Sept 2018

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.

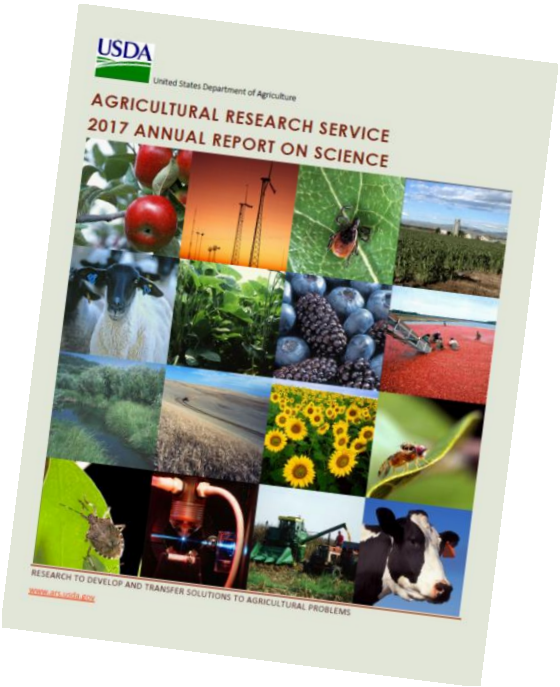
Please help us spread the word by sharing ARP Network Notes with your company contacts, colleagues, other organizations, etc. Thank you!

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

USDA ARS 2017 Annual Report on Science

This publication is the Agricultural Research Service's 2017 annual report on science, composed of numerical research outputs for the agency, accomplishments and impacts for each goal in the ARS 2012-2017 Strategic Plan and ARS' performance plan for 2018. Click here to read.

