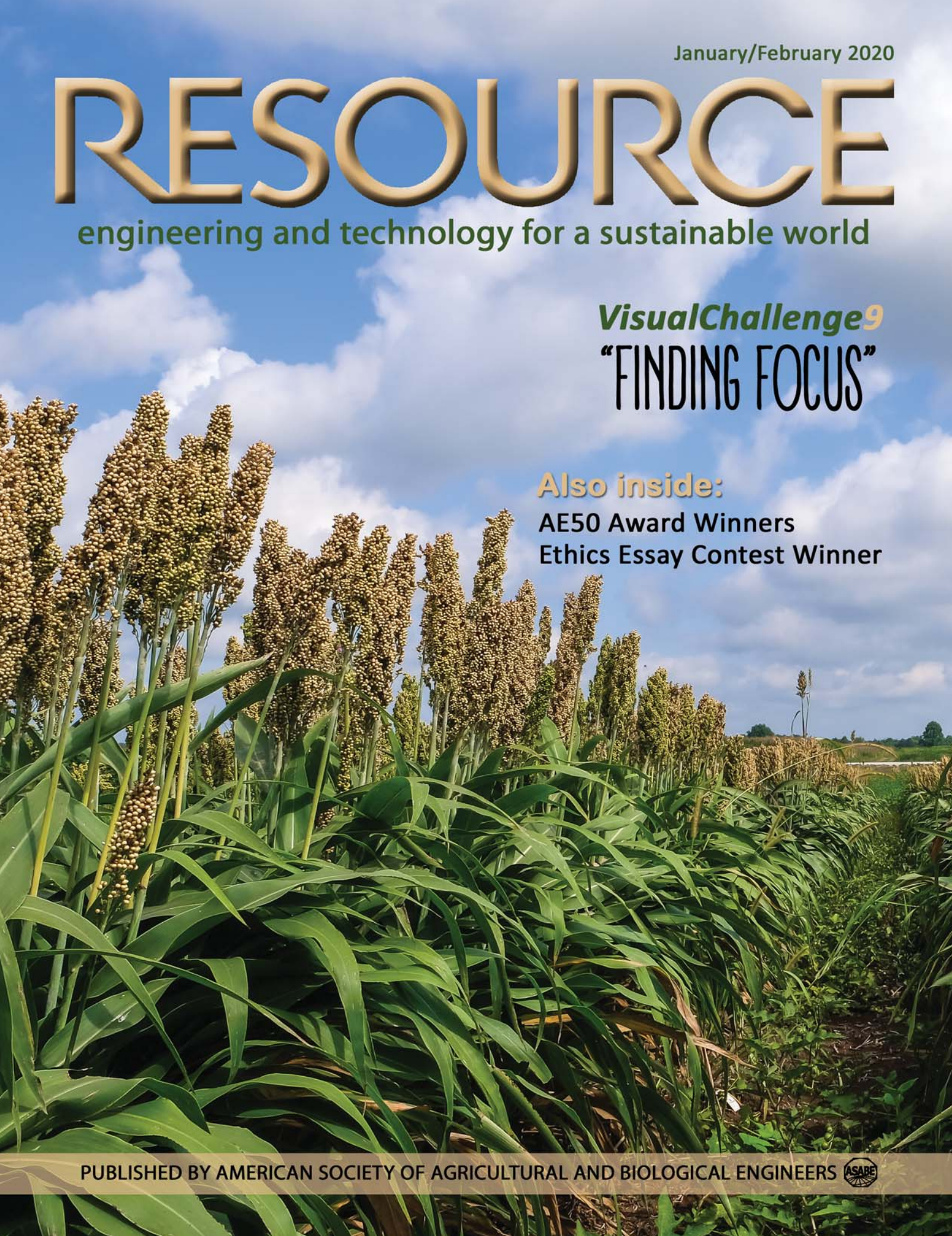
January/February 2020

RESOURCE

engineering and technology for a sustainable world

VisualChallenge9
"FINDING FOCUS"



Also inside:

AE50 Award Winners
Ethics Essay Contest Winner

PUBLISHED BY AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS ASABE

Publicizing the impact of ag and bio engineers

One of the privileges of serving as ASABE President is recognizing the accomplishments of our members. In particular, the AE50 Awards presented in this issue of *Resource*, provide a yearly forum for the Society to highlight advances in the broad field of ag and bio engineering. The award winners reflect the visionary ideas of our members, so the AE50 Awards are a great opportunity to publicize the impact that the ABE profession has on global food, water, and energy systems.

Representing our Society at various events and international forums also allows me to serve as an ambassador for the profession. I recently returned from San Jose, Costa Rica, where our ASABE delegation was hosted by our sister society and the University of Costa Rica. ASABE sent our advance team to Costa Rica in preparation for hosting the 2021 Global Energy Conference. (I encourage you to join us for this conference. Watch for further information later this year.)

The hospitality of our Costa Rican colleagues was outstanding. One of the highlights of the trip was meeting with the Costa Rican Ministers for Science and Technology, and for Energy and the Environment. In addition to discussing the logistics of the Global Energy Conference, our delegation was able to promote ASABE to these high-level administrators.

Wherever I travel as ASABE President, I'm humbled to see the enthusiasm that our members have for our profession. Ag and bio engineers continually amaze me with the impact that they are making on the world. However, a question often arises when I talk with other ABE professionals: "What would it take to educate others about the important contributions of the ABE profession?" How can we best share our accomplishments with those outside of ASABE?

Every member I talk with, around the world, is enthusiastic about our profession and has a great story to tell. My view is that every member is a potential ambassador for our profession. We need to share this enthusiasm by telling our stories to others. Just for fun, as an experiment, see how many people you can talk to in one day about the important work of the ABE profession: the bus driver, the mail carrier, your yoga teacher, your neighbors, and anybody else you talk with. Maybe we should hold a contest to find the most unlikely person to whom a member has promoted ASABE!

In addition to the enthusiasm that our members have, enrollment in undergraduate ABE programs is growing rapidly, so every year we are producing more potential ambassadors. Do the math: If each member serves as an ambassador for ASABE, and the number of ag and bio engineers is growing worldwide, then the number of people who know an ag and bio engineer will grow at an increasing rate. I look forward to the day when everyone knows someone in the ABE profession.

We celebrate the annual AE50 Award winners in this issue of *Resource*. These winners are also ambassadors for our profession because they showcase the breadth and depth of the work that we do. Reading about the creative solutions, the practical technology, and the environmental stewardship represented by our award winners will inspire you to go out and brag about our profession to everyone you meet.

Sue Nokes
suenokes@myasabe.org

events calendar

ASABE CONFERENCES AND INTERNATIONAL MEETINGS
To receive more information about ASABE conferences and meetings, call ASABE at 800-371-2723 or e-mail mtgs@asabe.org.

2020

Feb. 10-12	**Agricultural Equipment Technology Conference (AETC).** Louisville, Ky., USA.
July 12-15	**ASABE Annual International Meeting.** Omaha, Neb., USA.
Oct. 25-29	**The 2nd ASABE Global Evapotranspiration Symposium.** Nanjing, China.
Nov. 30-Dec. 4	**6th Decennial National Irrigation Symposium.** San Antonio, Tex., USA.

2021

Feb. 8-10	**Agricultural Equipment Technology Conference (AETC).** Louisville, Ky., USA.
Jan. 10-15	**Soil Erosion Research under a Changing Climate.** Aguadilla, Puerto Rico.
July 11-14	**ASABE Annual International Meeting.** Anaheim, Calif., USA.

ENDORSED EVENTS

2020

Feb. 24-26	**The Indoor Agriculture Energy Solutions (IAES) Conference.** La Jolla, Calif., USA.
Feb. 24-27	**Phenome 2020.** Tucson, Ariz., USA.
March 10-14	**The International Fluid Power Exposition (IFPE).** Las Vegas, Nev., USA.

January/February 2020
Vol. 27 No. 1
www.asabe.org/Resource

Resource: engineering and technology for a sustainable world (ISSN 1076-3333) (USPS 009-560) is published six times per year—January/February, March/April, May/June, July/August, September/October, November/December—by the American Society of Agricultural and Biological Engineers (ASABE), 2950 Niles Road, St. Joseph, MI 49085-9659, USA.

POSTMASTER: Send address changes to *Resource,* 2950 Niles Road, St. Joseph, MI 49085-9659, USA. Periodical postage is paid at St. Joseph, MI, USA, and additional post offices.

ADVERTISING: www.asabe.org/advertise.

SUBSCRIPTIONS: Contact ASABE order department, 269-932-7004.

Think Green! The poly-bag protecting this magazine can be recycled. Just toss it in with your other recycling.

ON THE COVER:

Duy Hau (Holden) Truong, *a technician at the University of Missouri, Columbia, captured this sorghum field on a sunny October day.*

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RESOURCE

engineering and technology for a sustainable world

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AE50 Winners

FEATURES

UPDATE

DEPARTMENTS

Celebrating the Winners

Resource magazine is pleased to sponsor the AE50 Award program, celebrating companies for their recent developments in agricultural, food, and biological systems. From the many entries submitted in 2019, an expert panel selected the products, showcased on the following pages, for recognition. The award-winning products are those ranked highest in innovation, significant engineering advancement, and impact on the market served.

The products represent the diversity of agricultural and biological engineering, as well as the variety of companies that continue to bring advanced technology and exciting innovations to the marketplace. This year's AE50 recipients join the ranks of many who have been honored for their ingenuity in product development—saving producers time, costs, and labor, while improving user safety as well.

The AE50 Awards had their beginning in June 1984, in a special issue of ASABE's *Agricultural Engineering* (now *Resource*), in which 25 new techniques, inventions, and innovations were showcased. The featured items were drawn from product information solicited by the Society and screened by a panel of engineers. From this focus on identifying innovative technology, two years later the AE50 Award program was born. As the announcement stated, "Acceptance in the marketplace is the highest accolade any new agricultural product can receive. But for innovative developments in the last 12 months, a singular honor is to be named one of the year's Agricultural Engineering 50 outstanding innovations." Product nominations poured in. An enlisted panel of experts reviewed the entries, and in 1986 the first AE50 Awards were presented.

