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Seed WORLD

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UNLOCKING THE FULL GENETIC POTENTIAL OF PLANTS

Photo courtesy of Shiaoan Chao, USDA

Since 1995, the genomes of nearly 50 plants have been sequenced and thanks to advances in technology, the rate at which these sets of genetic instructions are being deciphered is increasing rapidly.

JUST 10 PLANT genomes were sequenced between 2000 and 2008. In 2012, by comparison, 13 genomes were published and another 12 in 2013. They include major grain, fruit and vegetable crops such as corn, wheat, barley, rice, soybeans, hemp, cotton, flax, apple, peach, watermelon, tomato, strawberry, potato, cucumber, grape and Chinese cabbage.

“Having these increasingly comprehensive collections of DNA allows us to mine useful genes more efficiently and make better use of them,” says Owen Hoekenga, research molecular biologist for Cornell University.

Once the genome has been sequenced, genotyping tools can be used to determine the genetic variants that any individual plants may possess. Genotyping provides information about the complete genetic makeup of a particular plant variety or species. It allows breeders to very quickly and easily identify beneficial or desirable traits that can potentially be deployed across varieties of the same species, and in some cases across different plant species using transgenic technologies.

“As genotyping tools are becoming increasingly inexpensive, it’ll be more straightforward to deploy traits into a wider range of germplasm for broader impact,” says Hoekenga. “The question is whether or not the use of trans-gene technologies is going to expand beyond its current base in maize, soybeans, sugar beet and cotton to include other economically important crops like rice or wheat.”

Shotgun Sequencing

In November 2012, a team of international scientists announced that they had sequenced the wheat genome that contains 96,000 genes and is five times larger than the human genome. That was followed by sequencing of the barley genome in October 2012, which has 5.3 billion letters of genetic code.

Because the genomes of plants such as barley and wheat are so large, scientists use a technique called shotgun sequencing, which essentially breaks the genome into smaller, more manageable segments for analysis and then reassembles them.

“Shotgun sequencing is being routinely applied to increasingly large and complex organisms,” says Hoekenga. “It’s so much more efficient in terms of how much information you recover from a single experiment.”

DNA Mapping and Sequencing

Many people mistake DNA mapping and sequencing for the same thing, but they are different processes that provide different information. A DNA (or genetic) map shows where certain things (identified with genetic markers) are located and in what order on the chromosome of a genome. DNA sequencing (of a genome) is much more comprehensive and reveals not just where things are on the chromosome, but also what they look like and what they do.

Genetic sequencing identifies the specific genes or forms of a gene (alleles) that confer or control traits or functions that could be useful to plant breeders, such as those that influence yield, oil or protein content, drought tolerance, disease or pest resistance.

“It’s now more time and cost efficient to use genome sequencing to ask genetic mapping questions because for the same amount of time, effort and cost we can get 100,000 pieces of information simultaneously, rather than 10,” says Hoekenga. “In terms of creating a more comprehensive snapshot of the genome, it’s the difference between a masterpiece and a little paint-by-numbers picture. You have so much more information of such greater depth that it’s just more useful.”

Gene Silencing Technology

Understanding how plants turn specific genes on and off to perform certain functions or defend themselves may pave the way for new varieties with increased pest and disease resistance through the use of gene silencing technology.

One of these technologies, RNA interference (RNAi) is being employed by some major seed companies, such as Monsanto, to try and provide resistance to pests such as corn rootworm.

“RNAi is a one of a number of mechanisms by which genes can be silenced or turned off,” says Hoekenga. “Part of RNAi relies on the fact that in plants there are sensing mechanisms that can recognize RNA molecules that they regard as being pathogens in some way. If you can introduce into a plant a sequence that creates an RNA molecule that matches the gene you want to turn off, the plant will recognize this trigger and turn off the target gene. Gene silencing can not only be used to silence genes that exist in the plant, but they can also be used to silence genes of organisms that interact with the plant [like diseases and pests].”