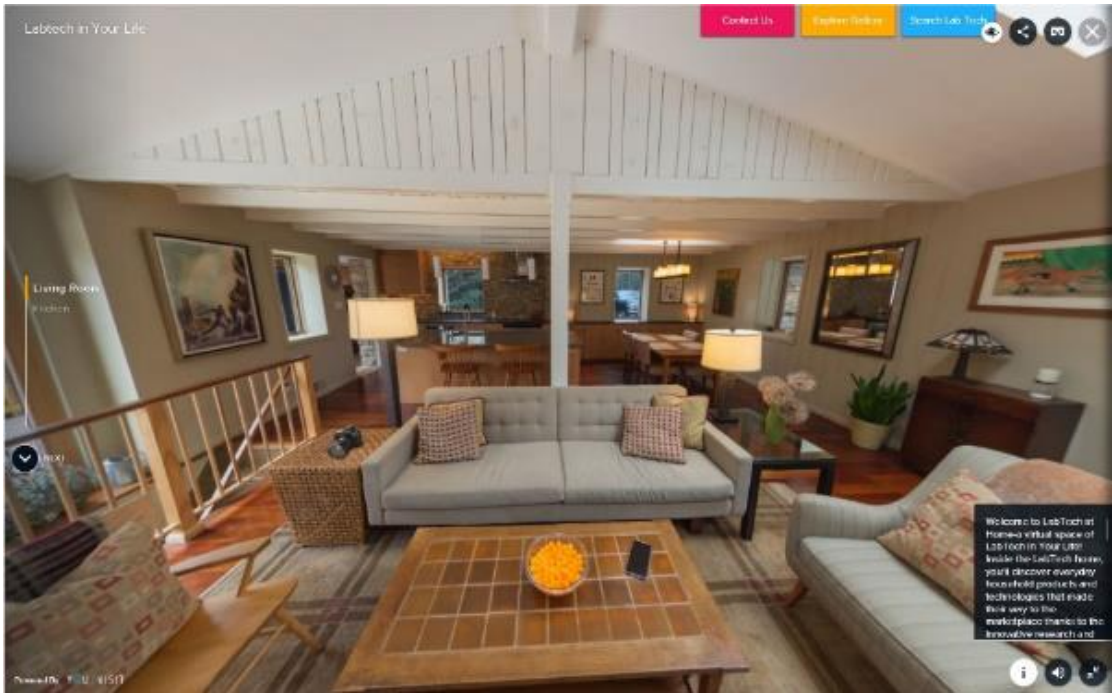


ARS Grazinglands Research Laboratory Research Report

The Grazinglands Research Laboratory in El Reno, OK, develops and delivers technologies, management strategies and planning tools to evaluate and manage economic and environmental risks for integrated-crop-forage-livestock systems under variable climate, energy and market conditions. This research mission leverages diverse partnerships with federal, state and local stakeholders. This booklet contains the 2017 research report for the laboratory. Click here to read.

ARS Technology in Your Life: Explore LabTech in Your Life

LabTech in Your Life is a virtual environment showcasing Federal technologies, including USDA-ARS technologies, you use every day on an interactive platform. Click here to check it out.



ARS Technology Transfer Snap Shot

A brief information sheet that highlights some technology transfer metrics resulting from ARS Research. Click here to read.

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.

Subsurface Applicator for Dry Manure

A novel, tractor-drawn implement that can apply dry poultry litter in shallow parallel bands beneath the soil surface. It can also be used for subsurface application of other dry bulky soil amendments such as manure, compost, or biochar. This technology utilizes an innovative auger system to crush and distribute dry, untreated poultry litter to soil openers, and no-till technology that minimizes damage to soil structure and perennial crops. It provides uniform litter distribution and precise control of litter application rates, including very low rates that are not feasible with litter spreaders.

Benefits

- Maximizes nutrient-use efficiency by preventing ammonia-N loss to the atmosphere, even during extended periods of adverse weather
- Improves water quality by preventing more than 90% of litter nutrient losses in storm runoff
- Increases crop yield and/or quality by retaining more nutrients and water in the soil
- Controls nuisance odor problems from litter

Applications

- This technology can help farmers utilize organic nutrients more efficiently to increase production while improving air and water quality, especially in perennial pastures and other no-till systems

ARS Docket no. 64.07. Please Contact Joe Lipovsky: joseph.lipovsky@ars.usda.gov

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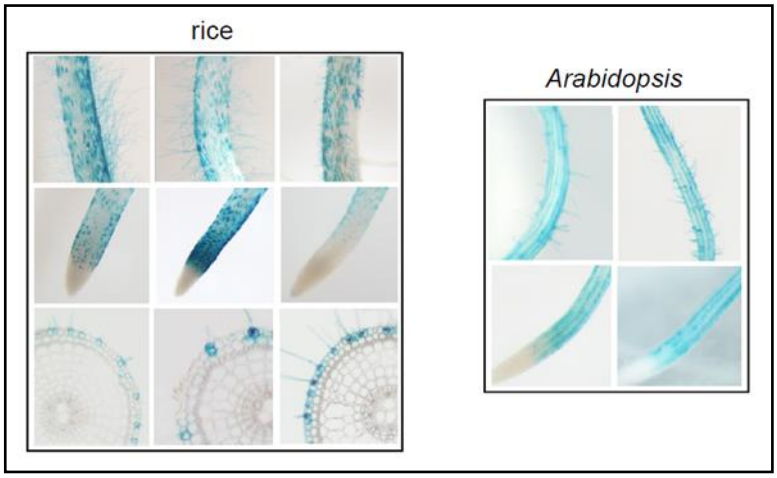
Highly Active, Root Hair Cell-Specific Gene Regulatory Sequences



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 Joe Lipovsky: joseph.lipovsky@ars.usda.gov