As *Resource* brings you the 33rd year of the AE50 Awards, the interest in new technology and innovative applications of existing technology remains constant. Over the years, many award-winning products were patented and their names trademarked. Some were further improved as technology advanced, and with time, won another AE50. But the most important yearly constant: all winning entrants continually strive for excellence, and we are pleased to honor their work with the highest honor in the only awards program of its kind. Congratulations to the winners!

2700/2750 PrecisionCut™ and E-Cut™ Hybrid Triplex Mowers

John Deere
Moline, Illinois, USA
www.deere.com

Labor is the biggest challenge facing the golf industry. The 2700/2750 PrecisionCut™ and E-Cut™ Hybrid solve this challenge by providing cut quality, regardless of operator. The passcode-protected TechControl display allows supervisors to have better control of operator performance. Electronic frequency of clip, standard on all models and industry exclusive on the PrecisionCuts, ensures consistent results throughout the course. Smart, electronically-controlled engines feature Eco mode, which automatically reduces engine speed while mowing, saving up to 30% in fuel and 3 dB(A) in sound levels. A three axis lift system provides excellent cutting unit contour following, and an innovative Cleanup Pass Mode allows for crisp, accurate perimeter cuts. The open platform design features a new grass catcher for easy installation and removal with superior retention.

Adaptive Lighting Controller

Cadidus, Inc.
Athens, Georgia, USA
www.candidus.us

Candidus' Adaptive Lighting Controller can control third-party greenhouse lights, including LEDs, high-pressure sodium, and metal halide lights, to ensure that the crop receives the grower-determined amount of light each day. Using a light sensor and a proprietary algorithm, the Adaptive Lighting Controller determines how much supplemental light is needed at any particular time. The algorithm automatically provides supplemental light when the crop is best able to use that light, such as when little sunlight is available. The controller can precisely control dimmable lights and turn non-dimmable lights on and off. Using an industrial microcontroller for computations and communications, the controller is capable of controlling any third-party lights, regardless of the type of signal required by those lights.

AXION 900 Series Tractors

CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

The AXION 900 Series Tractors break the 400 engine horsepower mark with no derate or boost logic, providing pure power for all applications. The AXION 900 Series ranges from 320 to 440 rated engine horsepower, with 445 maximum engine horsepower. The 8.7 L engine, coupled with a four-mode CVT transmission and efficient PTO and final drives, provides up to 91% of engine horsepower available at the PTO shaft for more efficient use of power and fuel. Designed similar to the AXION 800 Series, the straight-through PTO drive system provides the most efficient use of power for applications such as hay cutting, baling, forage chopping, feeding, manure spreading, and other PTO-intensive uses.

Case IH AFS Connect® Magnum™ Tractor

CNH Industrial
Racine, Wisconsin, USA
www.caseih.com

The Case IH AFS Connect® Magnum™ Tractor provides state-of-the-art electronic architecture with improved connectivity and new in-cab features that producers need for high-performance field operation. The new AFS Pro 1200 display allows operation of all tractor and implement applications and puts controls within easy reach at one convenient location. The new semi-active cab suspension and improved front axle suspension provide the operator with optimal ride comfort during long hours in the field. The redesigned cab interior provides extensive storage space and power outlets, allowing operators to stay connected through personal electronic devices. These and many other features make the new Case IH AFS Connect® Magnum™ one of the most comfortable and profitable high-horsepower row crop tractors available.

Case IH Precision Air™ 5 Series Air Carts

Case IH
Racine, Wisconsin, USA
www.caseih.com

Case IH has introduced a Curve Compensation option for its Precision Air™ 5 Series Air Carts. This optional feature automatically adjusts the seeding rate across the drill width to deliver more uniform seed distribution on both the inside and outside of curves. This technology option independently controls the individual electric motors of the AccuSection metering system on the air cart, as the tractor and seeding system travels through a curve. For example, if the drill is turning left through a curve, the left side of the drill will have proportionately reduced seeding rates, and the right side of the drill will have proportionately increased seeding rates. This keeps the overall seeding rate more consistent throughout the field, resulting in reduced weed pressure, reduced self-thinning, and ultimately improving crop yield and potential profit.

CLAAS 926 Series Corn Head

CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

These new corn heads include a variety of features compared to previous models. Dual-sided deck-plate adjustment ensures that corn stalks remain centered on the knife-rolls for consistent feeding and minimal loss. Optional down-corn augers mounted on top of the end dividers prevent lodged stalks from hair-pinning on the dividers, which would cause excess loss and require downtime to remove manually. The auger speed can be optimized in-cab to quickly adapt to changing conditions. Optional tall-corn risers prevent lodged stalks from hanging up on the end dividers. More durable poly snouts with stainless-steel wear strips increase the operating life for reduced downtime and repair costs. Additional autocontour sensors improve the speed and accuracy of the head's terrain compensation. Finally, the main row unit gear boxes and non-greasable knife-roll bearings increase uptime by reducing the number of maintenance points.

CLAAS JAGUAR 900 Series Harvesters

CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

The new CLAAS JAGUAR 900 Series Harvesters have many new features that represent advances in engineering. CEMOS AUTO PERFORMANCE is an automatic system that combines cruise control with DYNAMIC POWER to give maximum output, when needed, while saving fuel when maximum output cannot be achieved. Industry-only hydraulic pre-compression improves chop quality and also reduces vibration and noise in the cab. The new CEBIS with a touch screen is the most easy-to-use monitor in the industry. In combination with the new armrest and CMotion handle, comfort can be achieved for 18-hour days. The AUTO FILL system tells operators where the spout is and can adjust for windage during rear-filling so that the crop always reaches the transport vehicle.

CLAAS ORBIS 750 Forage Harvester Head

CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

The new CLAAS ORBIS 750 is a 10-row 7.5 m (25 ft) forage harvester head used to harvest an extremely diverse range of crops, including corn, milo, and sorghum. It features a revolutionary design using a pressed, hardened, and rounded metal frame that allows the head to unfold into working position or fold into transport position in just 15 seconds. The special design of its underside and its ability to adjust its tilt to remain parallel to the ground ensures short and even stubble across the entire working width. The crop stubble is consistent, clean, and shredded at the end for faster breakdown. The combination of large and small drums, with V-shaped crop flow, funnels the crop to the center for smooth feeding and excellent crop quality. The very low starting torque makes for easy starting and can be engaged at full throttle.

Cyclone Air System Controls

Sukup Manufacturing Co.
Sheffield, Iowa, USA
www.sukup.com

The Cyclone Air System Controls are used to control a pneumatic system that is moving grain through a tube, most commonly from a dryer to a cooling or storage bin. The control system uses sensors and algorithms to maintain a constant level of pressure in the pneumatic system, resulting in even grain flow, lower energy usage, higher grain quality, and reduced likelihood of a plugged tube. The automated system constantly adjusts the factory-installed dynamic bleed valve or optional variable-frequency drive to optimize the air pressure and energy savings. If a plug occurs, the system can clear it automatically. The Cyclone Air System Controls are used with a dedicated touch screen or with the touch screen of a Sukup dryer equipped with QuadraTouch Pro™ software. In either case, the system can control up to five independent air systems and can operate each system in automatic or manual mode.

Dura-ABS™ DI Automated Direct Injection

Dura Products
Arcadia, Indiana, USA
www.duraproducts.com

The Dura-ABS™ DI Automated Direct Injection is the newest and most cost-effective system on the market today. The DI allows the operator to increase profitability by decreasing sprayer fill time by up to 80%. The Dura-ABS™ DI directly injects multiple chemicals simultaneously into the carrier flow. This reduces operator error and herbicide exposure, in addition to providing recirculation and eliminating cross-contamination. It also allows the operator to multi-task while accurately dispensing repeatable batches. The Dura-ABS™ DI can reduce labor and machinery costs by optimizing loading efficiency during narrow application windows, providing a return on investment in less than 9 spraying days. At less than $7,000, it is the best solution for automating the filling process.

Fetch Communications Device

RealmFive, Inc.
Lincoln, Nebraska, USA
www.realmfive.com

The Fetch communications device extends the range of in-field wireless devices, bridging the gap between in-field RealmFive LoRa end devices and LoRa-to-cellular gateway communications edge devices. Unlike a typical wireless repeater, Fetch acts as a gateway while providing store-and-forward capabilities. R5 Core wireless does not require line-of-sight between devices. Users can install sensing devices below the canopy, and Fetch will receive and send data from miles away, even through dense foliage. Fetch stores and retransmits data at full power, making it especially effective for long-range data transmission compared to a simple repeater. When running on solar power, Fetch is ideal for remote, drop-in networks.

FieldNET Pivot Watch™

Lindsay Corporation
Omaha, Nebraska, USA
www.lindsay.com

FieldNET Pivot Watch™ is a universal remote irrigation monitoring system that features a small self-contained telemetry device with sensors, GPS, and cellular communication, powered only by solar and a battery. This design makes it an ultra-low cost, do-it-yourself installation that farmers can add to their center-pivot systems. FieldNET Pivot Watch removes the cost barriers that prevent many farmers from using pivot telemetry. The design requires no electrical connections and works on any pivot, including electric and hydraulic pivots. It is the most cost-effective and universal irrigation monitoring solution available. FieldNET Pivot Watch allows farmers and their agronomic advisors to easily monitor pivot shutdown, travel direction, travel speed, water application amount, position in the field, and water pressure.

Flip State Sensor

RealmFive, Inc.
Lincoln, Nebraska, USA
www.realmfive.com

The Flip state sensor uses RealmFive's vibration monitoring technology to identify when a machine is on or off. Upon installation, Flip adapts to a particular machine's vibration threshold using a self-training protocol. Installation is extremely quick and easy: first remove the battery pull tab, and then mount Flip, magnetically, to the machine to be monitored. In about five minutes, Flip completes a series of verification steps and self-training. Flip then wirelessly connects to an in-range gateway, which sends data to the R5 Cloud. Users can set alerts when the monitored machine changes state from on to off, or vice versa. A number of applications are envisioned for Flip, including monitoring of irrigation pumps and grain bin fans.

Furrow Underground System

RealmFive, Inc.
Lincoln, Nebraska, USA
www.realmfive.com

The Furrow Underground System combines a soil moisture probe with an underground wireless device. Prior solutions were limited by radio technology and required aboveground components. RealmFive's wireless technology allows a wireless probe to be completely buried, keeping all parts out of the way of fieldwork, with no wires to trip over in vineyards and orchards or get caught by machinery in row crops. The Furrow Underground System saves substantial time during planting, as users can install it ahead of time in the off-season. The patent-pending underground wireless device transmits data to an in-range gateway or store-and-forward fetch using RealmFive's R5 Core connectivity. Batteries power the system for five years. This buried soil monitoring system reduces recurring labor costs by minimizing sensor installation and removal each season. Furthermore, the sensors gather temperature, soil moisture, and electrical connectivity data year-round, not just during the growing season.

