multiple applications of pesticides are not necessary. Farmers thereby save application cost and labor, and environmental contamination is minimized. Compositions and methods of generating microcapsules are included in the invention.

Benefits

- No need for multiple application of pesticides
- Lower application cost
- Saves time and labor
- Minimizes environmental contamination and lowers applicator exposure

Applications

- Replaces conventional formulations for pesticides
- Can be applied to any plants that are infected by pests
- Especially useful when multiple applications must be avoided

Docket No: 140.17. Please contact Renee Wagner: renee.wagner@usda.gov

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Bioactive Peptides to Control and Deter Pest Slugs

Synthetic bioactive peptides have been developed from slug and insect neuropeptides that repel and deter slugs from feeding on agricultural plants. These peptides can be synthesized using standard laboratory equipment. Effective results can be obtained by applying the peptides directly to the pest or its environment.

Benefits

- Deter slugs, including the gray garden slug (*Deroceras reticuatum*)
- Peptides are specific and don't kill non-target and beneficial organisms
- Novel peptides are commercially viable
- Highly unlikely that pests will acquire chemical resistance to the synthetic peptides

Applications

- Simple and specific peptide that can be applied directly to the slug, plant, or soil. can be either through aircraft or personnel with backpack applicators

ARS Docket No. 22.19. *Please contact David Nicholson:* david.nicholson@usda.gov

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Cadherin Receptor Peptide for Potentiating Bt Biopesticides

A cadherin peptide that enhances the toxicity of Cry proteins. The approach uses a peptide fragment derived from an insect cadherin protein combined with *Bacillus thuringiensis* Cry protein toxin to work as an insecticide against coleopterans and lepidopteran species.

Benefits

- An increase in synergistic potency that would not be achieved via administration of the partial cadherin fragment or Cry protein individually

Applications

- Control of coleopteran and lepidopteran pests

ARS Docket No. 44.07. *Please contact Jeff Walenta:* jeffrey.walenta@usda.gov

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In Vitro Parasite Feeding System

The apparatus is an in vitro system for gathering parasites such as ticks for research, the production of vaccines, and the production of other products related to diseases spread by

parasites. The system includes a feeding vessel having an inlet, an outlet, and a membrane positioned across an opening in the vessel. Parasites (preferably ticks) are allowed to attach themselves to the membrane so that as a feeding fluid (preferably blood) is circulated through the vessel, the parasites feed on the feeding fluid through the membrane.

Benefits

- A simple, flexible, and economical tick feeding system that closely simulates a tick's preferred host throughout the entire tick life cycle
- Standardized, quality-controlled vaccine production

Applications

- Full tick life cycle system for production of live pathogen stage specific vaccines or testing of anti-tick compounds

ARS Docket no. 116.15. *Please contact David Nicholson:* david.nicholson@usda.gov

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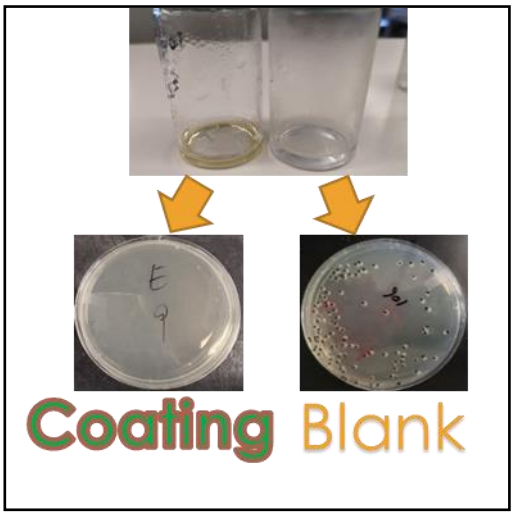
Antimicrobial Curing Agents for Epoxies



A bio-based epoxy curing agents has been developed that gives the final cured epoxy polymer good antimicrobial activity against both Gram-positive and Gram-negative bacteria. The manufacturing process involves mixing this curing agent with commercial epoxy resins and hardening the mixture at certain temperatures. The resulting polymer coating doesn't contain any small molecular biocides embedded, but instead inhibits the bacteria by mere contact without releasing any reactive agents.