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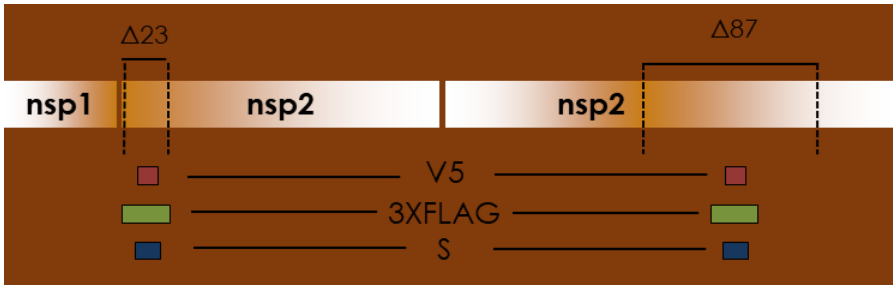
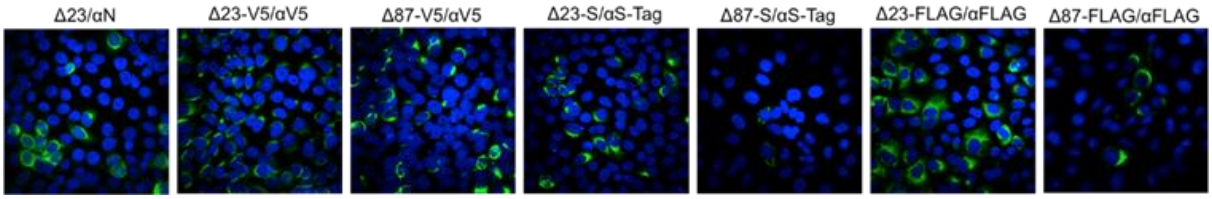
Viable Viruses with Foreign Tags

An attenuated porcine respiratory and reproductive syndrome virus vaccine has been engineered to harbor either one of two deletions and/or one of three small immunogenic tags at the two deletion sites. The eight viruses efficiently replicate, maintain the parental virus phenotype, and are stable in cell cultures.





Benefits

- The viruses are stable in cultured cells
- Allow efficient localization of nonstructural protein 2 (nsp2)
- Can be used to locate differently tagged nsp2 in co-infection studies

Applications

- Serves as a platform in developing new DIVA vaccines
- Molecular tool to study the role of nonstructural protein 2 in pathogenesis

ARS Docket no. 133.16. Please contact Renee Wagner: renee.wagner@ars.usda.gov

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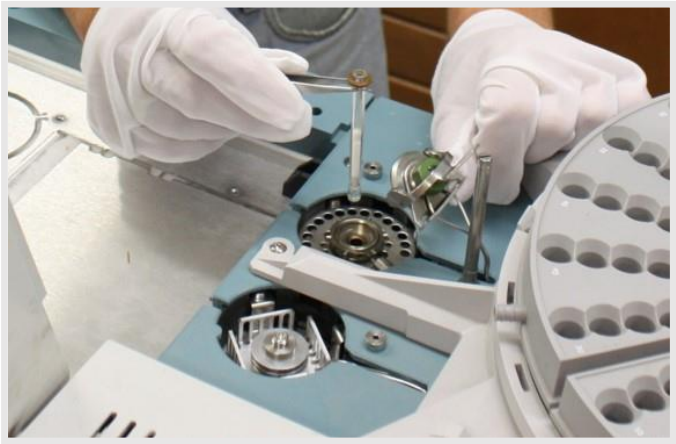
Technique for Thermal Desorption Analyses of Thermo Labile Volatile Compounds



An apparatus and method for the analysis of volatile organic compounds released by, for example, plants or insects. The apparatus is designed for adaption to existing GC /MS systems and utilizes a splitless injector as the desorption oven with a liquid CO2 cooled low thermal mass cryo trap.