Improving Yields

Two genetic discoveries in 2013 may help raise global crop yields. In November, an Israeli agri-tech company announced it hopes to increase crop yields without the aid of genetic modification by speeding up the multiplication of crop genomes using a technique called genome doubling.

Genome doubling occurs in nature, but takes thousands of years. Scientists have long tried to speed up the process, but could not avoid damage to certain agronomic characteristics of the crop.

Hoekenga explains that although this may be a new way to use genome doubling (also called polyploidy), it’s not a new

“It’s now more time and cost efficient to use genome sequencing to ask genetic mapping questions because for the same amount of time, effort and cost we can get 100,000 pieces of information simultaneously, rather than 10.”

– Owen Hoekenga

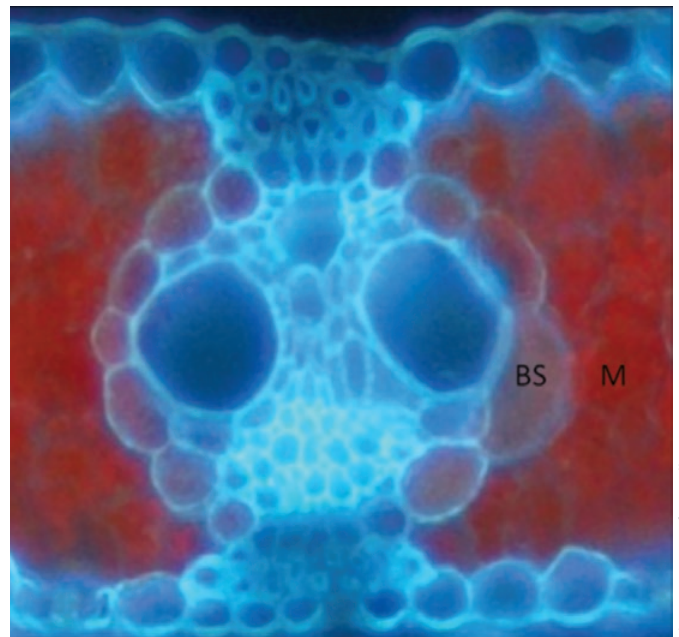


Photo courtesy of Cornell University

A gene, dubbed the “scarecrow gene,” has been studied in the stems and roots of plants. Cornell University researchers, however, discovered that the gene is also found in the leaves of certain plants. The C3 pathway is the most common photosynthetic pathway in plants and is found in crops such as rice. The C4 photosynthetic pathway is used in corn, sorghum and millet, which are grown in arid climates. Plants that use the C4 pathway use water, nitrogen and sunlight 50 percent more efficiently in areas where water is scarce than those that use the C3 pathway.

technology. “It doesn’t surprise me that someone is inducing polyploidy as a means of agronomic improvement, because that kind of technology has been around for a number of years now,” he says, adding that it has been used successfully in the past to add more genetic diversity to bread wheat, for example.

Cornell researchers also announced in 2013 the discovery of a scarecrow gene, which leads to more efficient plant photosynthesis. Researchers say the discovery opens the door to the transference of C4 plant mechanisms into C3 plants, such as wheat and rice, which would allow them to be grown in hotter, dryer environments with less fertilizer and still achieve up to 50 percent higher yields.

Pests and Diseases

The genomes of pests such as the pea aphid and the diamond-back moth have already been sequenced and a recent breakthrough has brought researchers one step closer to improved resistance to soybean cyst nematode. For many years growers have been planting soybeans with just one gene, *Rhg1*, as a defense against SCN. A U.S. research team has discovered that *Rhg1* is actually three genes located next to each other on the chromosome, which work together to provide SCN resistance and, if this gene group can be identified in multiple varieties, should provide more options to develop better resistance.

Diseases are also being examined at the molecular level. An international team of scientists in 2010 cracked the genetic code of a plant pathogen, *Hyaloperonospora arabidopsidis*, that causes downy mildew disease. This “stealth bomber” of plant pathogens is able to sneak undetected past a plant’s immune defenses and understanding the genetic mechanisms it uses to do this will be useful in developing better resistance to a variety of plant pathogens in the future.