Benefits

- Renewable
- Inhibits both Gram-negative and Gram-positive bacteria
- Non-volatile and non-migratory
- Good water-resistance

Applications

- Antimicrobial coatings for public sanitations like public bathroom wall coating, flooring or toilet seat coatings
- Coatings for reception desks, countertop, dining tables or biological lab benches.
- Medicine or food packaging materials
- Cosmetics additives to prevent microbial proliferation
- Polymeric disinfectants used for water treatment

ARS Docket No. 107.19. *Please contact Jim Poulos:* jim.poulos@usda.gov

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Bacteriophage-Based Electrochemical Biosensor

A biosensor using bacteriophages in a sandwich-assay system for rapid detect of foodborne pathogens (i.e. Shiga-toxin producing *Escherichia coli*, STEC). The capture element includes a substrate and a bacteriophage. The detection element includes a bacteriophage and a signal amplification element. The target bacterium is sandwiched between the capture element and the detection element, and a quantifiable signal may be generated to measure the amount of bacteria in a sample. The biosensor uses direct sensing to detect the bacteria in the sample as opposed to indirect sensing methods.

Benefits

- Hand-held and portability for on-site rapid analysis and detection of significant groups of foodborne pathogens and toxins
- The sandwich assay uses direct sensing to detect the bacteria in the sample as opposed to indirect sensing methods
- Biosensors overcome the limitations of traditional foodborne pathogen detection such as tedious and time consuming by providing reliable, specific and highly sensitive platforms with shorter turnaround times
- Bacteriophages possess excellent host selectivity attributes

Applications

- To improve the screening and detection methods of foodborne pathogens in food and environmental samples, thus reducing foodborne illness, hospitalization and economic loss through safe foods

ARS Docket no. 126.17. *Please contact David Nicholson:* david.nicholson@usda.gov

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An Economical X-ray Based Irradiator with High Dose Uniformity and Precision

A cabinet style irradiator employing standard commercially available x-ray components in a novel configuration that allows for precise dosimetry in real-time along with unprecedented uniformity of radiation dose among samples.

Benefits

- Substitute for gamma irradiation using radioisotope-based sources and subsequent reduction in cost, regulations, and safety concerns for operators
- High dose precision and uniformity
- High reliability and proven ruggedness

Applications

- Insect sterilization for Sterile Insect Control technique
- Irradiation of small samples such as seeds, nuts, grain, sprouts or rice

ARS Docket nos. 38.20. *Please contact David Nicholson*: david.nicholson@usda.gov

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Recombinant vaccine against Marek's disease and Newcastle disease

A recombinant dual vaccine against Marek's disease and Newcastle disease has been developed using reverse genetics technology. This vaccine is safe and stable and can be lyophilized or stored and transported at an amble temperature. Vaccine generation and vaccination methods are included in the invention.

Benefits

- Provides dual protection against Marek's disease and Newcastle disease
- Eliminates the "cold chain" requirement for Marek's disease vaccine production, storage, and transportation
- Can be delivered by mass immunization routes (e.g. aerosol, drinking water) to large chicken populations at an extremely low cost

Applications

- Safe, stable and efficacious vaccine to prevent Marek's disease and Newcastle disease in chickens, and to reduce vaccination and poultry production costs

ARS Docket no. 34.19. *Please contact Tanaga Boozer*: tanaga.boozer@usda.gov

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Recombinant Eimeria Maxima Protein Delivered as Nanoparticles for Poultry

A vaccine against avian coccidiosis has been developed that utilizes recombinant DNA technology and nanoparticles to stimulate an immune response in newly-hatched chickens against the causative agent *Eimeria maxima*. The recombinant protein, called EmaxIMP1 is purified and then conjugated to extremely small nanoparticles (20 nm in diameter) and orally give to newly-hatched chickens. This vaccine confers solid immunity against a challenge infection with the parasite Eimeria maxima. ARS scientists are now exploring the injection of embryonated chicken eggs as a practical means of delivering the nanoparticle-

conjugated EmaxIMP1 protein to chicks prior to hatching just as vaccines against several viral pathogens are given.