Benefits

- A solvent free injection technique that utilizes a desorption oven and a cold trap where

effluents are collected until flash heated onto a GC column

- Eliminates the need to dedicate a GC/MS system for thermal desorption by being designed as an integral part of a standard split/splitless GC injector which is used as the desorption oven but still can be used as a normal injector without any additional changes
- Eliminates the need for flash heating of volatile compounds
- The cold trap eliminates losses due to aerosol formation

Applications

- Natural product chemistry and chemical ecology laboratories

ARS Docket no. 23.14. Please Contact Joe Lipovsky: joseph.lipovsky@ars.usda.gov

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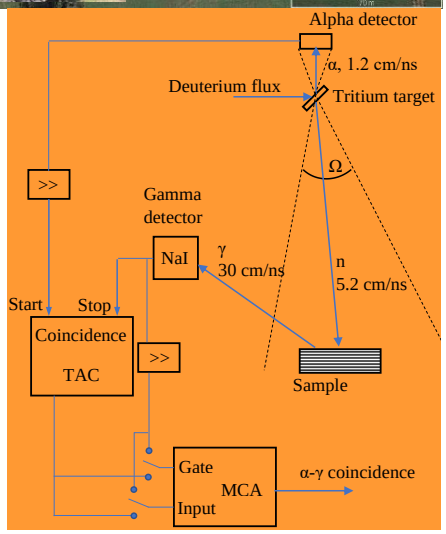
System for Soil Carbon Mapping



Neutron-gamma analysis for soil carbon (C) determination was developed as an alternative to traditional chemical analysis. This current invention uses associated particle imaging (API), an improvement on this technology which decreases survey time and improves minimum detection limits of soil carbon. With this technology, soil C maps can be generated faster and more accurately.

Benefits

- Soil carbon averaged over whole field unit
- Saves labor and cost of soil samples and laboratory analysis of soil samples
- Soil C maps generated as soon as mapping complete

Applications

- Soil C maps (and other nutrients) can be made following soil scanning with no soil disturbance

ARS Docket no. 61.18. Please Contact Joe Lipovsky: joseph.lipovsky@ars.usda.gov

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Fatty Ammonium Salt Starch Complexes for Numerous Products and Applications

ARS has developed cost effective, bio-based complexes for numerous applications and products such as: antimicrobials, plant wounds, increased water resistance of paper, wood protectants,

emulsifiers and providing other polymers with improved properties. This technology utilizes high amylose cornstarch and vegetable oil derivative(s) to produce the desired product, a complex. The raw materials are derived from plants produced throughout the mid-west. The process converts these compounds into Amylose Inclusion Complexes (AIC) using current industrial techniques.

Benefits

- The raw materials for these complexes are commercially available in multi-ton quantities – many are TSCA registered, some are GRAS

Applications

- AICs have numerous applications which are dependent on the vegetable oil derivative selected

ARS Docket no. 96.15 + 172.16 + 100.17. Please contact Renee Wagner:

renee.wagner@ars.usda.gov

Methods for Preparing Phenolic Branched Chain Alkyl Fatty Acids or Esters and Methods for Killing Microorganisms

Methods for preparing plant derived phenolic branched chain fatty acids and methods for using them to kill microorganisms.

Benefits

- Sustainable since phenolic and fatty acids are natural compounds

Applications

- Antimicrobials to improve microbial food safety
- Alternative to bleach
- Value added by-products of agricultural processing
- The crude phenolic branched-chain fatty acid mixtures do not have unpleasant odor

ARS Docket no. 47.15 +101.18. Please contact Jim Poulos: jim.poulos@ars.usda.gov

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Levulinic-capped Estolides

New and versatile estolide, Levulinic-capped estolides with improved physical properties including oxidative stability, hydrolytic stability, viscosity index, low temperature pour and cloud points and wear protection. Also, environmental benefits such as high renewable content and biodegradability. First generation estolides have been used in a variety of industrial and automotive lubricant applications.