Other research in the U.S. is trying to identify genetic targets to give resistance to fungal diseases such as fusarium, root rot and sudden death syndrome in corn, soybeans and wheat. Researchers in Canada have identified and are developing genetic markers for three genes providing resistance to the Ug99 strain of wheat stem rust.

Bioinformatics

Along with genome sequencing technologies comes a whole supporting cast of computational and bioinformatics technologies that are essential for analyzing information gathered in the lab.

“It’s an area that is growing fast and which is going to be increasingly important in the future,” says Hoekenga. “Bioinformatics is the computerized analysis of data,” he explains. “It was truly novel 20 years ago, but it’s an increasingly important skill set as the experimental biology gets easier and easier. Now we can generate more and more data which means there’s increased emphasis on analysis rather than actually collecting the original information.”

“As genotyping tools are becoming increasingly inexpensive, it’ll be more straightforward to deploy traits into a wider range of germplasm for broader impact.”

– Owen Hoekenga

Next Generation Genome Sequencing

The next generation of sequencing technologies will further accelerate the plant breeding process by producing even greater amounts of information simultaneously and at much faster speeds.

Pyrosequencing is a next generation technology that measures tiny flashes of light produced by different chemical reactions in DNA strands. “In one single pyrosequencing reaction you are looking at hundreds of millions of sequences simultaneously, so you are generating as much information as is found in the whole human genome at once,” says Hoekenga. “Your ability to generate data is vastly increased.”

The Future of Genomics

As genomic and computer technologies continue to become more efficient, cost effective and complex, what will the genetic secrets they unveil tell us and how will they help us prepare for agriculture a century from now?

“A big question is what is agriculture going to look like in the face of global climate change?” asks Hoekenga. “What will the agro-ecology look like if rainfall patterns become increasingly erratic and temperature fluctuations become increasingly larger? What is that going to do to both perennial crops and annual crops? Personally, I think definitely one of the big challenges is how do you respond to or anticipate increasingly erratic conditions and what can we do in terms of creating varieties with greater stress tolerance or other sorts of things.”

Angela Lovell

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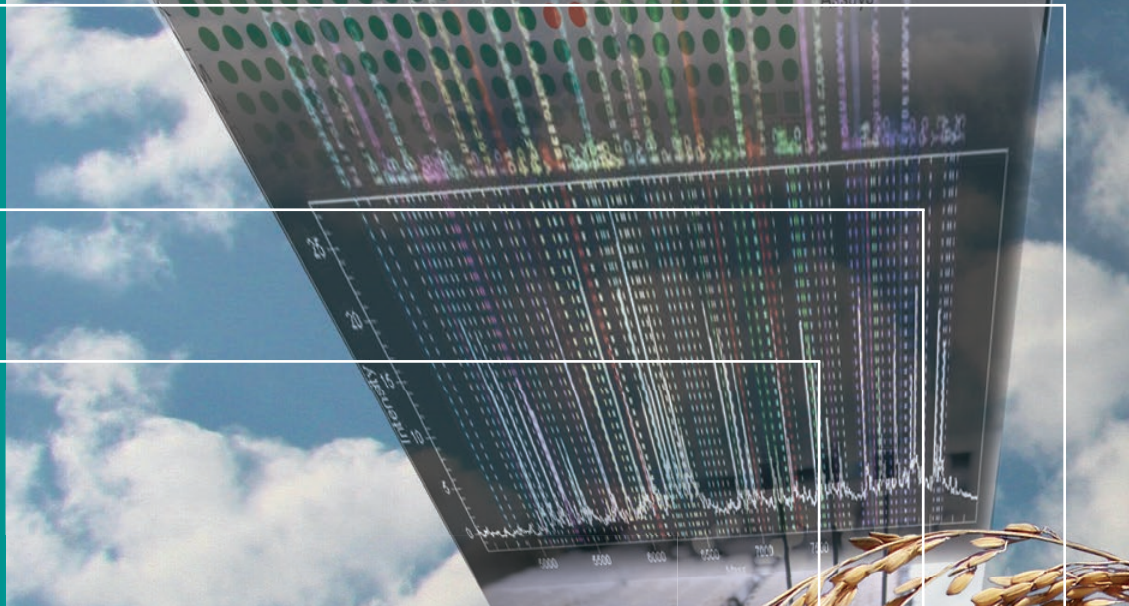
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Using TALENs and CRISPRs in Crop Development

Recently developed new breeding technologies could mean a number of new traits moving into improved crops faster, easier and more economically.