Benefits

- Delivering recombinant EmaxIMP1 as a conjugate to nanoparticles improves the level of production against *E. maxima* infection

Applications

- Incorporating a recombinant *E. maxima* antigen, namely EmaxIMP1 into nanoparticles and using these to orally immunize newly-hatched broiler chick

ARS Docket no. 94.17. Please contact Jim Poulos: jim.poulos@ars.usda.gov

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Recombinant *Mycobacterium Avium* Subsp. *Paratuberculosis* Proteins Induce Immunity and Protect Against Infection

Johne's disease or paratuberculosis is caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP). The invention is a vaccine for paratuberculosis comprised of MAP proteins. Induction of the immune response significantly reduces or eliminates colonization of the animal by MAP, and consequently reduces or eliminates the symptoms of clinical disease in animals infected with MAP and reduces or eliminates fecal shedding of MAP.

Benefits

- Vaccination with the compositions provides protection against clinical disease and reduces transmission of MAP infection within a herd

Applications

- A vaccine effective for stimulating a protective immune response in animals against paratuberculosis

ARS Docket no. *161.12. Please contact Renee Wagner:* renee.wagner@usda.gov

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Novel Polytriglycerides

Polyketone, polyamine and polyimine vegetable oil derivatives from renewable sources enable chelation or removal of heavy metal ions from aqueous solutions. The oil is heavier than water and can be regenerated and recycled after recovery of the heavy metal content.

Benefits

- High molecular mass compared to current neutralization agents
- Made from renewal resources in the form of vegetable oils

Applications

- Potentially used for neutralization, metalworking, metal ion absorption/extraction/sequestration
- Sequestration of toxic metal species from aqueous media and environmental purposes
- Biodegradable lubricating agents

ARS Docket nos. *124.19 + 156.17 + 190.13. Please contact Renee Wagner:* renee.wagner@usda.gov

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Animal Behavior Monitor

A system for monitoring ruminant animal foraging that utilizes a piezoelectric film sensor in communication with a computer processor to record and characterize jaw movement data for the foraging ruminant animal. The processor applies pattern algorithms to categorize the jaw movement data so that the jaw movements are categorized as at least chewing, biting, ruminating, and/or idling. Knowledge about livestock behavior and resource use can inform management decisions that influence outcomes in agricultural production, the environment and rural prosperity.

Benefits

- The system quantifies grazing behavior including grazing time, ruminating time, resting time, bites/min and bites/day
- It has GPS tracking at a fix frequency of 5 minutes. It can track time spent in sensitive areas (e.g. riparian) and time spent in forage patches (diet selection)
- Other metrics can be added, including tail switch to track nutrient deposition, activity monitor for # of steps and bites/feeding station
- Remote data access and troubleshooting

Applications

- This product would be of interest to grazing-based animal researchers
- It could be adapted for use for rangeland livestock, confinement livestock and for wildlife to monitor movement and grazing behavior

ARS Docket No. 125.17. Please contact Jim Poulos: jim.poulos@ars.usda.gov

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Electrospun Casein Fibers and Fibrous Membranes

Methods for forming a fiber mat, involving forming an aqueous solution of proteins, polysaccharides and optionally a plasticizer, and electrospinning the aqueous solution onto a collector to form a mat for potential food applications.