Fusion720 Xtractor Inline and Single-Bale Combination Wrapper

Groupe Anderson Inc.
Chesterville, Quebec, Canada
www.grpanderson.com

The Fusion720 Xtractor is a combination inline and single-bale wrapper. This new wrapper consists of an inline bale wrapper with modular mechanisms (retractable supporting rods, sliding and pivoting rollers, bale kicker, and more) that can wrap bales individually, so the wrapping can be optimized according to the operating factors (storage site, crop quantity, etc.). Individually wrapped bales can serve as perfectly sealed ends for inline tube wraps, all with the same machine. The Fusion720 Xtractor can wrap up to 180 bales per hour in inline mode and up to 50 bales per hours individually. Both wrapping modes are fully automatic and are controlled with a new color display. The Fusion720 Xtractor also features a plastic film cut-and-hold system, a plastic film and tensioner shield, and the new Anderson Smart-Start concept to prevent bales from sliding on the ground at the beginning of a tube.

Grain Bin Door Safety Latch

Sukup Manufacturing Co.
Sheffield, Iowa USA
www.sukup.com

The Grain Bin Door Safety Latch prevents closing of a grain bin's outer door unless the inner load-bearing doors are properly closed. It is designed to protect persons near the outer door from becoming buried by grain if the outer door is opened while it is holding back grain. The inner doors, which are comprised of locking panels, provide structural support for the bin and help bear the load of grain. However, when the outer door is closed, it may be difficult to determine if the inner doors are properly closed. There have been instances of persons being injured or killed by grain spilling out of the outer door because the inner doors were not properly closed due by operator error, and the outer door burst open. The new Grain Bin Door Safety Latch ensures proper closing of the load-bearing doors.

Ground Speed Management II

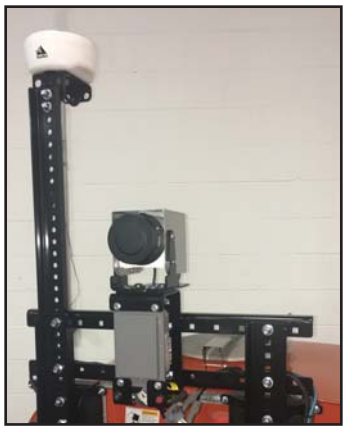
New Holland
New Holland, Pennsylvania, USA
www.newholland.com

Ground Speed Management was first introduced on the TG/T8000 tractors, where it brought CVT logic to power-shift tractors. Transmission shifting was based on a required forward speed target rather than an engine speed target, and the benefit was considerable fuel savings. Ground Speed Management II is a control package that brings a new and intuitive feature to New Holland T6 tractors equipped with the Dynamic Command transmission while maintaining the fundamental GSM target of increased efficiency. This second generation of Ground Speed Management introduces a vehicle operating interface and speed control system similar to that used on the Auto Command™ CVT, as well as interacting with key gearbox and engine features to achieve and maintain the operator's requested speed at the most optimum operating point, reducing fuel consumption and improving efficiency with significantly reduced operator input.

Intelligent Spray Control System

Smart Guided Systems LLC
Indianapolis, Indiana, USA
SmartGuided.com

The Android tablet-based Smart-Apply® Intelligent Spray Control System™ was developed over the last ten years by the USDA Agricultural Research Service and leading universities. Smart Guided Systems LLC has a five-year exclusive technology transfer agreement for this LiDAR-based system and has commercialized it. The Intelligent Spray Control System can be adapted to most models of air blast sprayers in less than eight hours. Published research reports have concluded that the Intelligent Spray Control System provides the following performance improvements while providing equal or better crop protection: 47% to 73% reduction in spray consumption, 40% to 87% reduction in spray loss beyond tree canopies, up to 87% less airborne drift, and 68% to 93% reduction in spray loss on the ground.



JAGUAR TERRA TRAC

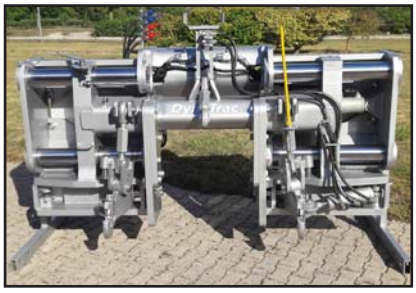
CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

The New CLAAS TERRA TRAC is the first OEM track system on a self-propelled forage harvester. This new series of forage harvesters was designed around the track system. The new tracks have a special hydraulic system for hay pickup and turning that pushes down on the center bogie wheels to create a wheel-like effect that does not scuff the stubble or damage the headlands. The benefits of tracks include a better ride in rough terrain, faster ground speeds in furrow-irrigated fields, improved handling in muddy conditions, and less soil compaction. The rear tire is taller, and the tire inflation gives the machine a long flat footprint in the field. The frame was lengthened by three feet to keep the turnability similar to that of a wheeled machine.

JOHN DEERE QUIK-KNECT™

John Deere
Grovetown, Georgia, USA
www.deere.com

John Deere Quik-Knect™ addresses driveline attachability with a simplified and universal approach that can be used on PTO drivelines and scaled to other power-driven units. Too often, operators must access a hard-to-reach area without visibility and then hold back a locking collar and rotate the driveline. The novelty of John Deere Quik-Knect™ is its simplicity and compatibility with a large range of products. John Deere Quik-Knect™ provides significant benefits for the coupling of PTO-driven implements, including no PTO spline alignment and hold-back requirements, automatic locking when the tractor PTO is engaged, integrated locking and coupling so that no external restraint is required, improved operator ergonomics, and increased operator safety. John Deere Quik-Knect™ is compliant with existing driveline standards and does not require modification to existing shielding.



LAFORGE DYNATRAC

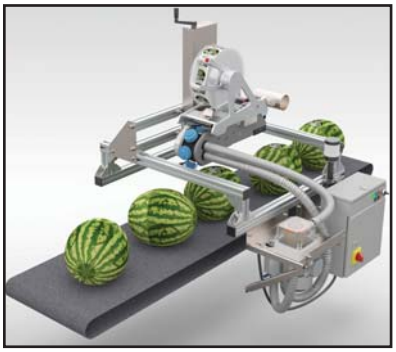
Laforge Systems LLC
Cedar Falls, Iowa, USA
www.Laforgegroup.com/en

LAFORGE DynaTrac is a universal guidance interface between the tractor and an implement for three-point, two-point, and trailed equipment. Tractor guidance using GPS has well-known benefits, and DynaTrac allows an implement to accurately trail the tractor to fully leverage those benefits. DynaTrac addresses two common scenarios when tractors operate with implements. In high-traction operations, such as tillage, the implement trails quite well behind the tractor, but the tractor struggles to stay on the intended line of travel. In low-traction operations, such as planting, the tractor follows the line easily, but the implement is unstable and deviates, even on flat ground. DynaTrac is applicable to any type of row crop farming. It can also be beneficial in situations where a consistent overlap is desired for optimal efficiency and to limit environmental exposure.

LARGE LABEL V6

Sinclair Systems International
Fresno, California, USA
www.sinclair-intl.com

Sinclair's customized Large Label V6 labeling system is designed to label larger fruits and vegetables (cantaloupes, honeydews, watermelons, squash, etc.) that are conveyed at high speeds. This design is a modification to the current V6 single-lane system, which is typically used for labeling smaller produce like apples, avocados, kiwifruit, etc. The modifications improve the V6 applicator to manage larger labels, and a new, scaled-up V6/RM6 cassette was developed to accommodate and dispense the larger labels. Automation of the process means increased productivity and efficiency, less human interaction with the produce for lower risk of contamination, and lower labor involvement and cost. The Large Label V6 includes four new label sizes, with the largest being 3 inches by 2.4 inches. The machine is capable of labeling commodities at speeds ranging from 120 to 400 fruits per minute.



LEXION 8000/7000 Series Combines

CLAAS of America Inc.
Omaha, Nebraska, USA
www.claas.com

The new LEXION 8000 and 7000 Series Combines have been redesigned to increase productivity by 10% (over the previous 700 Series) through the use of faster, more convenient changeover between crops and conditions, greater throughput and grain handling capacity, and more powerful drive train systems with a standard 25 mph top speed on all models. New in-cab controls allow the operator to shift between low and high speed ranges on both the threshing system and chopper from the safety and comfort of the cab, as well as separately vary the threshing area and separation area to match the crop and conditions more efficiently. These additional controls enable the CEMOS AUTOMATIC combine optimization system to autonomously optimize performance faster with more accurate results.

LS475 Liquid System

John Deere
Moline, Illinois, USA
www.deere.com

The LS475 is a versatile liquid application system capable of applying liquid nutrients and crop protection products. The dual-pump application system provides the widest available application range, a dedicated high-capacity filling system makes reloading efficient, and the widest factory-installed spray boom reduces working time in the field. Automated application controls and integrated dual-purpose boom plumbing improve rinsing and reduce water consumption. The LS475 is fully integrated into the John Deere Operations Center for simple management of prescriptions and application records. Mounting the LS475 on the John Deere F4365 application vehicle provides a smooth ride and industry-leading transport speed. This combination results in a superbly productive and efficient floater.

M & R Series Commercial Walk-Behind Mowers

John Deere
Moline, Illinois, USA
www.deere.com

The all-new M & R Series Commercial Walk-Behind mowers offer unsurpassed productivity and operator comfort. Improved ergonomic design of the steering controls includes recessed operator presence levers during machine operation and spring-loaded neutral locks to reduce operator fatigue and support full-day mowing by professional landscape contractors. The R Series delivers an industry-leading 8.5 inches of frame clearance, enabling these mowers to easily navigate over curbs without damage to customer property or the mower. In addition, optimized weight distribution gives operators increased maneuverability over varying terrain. The ground speed was also increased up to 7.5 mph while maintaining cut quality, so more acres per hour can be mowed in less time.