PLANT BREEDERS AND researchers are excited about TALENs and CRISPR/Cas-based systems—short for transcription activator-like effector nucleases and clustered regulatory interspaced short palindromic repeats, respectively—and what they may bring to bear on crop improvement and development.

“There’s a lot of intense interest right now in the community of individuals who investigate and develop improved crops and animals about the use of these technologies,” says Jeff Wolt, professor of agronomy for the Biosafety Institute for Genetically Modified Agricultural Products at Iowa State University.

Among these new breeding technologies are a group of diverse techniques that allow for very specific—or site-directed—modification of plant and animal genomes using natural processes of the cell.

Researchers use these techniques, also known as genome editing, to target a specific gene of interest. They then disable, or knock out, that gene to study the resulting phenotype (physical or biochemical manifestation of the gene) after the mutation has been performed. Observation of the plant’s phenotype provides information about gene function. For example, a specific gene is targeted and, in the simplest instance—known as nonhomologous end-joining—a point deletion and repair is performed, which is frequently error prone and causes a mutation of that gene. In some cases, the mutation may result in a beneficial new trait.

“The fundamental work at the front end of identifying gene function allows us to target specific genes for modification,” says Wolt. “The fact that we’re able to do very specific gene modifications means we’re going to get some traits that are going to be attractive ... [and] can be moved quickly into improved crops. I think a host of new traits are going to be available.”

Changes to a specific location within the genome can be affected in different ways. The nuclease systems can cause a double-stranded breakage in the DNA and the typical nonhomologous repair mechanisms will take effect. Errors are



Jeff Wolt is a professor of agronomy for the Biosafety Institute for Genetically Modified Agricultural Products at Iowa State University.



often incorporated into the genome at the time of repair. The errors are the mutations of interest in terms of how they alter the functioning—or phenotype—of the plant, explains Wolt. These same nuclease systems can also cause breaks that will be repaired by the process of homologous recombination, which allows the insertion of foreign DNA resulting in transgenic plants.

However, most of the interest is being directed to the study of mutations created by the nonhomologous repair mechanisms after inducing breakages. Once genes of interest are identified and if certain site-specific mutations provide utility, the genes can be moved into plants improving varieties easily and specifically, says Wolt.

In fact, it is the combination of ease of use and specificity that is generating buzz among scientists.

“These tools offer special opportunity in that they are exceedingly specific and appear to be very easy to use as well,” says Wolt. “They are amenable to high-throughput-type developments where we can look at them rapidly and in great detail. There are many promising [aspects] about them that we haven’t seen heretofore in some of the innovative techniques that have been used.”

These genome-editing nucleases are essentially mechanisms that carry information to a specific site within a genome. Through bioengineering, that information can be modified to indicate the specific site of interest within the genome and make changes to the gene at that site only. “The high specificity is really what’s of interest to people. If they’re highly specific, you don’t have any unintended changes ... and you don’t have as many issues around unintended occurrences which might have implications for the behavior of the phenotype, both from an efficacy as well as a safety standpoint,” says Wolt.

While the products of some related technologies, such as RNA interference and the use of zinc-finger nucleases, are well down the development pipeline and are currently being evaluated by regulators, the first published example of an improved crop using TALEN-based genome editing appeared last year. The study, led by Bing Yang, an associate professor in the department of genetics, development and cell biology at ISU, reported the development of disease-resistant rice in *Nature Biotechnology* in May 2012.

According to the study, researchers used TALEN technology to “edit a specific S gene in rice to thwart the virulence strategy of [*Xanthomonas oryzae*] and thereby engineer heritable genome modifications for resistance to bacterial blight.”