Benefits

- Allows inclusion of micronutrients, heat sensitive bioactives, probiotic/prebiotic blends into functional beverage and food formulations
- The texture and nutritious compositions can be tailored by the inclusion of nutrients during electrospinning or by altering operating conditions

Applications

- New types of foods based on dairy and other food proteins
- Potentially could be used to produce energy dense foods; foods to create satiety to fight obesity through loading of sensitive compounds known to curb hunger; foods for enhanced delivery or time-release of nutrients such as vitamins, antioxidants, minerals, lipids and bioactive peptides; deliver enhanced flavors or textures; tailoring of the bioavailability of foods; foods for medical use; the development of edible sensors; and casein-based non-food materials, such as new fabrics

ARS Docket no. 42.18 + 204.13. Please Contact Jim Poulos: jim.poulos@ars.usda.gov

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Available Technologies for Licensing

Each year, approximately 60 new patents are issued by the U.S. Patent Office for USDA inventions. The Office of Technology Transfer (OTT) transfers these inventions through licenses to the private sector for commercialization. Click here for a link to *recently filed* U.S. patent applications that are available for licensing.

Snapshot of ARS Technology Transfer

A brief information sheet that highlights some ARS Technology Transfer metrics and commercial products resulting from ARS Research. Click here to read.

Resources for Businesses

Some resources for small businesses at USDA and other Federal agencies. Click here to read.

Tellus

Tellus is a digital experience that features stories about the cutting-edge work at ARS. **Tellus**, Latin for Earth, reflects the global reach of our efforts to feed a growing population while remaining good stewards of the land. Click here for the latest articles.

Red clover (Trifolium pratense) hay field. Unlike supplements, isoflavones do not need to be extracted and concentrated to use; the natural isoflavone content in red clover hay is high enough to spur weight gain and alleviate fescue toxicosis in cattle. (Michael Flythe, D4615-1)

ARS Latest News

USDA's ARS is a leading source for U.S. agricultural research. The ARS vision is to lead America towards a better future through agricultural research and information. Click here for the latest news.

ARS Biomass Podcast

Learn about innovations and research that ARS scientists are conducting to turn farm waste, called biomass, into environmentally friendly products: https://www.ars.usda.gov/oc/podcasts/siysc/ep3/?utm_medium=email&utm_source=govdelivery

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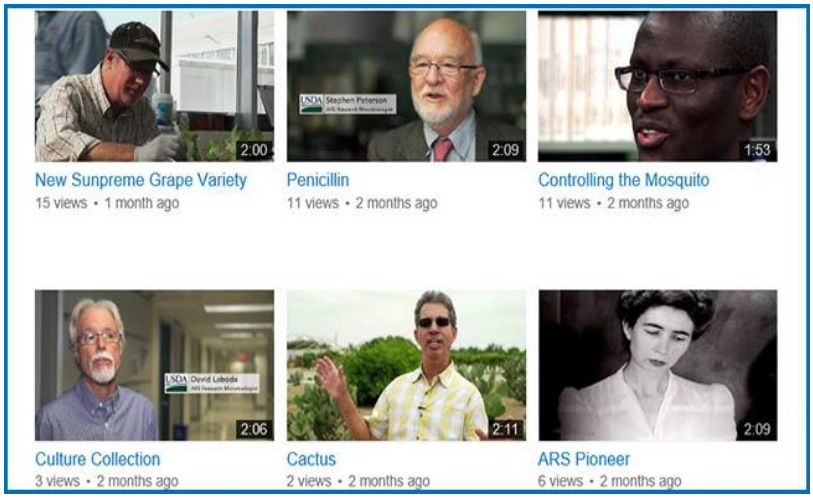
USDA-ARS YouTube Channel

Did you know that ARS is on YouTube? Explore our new YouTube channel to see how our research touches your life: USDA-ARS YouTube Channel



ARS

The Agricultural Research Service (ARS) is USDA's primary internal research agency. ARS conducts research to develop and transfer solutions to agricultural problems that are both national and international in scope. ARS has nearly 2,000 scientists nationwide and a few in overseas locations. ARS scientists carry out 690 research projects on a variety of subjects. ARS has a Congressional mandate to disseminate the research findings of these projects to the American public and other interested parties. Learn more by visiting: http://www.ars.usda.gov

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