Benefits

- Low temperature, viscosity and thermal properties that exceeds commercial base oils and fluids
- A highly functional base oil
- A starting bio-based oil that can be easily functionalized into a more complex material

Applications

- Passenger car engine oil (crankcase lubricant)
- Base material or starting material for other applications, such as hydraulic fluid, coatings, cooling fluids and inks

ARS Docket no. 61.17. Please contact Renee Wagner: renee.wagner@ars.usda.gov

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Bio-based Methacrylic Acid and Other Alkenoic-Derived Monomers via Catalytic Decarboxylation

Methacrylic acid is an important commodity monomer used for the production of many commercially significant polymers, most notably acrylic glass. The traditional route to methacrylic acid is petrochemically-based and involves the reaction of acetone with concentrated sulfuric acid and hydrogen cyanide. A novel method has been developed for selective catalytic decarboxylation to produce the organic acid, which consists of reaction of simple sugars from natural sources with appropriate catalysts in an aqueous solvent. This method can be used for synthesis of acrylic acid and other related monomers and provides an approach that can provide a renewable alternative to the current methods, thus further reducing the environmental impact of and demand for petroleum products.

Benefits

- A viable, bio-based alternative to producing methacrylic acid instead of using petrochemicals
- Requires lower operating temperatures and pressures and higher product selectivity than other bio-based methods, thus affording economical production of methacrylic acid

Applications

- A bio-based method for producing methacrylic acid

ARS Docket No. 70.14. Please contact Renee Wagner: renee.wagner@ars.usda.gov

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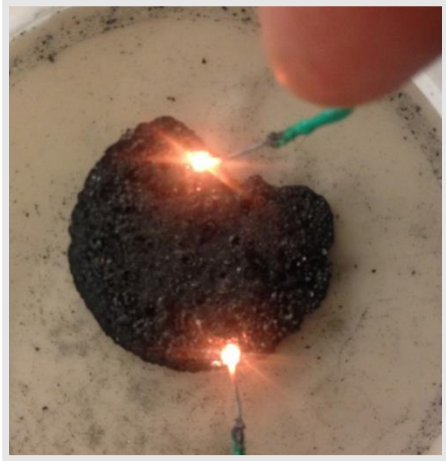
Producing Calcined Coke from Bio-Oil and Calcined Coke Produced



A process for synthesizing biologically-derived coke from a byproduct of bio-oil distillation. The process entails fast pyrolysis, atmospheric distillation and vacuum distillation to remove liquid and volatile products.

Benefits

- Biorenewable
- Sulfur is eliminated to trace levels below 500 ppm (vs. > 2 – 3%)
- Vanadium and nickel are absent completely in most cases (vs. > 300 ppm)
- Total ash/metal content is comparable and/or less than petroleum coke
- A desulfurization step is not needed

Applications

- The carbon rich product can be uses as a solid fuel (coal) substitute
- Can be calcined into coke suitable for use in aluminum smelting anodes, steel carburization and titanium dioxide production

ARS Docket No. 126.14 + 118.18. Please contact Jim Poulos: jim.poulos@ars.usda.gov

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Value-Added Products from Small Grains for Aquaculture Feed

A method for processing small grains (e.g. barley and oat) into four nutrient enriched fractions: proteins, starch, beta-glucan and fiber. The process recovers these major nutrients simultaneously before subjecting the remaining grain biomass to an ethanol production system as feedstock.

Benefits

- Fractionating valuable components before subjecting the rest of the biomass to an ethanol production system

Applications

- Beta-glucan, protein, starch and fiber from barley and oats as food, feed industrial ingredients and in the cosmetic industry
- The protein fractions produced comprise of a high quality, highly digestible protein that is suitable for use as an aquaculture feed

ARS Docket no. 154.13. Please contact David Nicholson: david.nicholson@ars.usda.gov

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High Oleic Acid Soybean Seeds

A soybean plant has been developed that contains chemically-induced mutations which cause the plant to produce more oleic acid in its seeds than that produced in a wild-type soybean plant. The mutations occur in the genes for delta-twelve fatty acid desaturase 2-1B enzyme (FAD2-1B) and delta-twelve fatty acid desaturase 2-1A enzyme (FAD2-1A). The alleles could potentially be used in combination with other alleles to generate new non-transgenic germplasm with high levels of oleic acid for the edible oil market. High oleic soybeans offer higher-functioning soybean oil that meets the needs of a growing number of food and industrial customers.