“Bing used TALENs to target that particular gene and to do a simple deletion and repair. Out of that, he was able to select plants that were modified but did not carry any genetic elements other than the plants’ own genetic elements. He then moved those further into development,” says Wolt, adding that

the researcher created a null-segregant—in which progeny lack any transgenic material—selected from the transformations he performed, resulting in the development of disease-resistant rice.

Kits are currently available to researchers or developers to perform plant transformations with TALENs. Although the development of CRISPRs is more recent, the technology is rapidly moving into labs. “From what I’ve read, the use of CRISPRs is even simpler than the use of TALENs. They will be in the hands of biotechnologists very quickly. There certainly have been successful transformations made on crop plants already, says Wolt.

Widespread adoption of these new breeding technologies may come down to economics. One of the avenues of research at ISU and its newly formed Crop Bioengineering Consortium is to address the economics of the new breeding technologies and whether or not they are more cost-effective than other current alternatives.

“Time to market, the cost of regulation and ease of use ... suggest [these new breeding technologies] are going to be attractive from an economic standpoint.”

— Jeff Wolt

“The feeling is they’re going to be much more economical,” says Wolt. “They’re going to allow you to move materials through a development pipeline more quickly.... Additionally, there is this hope, or belief, that we’re going to have a reduced regulatory burden and that would cut down on costs as well. Time to market, the cost of regulation and ease of use, these three things suggest [these new breeding technologies] are going to be attractive from an economic standpoint,” says Wolt, adding a cost analysis has not yet been performed.

It may be too soon for definitive statements about the regulatory environment surrounding these new technologies, but Wolt believes the regulatory burden may be reduced. “For most countries in the world, if you’ve used mutagenesis to obtain modifications of the plant for improved traits the regulatory requirements are minimal. That means a very low

hurdle compared with genetically engineered crops, where we've seen systems in various parts of the world buckle under the questions that are asked and an inability for policies to move the technology forward. There is a unique opportunity [for these new technologies] perhaps," says Wolt.

One other factor affecting adoption of these technologies is intellectual property rights of the techniques and whether or not they will be available to the developer community.

"It appears there are some real attractive opportunities here. As far as we understand, there is ready access to affordable licenses for TALENs—they're not restricted and they're supposed to be intended to be used widely," says Wolt, adding that in general CRISPR technology is also accessible to the user community.

The specificity, ease of use, cost-effectiveness, ready access and possible reduced regulatory burden make these new breeding technologies an appealing package for plant breeding and trait development communities.

"The technologies are intrinsically very attractive. They work very well, they're moving along very quickly, but their utility long term for crop improvement is going to depend on these externalities—what will be the regulatory view, how will governments throughout the world support the technology in terms of funding research and aiding in public communication, how will the intellectual property landscape evolve, and the economics—these are the things that people are trying to get their arms around right now," says Wolt. **Kari Belanger**

The specificity, ease of use, cost-effectiveness, ready access and possible reduced regulatory burden make these new breeding technologies an appealing package.



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Ensuring Seed Quality

From more efficient testing methods to high-speed seed counters with imaging capabilities, seed testing is rapidly becoming a critical player in the seed sector today.

S EED IS A VALUABLE investment today. Prices for a bag of corn or soybean seed are higher than ever before. Growers want to ensure they are protecting that investment to the best of their ability.

“Seed testing is more important than ever before because the price of seed corn, as an example, is so high; seed companies want accurate information on that seed bag so they can make sure the farmer they sell the seed to is getting what they paid for,” says Neil Foster, president of the Illinois-based Society of Commercial Seed Technologists.

According to Michael Stahr, manager of the Iowa State University Seed Laboratory, it is important to seed companies to identify which seed lots are of high quality and hopefully of high vigor. “I think seed testing is more important than ever before because even more is riding on the seed being high quality and being of the proper genetics,” he says.

However, when it comes to new technology, Foster says there aren't a lot of new testing procedures being developed.

Beni Kaufman, secretary general of the International Seed Testing Association, puts it another way. “Seed testing can never be on the cutting edge of technology because we have to have tried methods; there can be no risk-taking,” he says.