Microsystems Raw Food Pasteurization System

Microsystems First, Inc.
Tallahassee, Florida, USA
www.microsystems.pro

This system pasteurizes raw foods such as eggs, shellfish, fruits, vegetables, and meats to diminish harmful pathogens to undetectable levels. This is accomplished without changing any of the raw food's characteristics, so oysters remain alive, eggs are still raw (i.e., egg whites can be whipped), and tomatoes remain ripe and juicy with much higher lycopene content. This transformative technology allows consumers to enjoy their favorite raw foods with no concerns about *Salmonella*, *E. coli*, *Vibrio*, norovirus, or other unpleasant and possibly deadly illnesses. The system is completely customizable for applications ranging from the largest industrial users to local restaurants. It is safe and effective when used as directed and requires between 3 to 8 minutes to process almost any food. With increased incidences of foodborne illnesses, this technology is appropriate for any food processing or service facility.

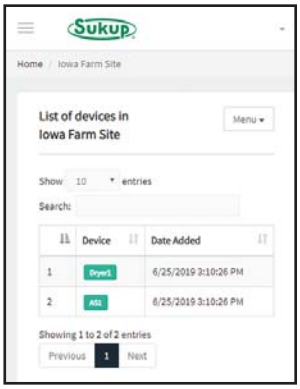
MowerPlus™ Smart Connector

John Deere
Moline, Illinois, USA
www.deere.com

The MowerPlus™ Smart Connector is a compact device that wirelessly transmits J1939 CAN data from select John Deere Residential Lawn Mowers to a mobile device. The smart connector can communicate fuel level, battery level, and hour meter information to the John Deere MowerPlus app for real-time and historical machine management.

MySukup.com

Sukup Manufacturing Co.
Sheffield, Iowa, USA
www.Sukup.com



MySukup.com is a new cloud-based platform for controlling Sukup grain handling and storage equipment. Users can set up a MySukup account to monitor and operate their grain drying, moving, and storage equipment from anywhere using a smart phone or personal computer. Setup is easy and does not require advanced skills. Users can invite others to see equipment status data and can set permissions appropriate for each user, ranging from view-only permission to permission to make changes to all equipment and operating parameters. The system can also send user notifications on operating status or failure of connected devices. This allows prompt resetting or repair of equipment, preventing situations that can become hazardous. Troubleshooting of operation problems is simplified in MySukup.com by allowing the sharing of data between the customer, dealer and, if needed, customer service representatives at Sukup Manufacturing Co.

N500C Series Air Drill

John Deere
Moline, Illinois, USA
www.deere.com

The John Deere N500C Series Air Drill integrates the latest in seeding technology to provide small-grain producers the most productive, accurate, and smart seeding tool in the industry. Building on the 1990 CCS™ Air Drill, the N500C Air Drill was designed to give operators easier meter access, a larger commodity tank, and the latest in integrated technology. The N500C features electric-drive meters that offer improved seed population control in four sections, and variable-rate seeding capabilities with SectionCommand™. Optional tank scales allow ActiveCal™ for on-the-go seeding calibration from the cab. RelativeFlow™ blockage offers row-to-row seedflow monitoring. TruSet™ allows operators to set opener downforce pressures from inside the cab as soil conditions change. The SeedPlus™ app allows calibration of meters, tank scale calibration, and weight monitoring of tank scales from a tablet or mobile device. ProSeries™ openers allow improved seed placement accuracy with reduced maintenance.

New Holland P-Series Air Carts

New Holland Agriculture
New Holland, Pennsylvania, USA
agriculture1.newholland.com/nar/en-us

The New Holland P-Series Air Carts introduce an automatic leveling and agitation system for air carts equipped with a fourth tank. This automatic system ensures that fine seed or inoculant, or other products with a small particle size, adequately cover the meter rollers during near-empty tank conditions. This smart system uses a mechanical leveling device powered by an electric motor, and bin level sensors to automatically move the product in the needed direction. This system uses software to control the device, alert the operator in the cab, and automatically perform either as a leveler or for agitation when leveling is not required. The automatic feature provides maximum productivity in situations when product is running low in the fourth tank, and it reduces the likelihood of product bridging.

Nexus Seat and TLS Suspension System

Sears Seating
Davenport, Iowa, USA
www.searsseating.com

The Nexus Seat and TLS Suspension System is comprised of a highly scalable and configurable upper seat structure combined with an advanced adjuster system and TLS (toggle link swing) air suspension. Unique features include a seat structure that allows multiple seat cushion widths and backrest heights, an operator restraint system that is integrated into the structure, a modular adjuster and isolator system that provides a variety of option levels, easy-access suspension controls, and advanced TLS air suspension that uses swing toggle scissors to replace the typical roller and track in the lower suspension structure for improved performance, stability, and durability. The Nexus Seat also provides advanced ride control options and internal mounting of an air reservoir for LSR/LNF (low spring rate/low natural frequency) applications.

Optidisc® Elite Cutterbar

Kuhn North America
Brodhead, Wisconsin, USA
www.kuhn-usa.com

With a redesigned cutterbar profile and reduced height, the Optidisc® Elite cutterbar on KUHN disc mowers and mower conditioners delivers outstanding performance to meet customer demands to harvest high-quality hay and forage. Building on the proven Optidisc cutterbar, this new cutterbar retains differential disc spacing, Protectadrive® disc bearing stations, and patented silent block cutterbar frame mounts. The Optidisc Elite cutterbar features a narrower height, enabling short cutting heights of 1.5 inches (40 mm) with a flat 2.5° cutterbar angle, reducing the amount of dirt and ash that can be incorporated into the windrow at steeper angles. The redesigned profile also increases the area in which the free-rotating blades cut the crop, ensuring a clean cut even in the most challenging conditions.

OptiSense™ Belt Stall Indicator

Kuhn North America
Brodhead, Wisconsin, USA
www.kuhn-usa.com

The OptiSense™ belt stall indicator on the new KUHN Merge Maxx® MM 890 continuous twin merger ensures maximum productivity in hay merging operations. The new OptiSense indicator alerts the operator if the merger belts begin to slow, helping prevent plugs and costly downtime. The exclusive system uses the ISOBUS monitor to alert the operator when the machine is reaching maximum capacity, and it will stop the belts and pickups if a belt stalls. This reduces the amount of crop plugged in the machine, as well as reducing the possibility that the machine will be damaged as a result of a stalled belt. This innovative feature helps even inexperienced users operate the merger at peak efficiency levels.

Paddle Sweepway

Sukup Manufacturing Co.
Sheffield, Iowa, USA
www.sukup.com

The Paddle Sweepway is a grain bin sweep with an open head section. The skeleton-like design allows grain to pass through the head section, which increases the speed of bin unloading and reduces the likelihood of center sump plugging. Grain bins are emptied by first opening a center sump that allows grain to flow into an under-floor removal system, such as an auger or conveyor. Traditional paddle sweep head sections are covered by metal plates that tend to block the flow of grain into the center sump, in some cases resulting in plugging, which can be very costly and time-consuming to remedy. This new sweep combines the open design of a traditional auger sweep with the increased sweeping efficiency of a paddle sweep. Angled support bars block and redirect grain clumps to the sides of the sweep, helping to keep the center sump open.

Plant Stand Analyzer

FieldRobo LLC
Ames, Iowa, USA

Plant Stand Analyzer (PSA) is the world's most accurate high-throughput plant stand mapping system for large-scale maize breeding programs. PSA is a motorized 4-row or 8-row ground system that can produce a stand detection accuracy of 97% on average at travel speeds of up to 14 mph by using high-speed reflective laser proximity sensors. PSA works under any lighting conditions and offers a large operational time window that spans from the V4 to the R1 growth stages of maize plants, as long as the platform's ground clearance permits. PSA counts plant stands in real-time, and with the use of its accompanying mapper software, it can generate a rich set of georeferenced and plot-based data analytics, including population, interplant spacing, gap length, stalk size, stalk inclination angle, and number of doubles and tillers.

QJS-D Multiple Outlet Turret Nozzle Body

TeeJet Technologies
Wheaton, Illinois, USA
www.teejet.com

This turret-style nozzle body fits within TeeJet's QJS system of stackable nozzle bodies. For installation of the turret near the bottom drop, a dual check valve body was created by overlapping two independent flow passages. Additionally, this nozzle body features two opposing outlets downstream of one check valve, which creates a fully reversible design. The complete assembly includes three new plastic parts: the QJS- D main body, the QJS turret body, and the QJS end cap. All of these parts can be combined with parts from TeeJet's current QJS Series, such as QJS end bodies, QJS middle bodies, and QJS extender bodies. Due to the number of combinations available, the QJS Series is z robust, customizable, and stackable nozzle body solution.

R216 SP Rotary Disc Header

MacDon Industries Ltd
Winnipeg, Manitoba, Canada
www.macdon.com/en/

MacDon has introduced the R216 SP, a new 16 ft rotary disc header for self-propelled windrowers. This header features the widest conditioner rolls of any 16 ft self-propelled disc header on the market at 129 inches (328 cm). Unique EvenFlow™ header geometry eliminates internal augers and allows more even crop conditioning, especially in heavy conditions. Two conditioning options are available: steel inter-meshing rolls that are ideal for high-volume crops that require aggressive feeding, or polyurethane rolls that deliver a crimp/crush action to gently condition leaves and delicate stemmed crops. The product was designed for all-around performance in cut quality, capacity, and windrow formation. In-cab adjustment of the rear baffle allows operators to adjust the width of the windrow on the go, and configurable disc rotation patterns allow the header to be optimized across a wide range of conditions.

R5 Click

RealmFive, Inc.
Lincoln, Nebraska, USA
www.realmfive.com

R5 Click provides a comprehensive tool for managing an agricultural operation from a smart device or computer with a single, unified app. R5 Click uses patent-pending CardView so users can navigate through previously disparate sensing devices and data in a single, geospatial platform. Users can view historical and current data on a slide-out contextual menu for a variety of sensors, including soil moisture, soil temperature, rainfall, wind speed, wind direction, water level, equipment status, and center-pivot irrigation status. Users have full control over their farms and fields, and R5 Click helps wireless system administrators proactively monitor device data like battery health and device signal strength through the Device Health dashboard. The default notifications and customizable alerts notify users of specific issues to help them manage their operation efficiently and effectively.