Benefits

- Increased amount of oleic acid in soybean seeds is potentially a way to obtain a healthier oil

Applications

- Soybean plants with elevated oleic acid for the edible oil market

ARS dockets 31.15. Please contact Renee Wagner: renee.wagner@ars.usda.gov

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Adhesive Compositions and Methods of Adhering Articles Together

There is ongoing interest in using agro-based materials (like proteins) in wood adhesives. The issues are cost, adhesive strength, and water resistance. New adhesive compositions involving cottonseed protein are shown here to be attractive adhesive ingredients. These include the use of specific modifiers that enhance cottonseed protein performance and several biopolymers (e.g. soy protein or polysaccharides) that can decrease the cost of use. With these compositions, the performance/cost ratio for cottonseed protein-based adhesives can be enhanced.

Benefits

- Use of agro-based materials will minimize toxicity and environmental impact
- Cottonseed protein with modifier provides effective adhesive strength and water resistance
- Blends with modifier provides effective adhesive strength and water resistance
- Potential new products for wood adhesives

Applications

- These can be used as cost-effective, eco-friendly products for wood adhesives

ARS Docket no. 115.16. Please Contact Joe Lipovsky: joseph.lipovsky@ars.usda.gov

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Methods of Attracting *Drosophila Suzukii*

A Method of attracting *Drosophila suzukii,* involving treating an object or area with a chemical attractant composition based on volatiles that attract *Drosophila suzukii*.

Benefits

- The compound is a synthetic natural attractant based on fruits
- The method provides a means of early detection and population monitoring of *Drosophila suzukii*

Applications

- Infestation detection and monitoring

- Could potentially enable future development of mass trapping and mating disruption technologies for managing this pest

ARS Docket No. 58.16. Please contact Jim Poulos: jim.poulos@ars.usda.gov

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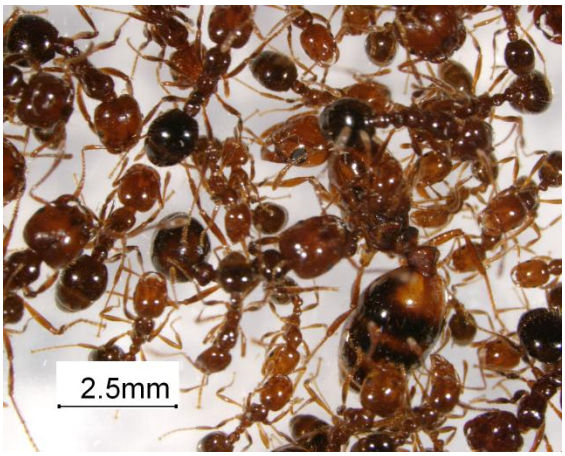
Novel RNA Viruses Infecting Ants



Invasive ant pesticides are usually synthetic chemical compounds, often incorporated in baits. While these compounds can be effective, they are toxic to non-target organisms. Both virus and RNAi pest control strategies are specific to the targeted pest. Viruses have been identified that are very easily spread in the species, and with the right RNAi construct could be used as a biopesticide for the targeted insect.

Benefits

- Small genomes
- Fully sequenced from multiple sites

Applications

- Direct use for biological control for ants
- Potential for combination with other genetic elements

Docket Nos: 13.18 + 24.18. *Please Contact Joe Lipovsky:* joseph.lipovsky@ars.usda.gov

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Starch-based Fire Retardant

Spraying a home or business with a temporary fire-retardant coating may prevent it from being destroyed by a forest or brushland wildfire. The composition is made of sodium bentonite clay, corn starch and water. Tests suggest that a quarter-inch layer of the gel may protect wood-based home siding for up to 30 minutes.