Evolving Technology

Despite the limited introduction of new tests, seed testing continue to move forward. Several significant advancements in seed testing have been made in the last few years, and Kaufman says many other trials are being testing that could lead to exciting new developments.

“The way the industry defines seed quality is not likely to change soon; however, the methods seed technologists test it by are evolving constantly,” says Kaufman.

For example, traditional genetic and trait purity methods are being replaced with new, molecular methodologies. “Although not brand new, one of the biggest advancements is the use of DNA instead of protein in checking that seeds are true to variety. Electrophoresis has been used for many years and has been effective, but single nucleotide polymorphism, or SNP, testing allows more efficient testing,” says Stahr.

A second advance is the availability of high-speed seed counters, some of which also have imaging capabilities. “It is not an exaggeration that seed lab customers need results yesterday and so anything that promotes efficiency without sacrificing



With the value of seed rising, seed testing unlocks hidden information for producers to maximize their yields.

accuracy is a plus,” says Stahr. “The imaging capabilities have the potential for determining the breakdown of sizes of seeds electronically in addition to traditional methods and for Integrated Refuge Corn—refuge-in-a-bag—they may be used to determine the percentage of refuge product in a sample.”

Focus on Purity

Purity analysis, including purity separations and other seed determinations, can be very time consuming and is therefore another area where new technologies are cropping up. These include:

- Uniform blowing procedure—The uniform blowing procedure is widely used in laboratories that test grass seed crops, to separate empty florets and other lightweight inert matter from pure, well-developed seeds. Laboratories are using the blowing process in a broad range of species to make preliminary separations, in order to increase the efficiency and effectiveness of the purity analysis. Despite the potential applications of the uniform blowing procedure, the use of this technology is still

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2. NO WEEDS.
3. NO WEEDS.



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limited. Its applications can be expanded to additional species, to achieve greater consistency among laboratories in separating lightweight inert matter. Blowers that can handle large sample sizes in various grass crops and cereals are needed.

- Ergovision system—An important aspect for seed testing laboratories is the ergonomic working conditions of the purity analysts. The Oregon State University Seed Laboratory has developed a purity testing system called the Ergovision system, which is mainly used in purity testing of small seeded species such as grasses or vegetables. Its value lies in its ergonomic design, a fibre-optic light for image clarity, optimum magnification and an automated seed flow in the field of view.

“We need to ensure the quality of the seeds farmers are putting in to the ground.”

— Beni Kaufman

- Molecular technologies—Molecular methods such as SDS-PAGE and SSR markers are being used in a few laboratories, mostly for variety identification, and in some cases to assist analysis when more detailed variety analysis and confirmation of a variety is needed. With additional research, this technology can be expanded for use with seeds that cannot be distinguished simply by morphological characteristics.

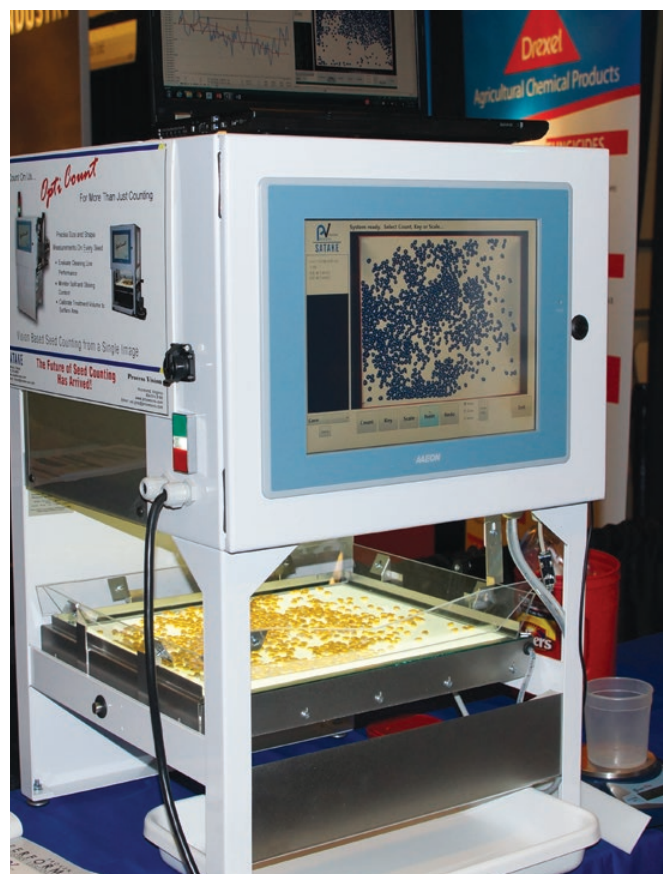
- Seed scanner—As purity analysis is very time consuming, especially for small seeds, a seed scanner that does part of the separation work is of much interest. Few models are available in the market today. Some laboratories believe that the ones that have been presented so far do not produce accurate results.