SideWinder Ultra

New Holland
New Holland, Pennsylvania, USA
agriculture.newholland.com

The SideWinder Ultra armrest is the third evolution of New Holland's SideWinder interface. It places all of the tractor's key controls in a single logical location. The controls are grouped for easy identification and for ergonomic reasons, where the driver will be looking while using the controls. Groupings include engine and transmission, three-point hitch limits, media, and climate control. A comprehensive number of functions are located on the force-based multifunction handle for precise control of the tractor's speed and end-of-row operations. The SideWinder Ultra is a fully customizable operator interface. Controls can be easily configured by choosing functions from a pick list on the armrest's new IntelliView 12 touch monitor. Hardware customization includes choosing between an advanced joystick or remote levers and positioning of the elbow pad. Third-party tablet or phone mounts can also be attached to the SideWinder Ultra.

Sinclair EcoLabel®

Sinclair Systems International LLC
Fresno, California, USA
www.sinclair-intl.com

Sinclair EcoLabel® is a food-safe, certified compostable fresh produce label. Sinclair EcoLabel meets EN13432, a European standard for compostable and biodegradable packaging. To meet this standard, four different tests need to be conducted by an accredited third party: heavy metal and fluorine analysis, biodegradation, disintegration, and plant toxicity analysis. In addition to meeting EN13432, Sinclair EcoLabel is certified by TUV Austria and holds OK compost Industrial and Seedling certification. Sinclair EcoLabel was designed to be compatible with Sinclair high-speed labeling equipment for use on a variety of fruits and vegetables, such as apples, kiwifruit, pears, peppers, tomatoes, etc., that are conveyed at high speeds on sizers and graders.

SpotOn® Quantum PAR Light Meter

Innoquest, Inc.
Woodstock, Illinois, USA
www.innoquestinc.com

The SpotOn® Quantum PAR Light Meter is a handheld meter for quickly and accurately assessing the quantity of light present for plant growth. This meter was specifically designed to work under both natural and artificial light sources, such as LEDs. Accurate measurement of photosynthetically active radiation (PAR) has been problematic for some light meters under LED light sources due to their narrow wave bands. The SpotOn® Quantum PAR Light Meter has been designed to excel under LED light sources with an instant spot measurement mode, a scan mode for quickly averaging light over an area, and a daily light integral (DLI) mode for accumulation of 24-hour light totals when left in place. The meter features a long battery life, water-resistant design, is pocket-sized for easy carrying, and includes an integral stake/stand for in-place DLI measurements.

Tractor Implement Management (TIM)

Agricultural Industry Electronics Foundation (AEF) e.V.
Frankfurt, Hesse, Germany
www.aef-online.org

Tractor Implement Management (TIM) is a cross-product and cross-manufacturer ISOBUS solution that allows an implement to control certain tractor functions and optimize the work process. The implement sends information to the tractor via standardized and secure communication, which leads to a new optimization of the overall system. The AEF has taken the basic idea of the ISOBUS Class 3 solution and made decisive progress with a new infrastructure for secure communication. This standardized solution with digital certificates is the only way to ensure manufacturer-independent cooperation between tractors and implements for maximum brand flexibility. With TIM, growers work more precisely, effectively, and economically while simultaneously increasing quality. Field operations become simpler and more convenient as TIM takes over tiring repetitive tasks.

U-Trough Extended Center Sump

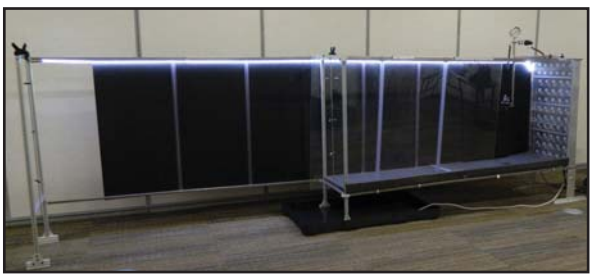
Sukup Manufacturing Co.
Sheffield, Iowa, USA
www.sukup.com

The U-Trough Extended Center Sump has sumps on both sides of the gearbox that drives the sweep auger in a grain storage bin. Having a sump on both sides of the gearbox improves sweep performance by collecting grain faster than traditional sumps, which have only one passageway from the center of the bin floor to the unload system below. Once the sweep reaches the backside of the bin, it tends to pile grain around the top gearbox until it can flow into the sump. By placing a sump on the backside of the gearbox, grain does not have to flow over or around the gearbox to reach the sump, which significantly improves sweep performance.

Valley GPS Guidance

Valley Irrigation
Racine, Wisconsin, USA
www.caseih.com

Valley Irrigation has announced improvements to Valley GPS Guidance, providing growers with the latest advances in competitive GPS corner technology. Valley GPS Guidance uses power line carriers (PLCs) to communicate RTK GPS correction signals. This technology improves the reliability of communication with the corner and eliminates the need for data radios. Built-in terrain compensation reduces over-steering on rolling terrain or high ridges, resulting in straighter and more consistent wheel tracks for less crop damage. Valley GPS Guidance is compatible with all Valley control panels and corner models. It also easily retrofits into existing John Deere/NavCom or Trimble multi-frequency or single-frequency systems.



Wind Tunnel in a Box™

Application Insight LLC
Lansing, Michigan, USA
www.applicationinsightllc.com

The Wind Tunnel in a Box™ is a portable spray demonstration device that allows users to see real-scale, on-site, visual and tactile simulations of how wind affects the risk of spray drift. This is a critical issue as applicators struggle to maintain spray efficiency without impacting neighboring crops and landscapes. The Wind Tunnel in a Box demonstrates different spray application variables, such as nozzle type, boom height, wind speed, spray pressure, and even adjuvants. It can operate continuously or in timed mode for accurate comparisons between treatments. It is large enough for groups of people to easily view the demonstrations, and users can even enter the windstream for a tactile experience. The device is portable, can be transported easily in a van or pickup truck, and sets up in 30 minutes.

Wing Wheel System for Case IH Early Riser® 2160 Split-Row Large Front-Fold Planter

CNH Industrial
Burr Ridge, Illinois, USA
www.caseih.com

The Wing Wheel System for the Case IH Early Riser® 2160 Split-Row Large Front-Fold Planter is an industry-first feature that maintains continuous ground contact with the 47-row 15-inch planter's tandem wing wheels in both the planting and transport positions. This allows greatly improved weight distribution between the tractor drawbar, the planter wing wheels, and the planter center section carrying wheels during road transport, rather than having all the weight on the tractor drawbar and planter center section carrying wheels, as is typical with competitive 47-row 15-inch planters. The significantly decreased weight on the tractor drawbar during transport reduces strain on both tractor and planter, reduces or eliminates the need for heavy-duty tractor drawbar support, and generally improves road transport characteristics of the planter. Conversion from the planting to transport positions and back is accomplished from the comfort of the tractor cab with an in-cab display.

Woods® BH100 Groundbreaker® Backhoe

Woods Equipment Company
Oregon, Illinois, USA
www.woodsequipment.com

Woods has developed a unique set of ripping, gripping, and sawing capabilities for the bucket, thumb, and dipperstick on the new BH100 Groundbreaker® Backhoe. Serrated, sawtooth edges on each of these components allow the backhoe operator to efficiently dig in a wide variety of soil conditions, grub out roots to remove stumps, and reposition odd-shaped, oversized materials. Coupled with a long reach-to-digging depth ratio, powerful digging and swing forces, and high-capacity buckets, the BH100 is a highly capable backhoe attachment for compact and utility tractors. Mounting to the tractor is accomplished with either dedicated four-point subframes or the three-point Saf-T-Lok® limiter hitch.

ZR5-1200 Self-Propelled Baler

Vermeer Corporation
Pella, Iowa, USA
www.vermeer.com

The ZR5 Self-Propelled Baler provides an unprecedented level of automation, operator comfort, and maneuverability. By automating the baling process, the ZR5 reduces the number of manual operations involved in making a bale to just one step: all the operator needs to do is push "go." An independent suspension system, with the cab positioned over it, gives the operator better handling in the uneven ground conditions that naturally come with baling hay. In field mode, the zero-turn capability helps the operator minimize skipping windrows. Operators can spend less time maneuvering in the field and more time baling when compared to conventional tractor-baler combinations, and the integrated quarter-turn technology allows the bales to be placed parallel to the windrow, which saves time when picking up the bales.

INDEX OF WINNERS BY COMPANY

Agricultural Industry Electronics Foundation AEF e.V.
Tractor Implement Management (TIM)

Application Insight LLC
Wind Tunnel in a Box™

Candidus, Inc.
Adaptive Lighting Controller

Case IH
Case IH Precision Air™ 5 Series Air Carts

CLAAS of America Inc.
AXION 900 Series • CLAAS 926-Series Corn Head • CLAAS JAGUAR 900 Series • CLAAS ORBIS 750 • JAGUAR TERRA TRAC • LEXION 8000/7000 Series

CNH Industrial
Case IH AFS Connect® Magnum™ • Wing Wheel System for Case IH Early Riser® 2160 Split-Row Large Front-Fold Planter

Dura Products
DURA-ABS DI Automated Direct Injection

FieldRobo LLC
Plant Stand Analyzer

Groupe Anderson Inc.
Fusion720 Xtractor - Inline & Single Bale Combination Wrapper

Innoquest, Inc.
SpotOn® Quantum PAR Light Meter

John Deere
2700/2750 PrecisionCut™ and E-Cut™ Hybrid Triplex Mower • John Deere Quik-Knect • LS475 Liquid System • M & R Series Commercial Walk Behind Mower • MowerPlus™ Smart Connector • N500C Series Air Drill

Kuhn North America
Optidisc® Elite Cutterbar • OptiSense™ Belt Stall Indicator

Laforge Systems LLC
LAFORGE DynaTrac

Lindsay Corporation
FieldNET Pivot Watch™

MacDon Industries Ltd
R216 SP Rotary Disc Header

Microsystems First, Inc.
Microsystems Raw Food Pasteurization System

New Holland
Ground Speed Management II • New Holland P-Series Air Carts • SideWinder Ultra

RealmFive, Inc.
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Sinclair Systems International
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Cyclone Air System Control • Grain Bin Door Safety Latch • MySukup.com • Paddle Sweepway • U-Trough Extended Center Sump

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The Ethics of Sustainable Agricultural Practices

Hannah Thomascall

Photo courtesy of USDA NRCS.