Benefits

- Inexpensive to make the gel and the components are widely available

Applications

- Fire retardant gel for protecting structures or objects

ARS docket no. 57.11. Please contact David Nicholson: david.nicholson@ars.usda.gov

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Sorghum Yield Enhancement Gene

Global demand and consumption of grain crops for food, feed and fuel is increasing at a rapid pace. This demand has expanded for many years and is expected to continue to increase as human population increases. This invention relates to multi-seed sorghum mutants (MSD1) which develop seeds at not only the sessile spikelets of the panicles, but also at the pedicellate spikelets, thereby significantly increasing the seed production and yield. Further details are in U.S. Patent App. Publication No. 2014-0068798.

Benefits

- Sorghum exhibiting a multi-seeded phenotype

Applications

- The results of the MSD1 mutant show potential as a resource for increasing grain yield as a parent to use for crosses

ARS Docket No. 222.13. Please contact Jeff Walenta: jeffrey.walenta@ars.usda.gov

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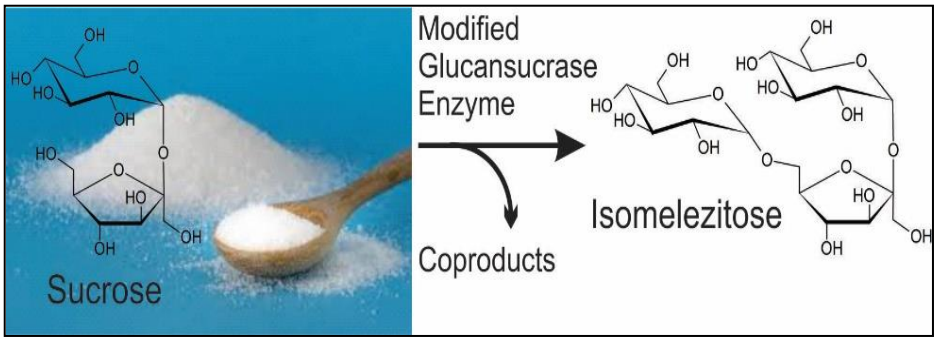
Mutant Sorghum Bicolor Having Enhanced Seed Yield

This invention relates to a novel mutation in a sorghum gene which further increases the seed yield in sorghum. Specifically, genetically altered sorghum plants expressing the multi-seeded 2 (MSD2) phenotype and genotype contain one of two genomic alterations which result in the activity of an encoded protein. These alterations result in an increased number of seeds and seed weight, thus increasing the yield. These alterations can be generated in ortholog genes in maize (TS1), rice, barley, and other monocot plants, generating the MSD2 phenotype.

ARS Docket No. 52.14. Please contact Jeff Walenta: jeffrey.walenta@ars.usda.gov.

Enzymatic Synthesis of a Novel Bioprotectant



ARS has engineered an enzyme to produce high yields of a rare sugar, called isomelezitose. Similar types of sugars, such as trehalose, are known to have bioprotective properties that minimize damage to proteins from heat, freezing, or drying; and are therefore extremely important to the pharmaceutical, agricultural, and food industries. Isomelezitose was originally found in trace amounts in honey, but efforts to produce this compound were hampered by inefficient synthesis methods. This technology allows the valuable isomelezitose sugar to be produced in commercial quantities.

Benefits

- High product yield from a simple enzymatic conversion of inexpensive sugars
- Demonstrated ability to maintain bacterial viability when added to cultures during drying

Applications

- Low-calorie sweetener that does not promote tooth decay
- Improved long-term stability of foods, drugs, vaccines, cells and bacterial cultures
- Potential prebiotic food ingredient for improved intestinal health

ARS Docket no. 19.16. *Please contact Renee Wagner:* renee.wagner@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. Here is a link to *recently filed* U.S. patent applications that are available for licensing. This list is updated monthly so check back often!
http://www.ars.usda.gov/Business/Business.htm

ARS Technology Transfer at a Glance

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.

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 latest news.

USDA Blog

Check out USDA Blog site for updates on Agricultural issues. Click here to read. One can sign up for email updates on the website by checking boxes of categories of interest including the blog, news categories and social media.

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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