Editor's note: ASABE member Hannah Thomascall, a student at Auburn University, took first place in the 2019 Ag and Bio Ethics Essay Competition by submitting "an original work of up to 1,500 words on an ethics topic impacting the practice of professions related to agricultural and biological engineering, systems, or technology." Open to undergraduate and graduate student members of ASABE and IBE, second place went to **ASABE member Megan Boland** of North Carolina State University for "Doing It Right with the Second Generation of Gene-Editing for Agriculture: CRISPR Crops," and third place was awarded to **ASABE member Margaret Anderson** of Auburn University for "Ethical Dilemma of Managing the Mississippi River." Congratulations to our 2019 finalists, who presented their essays at the 2019 Annual International Meeting in Boston, Massachusetts.

Sustainability is commonly defined as "development that meets the needs of the present generation without compromising the ability of future generations to meet their needs" (WCED 1987, 48). In the context of this paper, agricultural sustainability means reducing the consumption of resources such as water, chemical fertilizer, and soil, maintaining biodiversity, and creating less pollution—all while preserving the production rate. Without modifying the current agricultural practices, food production will be reduced dramatically when topsoil runs out in about 60 years (Arsenault, 2017) . Another drop in production will occur in approximately 75 years when the phosphorus mined to create fertilizer is depleted ("Phosphorus depletion: the invisible crisis," 2011) . Ethically, it is unacceptable to continue using resources at a rate that will leave future generations to starve, yet switching to sustainable farming may cause food shortages and economic hardship for many farmers now.

Monoculture farming became widespread in America after World War II to feed a rapidly growing population ("Industrial Food Production," n.d.). However, there are several unsustainable aspects of monoculture farms that could be reduced or eliminated by switching to polycultural farming. In polyculture farming multiple species are grown together, as opposed to monoculture where only one species of crop is grown. Monoculture farms harm local wildlife. For example, bees do not get sufficient and balanced nutrients from one crop's flower and because the crop all blooms at the same time they are left without a food source the rest of the year (Donaldson-Matasci, 2013). Bees and other beneficial insects are also harmed by pesticides sprayed on the crops. Monoculture depletes the soil of essential nutrients by growing the same crops repeatedly in the same location. This leads to an increased need for chemical fertilizers—which are made using mined phosphorus. Runoff from fields is polluted by these chemical fertilizers and pesticides.

All of these negative environmental impacts can be ameliorated by adding cover crops to convert fields into polyculture farming. Cover crops are plants grown between the rows of the commercial crop. The cover crops are not harvested and are typically left to decompose on the field before being tilled back into the ground the following season to act as a fertilizer—reducing the need to add chemical fertilizers. Cover crops also add habitat for birds (which eat crop-damaging insects) as well as limiting the area available for weeds to grow, reducing the need for pesticides. Finally, cover crops provide an alternative food source for local animals which means better nutrition and longer access to food. Overall, transforming a monoculture farm to a polyculture farm with the addition of cover crops creates healthier soil, reduced need for added chemicals, cleaner runoff water, and a better habitat for local wildlife.

Large, remote farms are also unsustainable—whether they are polycultural or monocultural. In America, 20% of the farms produce 80% of the crops (Gleason, 2014). The percent of the American population working in the agricultural industry dropped from 41% in 1900 to under 2% in 2000 (Dimitri et al., n.d.). This represents a huge number of jobs lost and a significant concentration of the economic benefit of the agricultural industry. Switching to smaller farms would increase the percent of the population involved in farming and allow

more people to benefit economically from this industry. Large, remote farms also mean that food has to travel a very long distance to get from farm to table. Food miles are a unit used to describe the carbon footprint of transporting the food, not just the physical distance the food travels. Interestingly, this means that food travelling from Asia to America by cargo ship actually has fewer food miles than food flown across America because of the relative efficiency of the respective modes of transportation (Leavens, 2017). Local farms that use efficient transportation can significantly reduce the carbon footprint of food.

Despite the many benefits of sustainable farms, there are some obstacles to switching from large, monoculture farms: lower crop yields, increased cost, and reduced food diversity available to consumers. Monoculture farming produces more food at a lower cost due to having the same growing requirements across the field and less diverse machinery needed. Growing only one crop also means that the crop tends to be chosen specifically for the climate and soil type and thus will have optimal growth and production (McGuire, 2015). The increased costs of more workers, different seeds, and new machinery to plant and harvest crops may be passed onto the consumers and create food deserts where people are unable to afford the available food. Switching to sustainable farms also means a decrease in food miles. One disadvantage to reducing food miles is it decreases the diversity available to many consumers, especially those who live in areas not conducive to farming. Currently 1 in 6 people in the world are dependent on food imports and 34 countries are unable to produce enough food for their populations due to water or land limitations (Cago, 2017). This means that reducing food miles is not realistic everywhere. The best way to improve the carbon footprint of food transportation right now is to reduce food miles where possible and use more efficient vehicles where food importation is required.

Now that some of the problems and benefits of sustainable farming have been stated, the ethical implications must be examined. Continuing farming with the current methods will lead to loss of topsoil and phosphorus for chemical fertilizer (among other things) which will cause a severe reduction in crop yield in the near future. Yet, switching to sustainable, local, biodiverse farms could cause economic hardship on farmers, increase food prices, decrease food variety for consumers, and reduce yield. It is unethical to deplete the resources needed to produce food for future generations, but it is also unethical to reduce the current food production and cause food shortages.

Different ethical theories resolve this dilemma in various ways. Utilitarianism argues that the morally correct option is the one that causes the greatest net happiness regardless of the motive behind the action (Duignan, 2017). Therefore a utilitarian would believe sustainable farming must be implemented because a slight food shortage now would cause less unhappiness than future generations starving and not being able to produce food. Conversely, ethical egoism claims that actions should be performed only to maximize one's self-interests (Shaver, 2019). This theory would reason that sustainable agriculture should not be implemented as it could cause negative effects now and the negative effects of continuing large, monoculture farms will occur after their lifetime.

There are several possible compromises that would partially satisfy both utilitarianism and ethical egoism—along with most other ethical theories. One compromise is crop rotation, which involves planting monoculture farms but changing the type of crop year to year. This provides many of the benefits of sustainable farming, including increased retention of soil nutrients, less need for fertilizers and biodiverse food sources for wildlife. Crop rotation also retains the increased yield of monoculture farming and can easily be enhanced with other sustainable farming practices like cover crops. This ethical compromise would allow the conservation of agricultural resources for future generations without compromising the current food production rates. Other compromises include vertical farming, hydroponics, and lab grown meats. These would all address some of the problems of monoculture, such as space and soil nutrients, while maintaining high yields.

The ethical dilemma of whether to switch to sustainable farms is viewed differently by various ethical theories. A compromise between monoculture and polyculture farming, like crop rotation, offers a favorable option for most ethical theories.

Monoculture is widely used because it reduces costs for farmers and increases crop yield. Unfortunately, monoculture farming depletes the soil of nutrients, requires chemical fertilizers, needs large amounts of water, and harms local wildlife. Small, sustainable farms use techniques such as cover crops to mitigate these problems and reduce food miles and the associated pollution. The ethical dilemma of whether to switch to sustainable farms is viewed differently by various ethical theories. A compromise between monoculture and polyculture farming, like crop rotation, offers a favorable option for most ethical

theories. There is no clear answer of what the moral option is in regards to sustainable farming; what works in one part of the world may not work everywhere and people disagree about what the top priority should be. However, improvements in sustainable farming are being made all over the world, and new technologies may provide a better solution that is currently unimaginable.

ASABE member Hannah Thomascall, Department of Biosystems Engineering, Auburn University, Auburn, Alabama, USA, hbt0007@auburn.edu

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Planning for the 2020 AIM

The YPC kicked off the 2019-2020 year with a successful retreat. Last November, several Executive Committee members and members-at-large met in Omaha, Nebraska, to check out the site for the 2020 Annual International Meeting and sketch out some preliminary session planning for the meeting. We are excited to share some beneficial and educational events with the Society:

- **AIM orientation.** As the YPC, we strive to help first-time AIM attendees (as well as people who are a little rusty at the AIM) understand ways to get involved with the Society and discover the opportunities that the AIM has to offer.
- **Graduate student events.** Check out the socials and panels that the YPC hosts for graduate students and potential graduate students. The best part is: most of these events are free to attend!
- **Family programming.** This year in Omaha, the YPC has worked with the Local Planning Committee to come up with a list of family events in the Omaha area, and we've found some possible discounts for families!
- **Professional development and networking.** Register for the Continued Professional Development (CPD) course offered by the YPC, as well as our local technical tour. We'll also have a session on local agriculture in Nebraska and the Midwest, an opportunity to get a professional headshot at the Welcome reception, as well as a social for Young Professionals (and all ASABE members are welcome).

These events are already in the works to make the 2020 AIM a great success. Keep your eyes peeled for more YPC events when you register for the AIM. We'll see you in Omaha!

ASABE member and YPC Chair Noël Menard, Applications & Evaluations Engineer, John Deere, Waterloo, Iowa, USA, menardnoelr@johndeere.com.

Honoring the Newly Elected

Twelve new ASABE Fellows were recognized at the Annual International Meeting in Boston, Massachusetts, in July. *Resource* is proud to highlight these recent honorees.

Fellows must have a minimum of 20 years of active practice in, or related to, the profession of engineering, the teaching of engineering, or the teaching of an engineering-related curriculum. The designation Fellow has honorary status, to which members may be elected but may not apply.

As the ASABE Constitution states, Fellows are "of unusual professional distinction, with outstanding and extraordinary qualifications and experience in, or related to, the field of agricultural, food, or biological engineering." Election to Fellow is one of the highest distinctions an ASABE member can achieve, and *Resource* looks forward to acquainting you with more of ASABE's best and brightest.

John R. Fisher, retired Vice President of Technical Affairs and Safety, Alamo Group Incorporated, Seguin, Texas, is honored for his long dedication to the development and application of industry standards and encouragement of off-road equipment safety.

At Alamo Group Incorporated, Fisher was responsible for providing senior management with leadership and direction regarding the organization's safety culture, proactive safety training, status of product liability, employee safety injury investigations, and compliance with environmental laws and regulations. Fisher has been a leading figure in the development of agricultural equipment safety standards in the ISO forum, later introduced and adopted by ASABE, and has spent time encouraging colleagues to work with his educational vision for engineers in the future through various training initiatives. Fisher has increased the understanding and importance of Alamo Group's employee workplace safety mission through education and implementation of employee safety programs and reviews, significantly reducing work-related injuries. OSHA recordable and lost time injuries at Alamo Group have continually decreased to the lowest levels in 20 years.

Pictured above: John and Louann Fisher with their grandson, Gareth MacAllister. Gareth was 8 months old at the time of this picture and is now a 2-year-old with lots of never-ending energy.

Tony E. Grift, Professor of Agricultural and Biological Engineering, University of Illinois, Urbana, is recognized for his contributions in teaching, research, and service.

Together with graduate students and post-doctoral researchers, Grift has conducted extensive research on the development of uniformity controlled granular fertilizer spreaders using a unique optical feedback system. He spearheaded the measurement of energy requirements for various operations in biomass feedstock production. In the area of high-throughput phenotyping, Grift developed a Corn Root Imaging Box (CRIB) which enables imaging of 100 corn roots per hour. He developed innovative methods of characterizing corn root complexity, as well as a new definition of root angle. Currently, Grift is pioneering On-The-Implement-Intelligent-Soil-Sensing (OTIISS) methods that include acoustics, shear wave technology, and electrical impedance measurement. Additionally, Grift has taught thousands of undergraduate and graduate students in the areas of agricultural machinery, electro-hydraulics, instrumentation, and machine vision. Grift initiated the ASABE Student Robotics Design competition in 2007 and led it for nine years. This competition started with three teams and over the years has seen remarkable growth in both participation and technical sophistication.

Pictured above: Tony (*back row, far right*) and colleagues from the University of Illinois, during a visit to the Nelson Mandela Capture Site memorial, Durban, South Africa, June 2019.

VisualChallenge9

FINDING FOCUS

When we put out the call for submissions for the 2020 *VisualChallenge9*, we knew we would be in for some great images. Each year *Resource* asks ASABE members and their colleagues to communicate with images—statements without words—to celebrate the visual aspects of agricultural and biological engineering. For our ninth year of the Visual Challenge, we are excited to present selected images from the many entries we received.

We thank our many contributors who focused in on the profession—finding beauty and meaning in their work. Their work comes to life in these images, showing those outside the ABE field: "This is what we do."

While the selection process was inevitably subjective, we hope these photos provide a glimpse into the variety of activities, workplaces, and surprises that an ABE career can offer. As you find focus in 2020, please remember to pull out your camera or phone and take a shot. We will be looking for images for next year's challenge and look forward to your entry!

Duy Hau (Holden) Truong, ***technician, Stacey Lab, University of Missouri, Columbia, USA.***

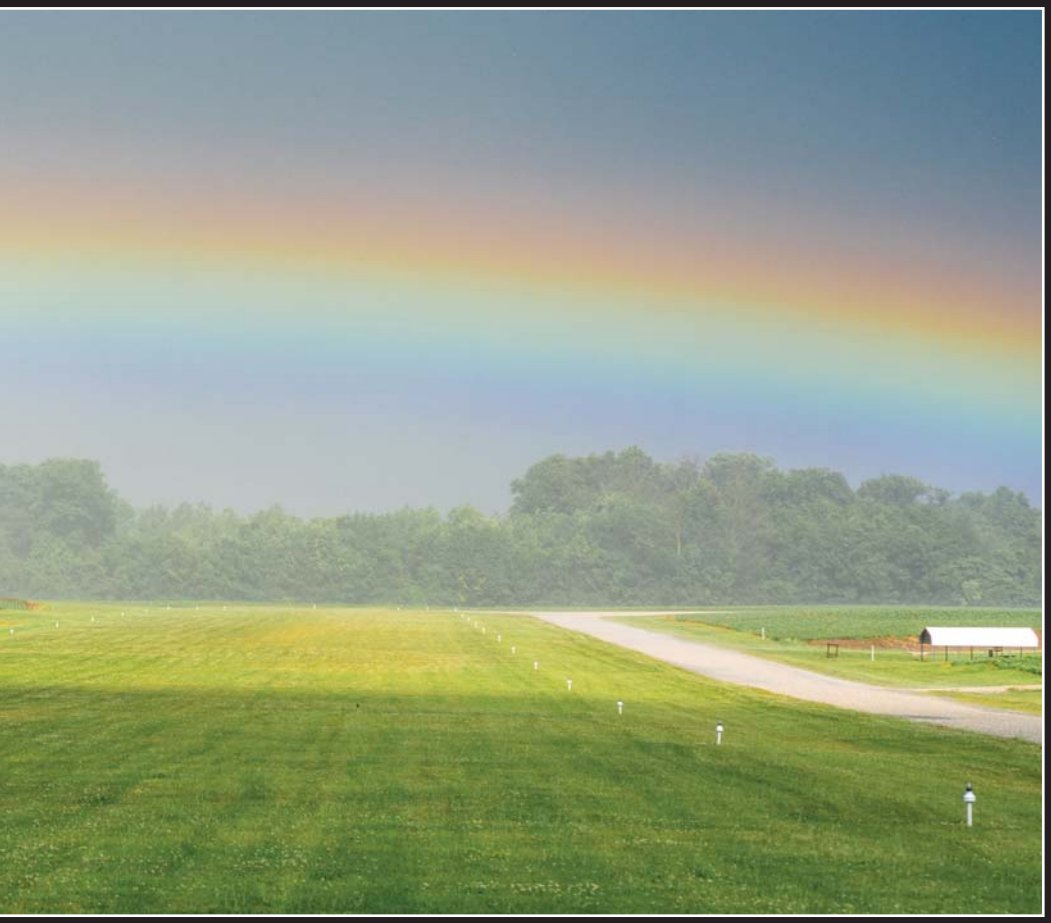
CLOUD HARVESTING

Could this tractor be harvesting clouds? It sure looks like it! Instead it is headed to collect wheat grown near the Bradford Research Center, University of Missouri, Columbia, USA.

ASABE member A.J. Both,
Professor, Department of Environmental Sciences,
Rutgers University,
New Brunswick, New Jersey, USA.

JUST PLUGGING AWAY

A robotic transplanter is used to transfer young plants from their initial growing tray (foreground) into individual pots. This process allows the plants more space to grow to the desired marketable size. The system transplants 12 plants in a single movement at a high rate of speed.



ASABE member John Lumkes, P.E., ***Professor, Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, Indiana, USA.***

SOMEWHERE OVER THE RAINBOW

Farmland is visually "worth its weight in gold" when a beautiful rainbow takes off from a soybean field, arches over a grass airstrip, and touches down in a corn field.

"THE LITTLE CHIEF THAT COULD"

A 1941 Aeronca Chief approaches a grass strip bordered by Midwestern cornfields. Fall weather is great for flying and provides a unique and beautiful perspective on the scale and impact of agriculture.

ASABE member Casee Eisele, *Technology Alliances and Product Management, Compass Minerals, Overland Park, Kansas, USA.*

FERTILIZER HARVEST

Sulfate of potash (SOP) harvest takes place at Compass Minerals in Ogden, Utah, every September through May. Through three years of evaporation across 47,000 acres of ponds, the process yields salt, SOP, and magnesium chloride. The scope of the operation is breathtaking and was even more picturesque on this day with the approaching storm (https://www.youtube.com/watch?v=30P2BUOgds8).

ASABE member Joel Peele Jr., *Senior Engineer, Amadas Industries, Suffolk, Virginia, USA.*

LETTING THE DUST SETTLE

Field-testing and efficiency evaluation of the upcoming model of Amadas Industries' self-propelled peanut combine in Florida took place during the 2019 harvest. The test window for peanut harvest is limited. It takes untold hours to get to the point of field-testing and sometimes only minutes to see things aren't going to work as planned. Fortunately, our testing was successful.

ASABE member Gedalyahu Manor, *retired Associate Professor, Technion—Israel Institute of Technology, Haifa, Israel.*

REACHING NEW HEIGHTS

The new high tree sprayer, DALI, uses turbulent air jets to send chemical droplets onto the canopies. It does so by vibrating and rotating the leaves, efficiently depositing droplets on both sides, and in the process uses less chemicals. Vineyard and strawberry sprayers using the turbulent air jets system have already been used in Australia and Israel.

ASABE Member Paula Steiner,
Engineer, USDA-NRCS,
Mason, Michigan, USA.

SUNSET OVER LAKE MICHIGAN

Take in the beauty at one of the largest fresh water resources in the world.

ASABE member Duran Gulec, *PhD student,*
Department of Agricultural and Biosystems Engineering,
South Dakota State University, Brookings, USA.

PROMISE TO OUR FUTURE

The grand challenges address our ever-increasing global population. How will we house and feed the world's peoples in the years to come? My photo asks, "Are we paying attention to Mother Nature?" Considering the codes, rules, laws, regulations, and political decisions to be made, we must step up the pace and keep our promise to future generations by fostering naturally elegant and practical solutions.

ASABE member
Brian McLaughlin,
2015 AE50 Winner,
Safety Psychographics LLC,
Notre Dame, Indiana, USA.

A RURAL MEETING

A scene outside the annual Amish Safety Day in Holmes County, Ohio. The buggies are all displaying the slow-moving vehicle (SMV) emblem, a standard vehicle marker developed by ASABE, and their owners have come to see the latest in safe farming and road-use practices. The field in the foreground underscores how most Amish are still tied to the land. The reflective SMV emblem helps keep this population safe on modern roads, so they can continue to farm in their traditional ways.

STILL STANDING

***This veteran barn behind an empty farmhouse in Berrien County, Michigan (home of ASABE), is a typical rural sight across the Midwest. While picturesque, most such structures are no longer useful. They are too small to house modern equipment, or they are simply unnecessary on unoccupied farmsteads that have been incorporated into larger operations. This particular barn once served a small dairy operation, as indicated by its rusting stanchions. If you look closely, you can see a message in the fading paint: "*Men can take your life, but ... soul."

ASABE member Shane Williams,
Design Engineer, Kuhn North America, Madison, Wisconsin, USA.

FOGGY BEGINNING

The barn, during the morning milking on my family's dairy farm in rural Wisconsin, is enshrouded with fog hiding the background distractions and keeping the focus on the big picture.

Photo by Mark Thallman, courtesy of USDA.

New screening tool developed by Iowa State University researchers can speed detection of bovine tuberculosis

In Brief: A new screening tool developed by researchers at Iowa State University and the USDA can dramatically reduce the time required to detect strains of bacteria that cause a serious livestock disease and that impact the health of millions of people worldwide.

Bovine tuberculosis is a zoonotic disease—one capable of being transmitted from animals to humans. The disease is caused by infection with *Mycobacterium bovis*, a pathogen closely related to the one that causes human tuberculosis.

The new tool collects extremely low levels of volatile organic compounds emitted by the bacteria, making it possible to differentiate between disease-causing and non-disease-causing strains of Mycobacteria, said **ASABE member Jacek Koziel,** professor of agricultural and biosystems engineering at Iowa State University. The device can be used to collect and analyze samples within hours, much quicker than current methods that often take up to eight weeks.

In addition to speeding up identification, the new testing platform is also portable and less expensive than tools typically used to test for bovine tuberculosis in the laboratory.

Bovine tuberculosis causes coughing and lung damage, often leading to death. It primarily affects cattle and white-tailed deer in the U.S. and can be transmitted to humans who come in contact with infected animals, and their meat or hides, or unpasteurized dairy products. Other mammals, including bison, elk, and feral and domestic swine, are susceptible.

Human tuberculosis is generally linked to a different species of bacteria. However, about 30% of human cases worldwide—out of an estimated 9.6 million total new cases (in 2014)—are linked to bovine tuberculosis. These cases represent an estimated 200 to 300 human TB cases annually in the U.S. and millions in developing countries where the disease is more prevalent in cattle.

Bovine tuberculosis often goes underreported and can spread widely. The course of the disease is slow, and a sick animal can infect others before symptoms start to show. Disease transmission can also occur during the long incubation time that current testing procedures require to culture and identify the bacteria.

"That's why the speed of the new lab-scale method is so valuable," said Koziel. "This is an important step toward an accurate, real-time screening device for these diseases."

ASABE member Jacek Koziel (*right*) and research collaborator Devin Maurer, with a prototype of their new tool that can dramatically speed detection of bovine tuberculosis by identifying the unique signature of the gases that different microbes emit over time.

The new tool uses a biosecure, closed-loop circulating airflow system to collect the volatile organic compounds from bacteria growing in lab cultures. The collected samples are then analyzed using detailed statistics and other methods to identify the unique signatures of the gases that different microbes emit over time.

"This ability to detect the evolution of disease 'fingerprint' volatiles is something that current methods cannot provide," said Koziel.

"The tool was developed with many materials that we had on hand and with support from collaborators who believed in the idea and knew it could be an important advance," he said.

Koziel worked with Devin Maurer, a research associate in agricultural and biosystems engineering at Iowa State who now works in industry. "Devin had the unique blend of practical skills, interest in livestock, and knowledge that made it possible to create this ingenious device," said Koziel. They collaborated with Christine Ellis, then an APHIS research fellow at the USDA Animal Plant Health Inspection Service's National Wildlife Research Center in Fort Collins, Colorado, and Tyler Thacker, a research microbiologist affiliated with the USDA Agricultural Research Service's National Animal Disease Center in Ames.

"I hope this leads to more in-the-field, quicker response screening tools to help control the spread of livestock disease," said Maurer. "It also has potential to be adapted to help diagnose other diseases—and even to fingerprint environmental, forensic, or pharmaceutical specimens that you might want to limit direct contact with."

The tool is not yet ready for widespread use, but Koziel expects it could soon become part of a standardized test. To take it to the next step, he said, additional side-by-side cross-check testing with current "gold standard" methods is still needed.

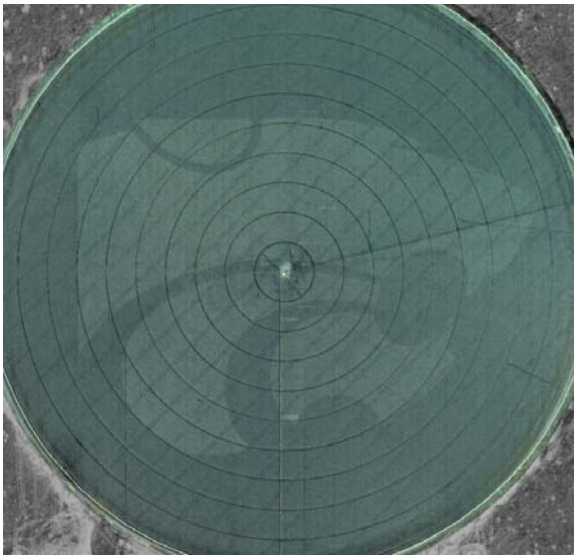
For more information, contact **ASABE member Jacek Koziel,** koziel@iastate.edu, Devin Maurer, dmaurer@iastate.edu, or Ann Robinson, ayr@iastate.edu.

Farmer uses agricultural technology to plant image of popular K-State logo

In Brief: Kansas farmer Rocky Ormiston found a unique way to honor his alma mater: this summer, he planted corn to form a 2,000-foot image of the K-State Powercat.

Folks across the country find all kinds of ways to celebrate their favorite universities and sports teams. This summer, Rocky Ormiston may have outdone them all.

The co-owner of Ormiston Farms used precision agriculture technology to plant a corn hybrid in the shape of the Kansas State University Powercat, which—at 2,000 feet wide—is thought to be the largest version ever made of the popular logo.



Rocky Ormiston of Kismet, Kansas, planted corn in the shape of the K-State Powercat. At 2000 feet wide, it's thought to be the largest version ever made of the logo. *Photo courtesy of Ormiston Farms*.

Pictures taken several hundred feet above the field show a perfectly groomed Powercat inside a 125-acre circle that measures one-half mile wide. "The Powercat covers about 40 acres of that circle," Ormiston said.

Today's precision agriculture machines allow farmers to plant multiple varieties of crops in one pass, depending on the soil or other factors. In the case of Ormiston's Powercat, he used the technology to plant one corn variety in a very precise pattern, and then used a different variety for all other parts of the circle.

The two varieties have different colored tassels, creating a color difference between the larger field and the Powercat, "measured right down to the inch," Ormiston said. The image, which represents the university's mascot, is expected to last for about two weeks.

Using computer software from CropQuest, an agricultural consulting company, Ormiston and his wife Stephanie, dropped an image of the Powercat onto a picture of the field to assign "zones" for planting corn. "You assign that one variety to the Powercat, and the rest of the field gets the other variety," Ormiston said.

The computer program communicates with the tractor, which serves as a controller for the 80-foot-wide planter. As the farmer drives through the field, the computer program communicates with a pair of meters on the planter, which methodically release the assigned variety at the precise time and in a precise location.

Ormiston Farms, which manages 7,000 acres of irrigated land, purchased the technology nearly two years ago because

their farm's soil was highly variable. "This technology was created to plant the best variety regardless of soil type, so you could maximize every acre on planting just one variety that does average across the entire field, we can plant two varieties that both do well on that field."

The field where the Powercat was planted was an area where the soil was consistent, Ormiston said. It gave him the opportunity to "just have some fun."

"We've been talking about doing this since we bought the planter," he said. "I didn't do it the first year, because I wanted to make sure everything was going to work first."

For more information, contact **Pat Melgares**, Communications Coordinator, KSU Communications and Agricultural Education, melgares@ksu.edu.

Plastic water bottles may one day fly people cross-country

In Brief: A research group led by **ASABE member Hanwu Lei** and Washington State University (WSU) scientists has found a way to turn daily plastic waste into jet fuel.

ASABE member Hanwu Lei and his colleagues at WSU melted plastic waste at high temperature with activated carbon, a processed carbon with increased surface area, to produce jet fuel.

"Waste plastic is a huge problem worldwide," said Lei, an associate professor in WSU's Department of Biological System Engineering. "This is a very good, and relatively simple, way to recycle these plastics."

How it works

In the experiment, Lei and his team tested low-density polyethylene and mixed a variety of waste plastic products, including water bottles, milk bottles, and plastic bags, and ground them down to around 3 mm, or about the size of a grain of rice.

The plastic granules were then placed on top of activated carbon in a tube reactor at a high temperature, ranging from 430°C to 571°C (806°F to 1,060°F). The carbon is a catalyst that speeds up the chemical reaction without being consumed.

"Plastic is hard to break down," Lei said. "You have to add a catalyst to help break the chemical bonds. There is a lot of hydrogen in plastics, which is a key component in fuel."

Once the carbon catalyst has done its work, it can be separated out and re-used on the next batch of waste plastic conversion. The catalyst can also be regenerated after losing its activity.

After testing several different catalysts at different temperatures, the best result produced a mixture of 85% jet fuel and 15% diesel fuel.

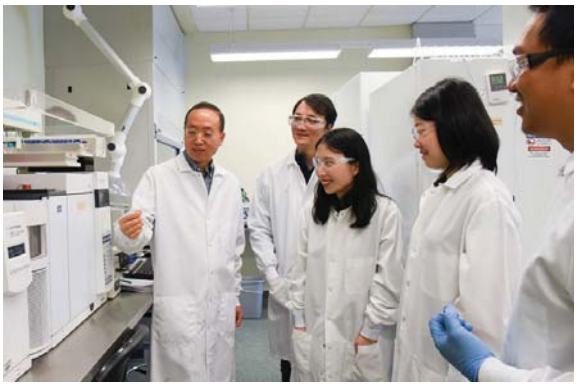
Environmental impact

According to the U.S. Environmental Protection Agency, landfills in the U.S. received 26 million tons of plastic in 2015, the most recent year for which statistics are available. China has recently stopped accepting plastic recycling from the U.S. and Canada. Conservative estimates by scientists say that at least 4.8 million tons of plastic enters the ocean each year worldwide.

Not only would this new process reduce that waste, very little of what is produced is wasted. "We can recover almost 100% of the energy from the plastic we tested," Lei said. "The fuel is very good quality, and the byproduct gases produced are high quality and useful as well." He also said the method for this process is easily scalable. It could work at a large facility or even on farms, where farmers could turn plastic waste into diesel.

"You have to separate the resulting product to get jet fuel," Lei said. "If you don't separate it, then it's all diesel fuel."

For more information, contact **ASABE member Hanwu Lei,** hlei@wsu.edu.



ASABE member Hanwu Lei (*left*) and his team at the Bioproducts, Sciences and Engineering Laboratory are working to turn plastic waste into jet fuel.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