Stahr says in the end, when it comes to seed testing developments, it is more about an evolution in technology, and resulting changes to seed testing rules, then completely reinventing the wheel.

“The Association of Official Seed Analysts and the Society of Commercial Seed Technologists continue to update the *Rules for Testing Seeds* to reflect changes in seed products, such as species formerly considered to be weeds now being considered native species which are used along roadsides, in prairies, and for other purposes,” says Stahr.

It all comes down to ensuring what’s inside the seed bag is what a company says it is.

“There is no question that seed testing is becoming more important,” says Kaufman. “We need to ensure the quality of the seeds farmers are putting in to the ground. Seed testing is a critical part of the seed industry’s challenge of feeding the world.” **Julie McNabb**



Iowa State University Seed Lab’s OptiCount high speed seed counter.

NEW DEVELOPMENTS

Some developments in seed testing from around the world include:

- SpectraSeed—Seed phenotype database through spectral imaging
- Seed identification of medicinal plant species using machine vision
- Development of a diagnostic tool and resource for seed identification with Lucid and imaging technologies
- An image analysis for determination of genetic purity of different wheat varieties—Biochemical and Imaging Technique for Analysis
- Speed of seed imbibitions related to seedling evaluation—precocious criteria from image analysis to predict the seedling type in germination test
- Multiplex detection of plant pathogens—xMAP technology uses colour coded microspheres and allows cost effective multiplex detection of up to 100 targets simultaneously

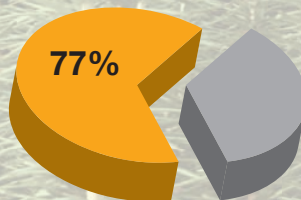


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NEW EQUIPMENT PROMISES EVEN MORE EFFICIENCY

The seed industry is always looking to improve its processes, and new technologies coming on market are making that possible.

EFFICIENCY. It's something the seed industry is always chasing, and thanks to emerging equipment technologies, it's something that's always within its grasp.

"As an individual company, we're looking at making improvements to our seed conditioning facility to increase capacity for sizing and grading and so on," says John Hennenfent, president of the Illinois-based Munson Hybrids and past president of the Independent Professional Seed Association.

Munson Hybrids offers a variety of seed products to its clients including corn hybrids, soybeans and small seeds. The company began in the 1930s and Hennenfent took over in 1999. Technology has changed tremendously, and Hennenfent is always looking to improve the company's operation processes and is constantly keeping his eye on new technological developments that can help do that.

"One of the things we probably want to include in our new system is equipment that weighs seed as it's moving across the belt or conveyer. To be able to weigh seed on the fly and not have to weigh whole batches in a bin, to be able to see what your volumes are on the fly," would be ideal, he says.

FloMetrix

One new technology that does exactly that is the FloMetrix, a flow meter that, according to the manufacturer's website, "allows flexible placement to capture data not previously available to the processing plant operator. The real-time data output allows for quick response and more precise control, which takes much of the guesswork out of the conditioning process."

Essentially, the FloMetrix does the work of a scale but does it inside of a pipe, weighing materials in real-time without interrupting the flow of seed. "Our dynamic scales provide a simultaneous reading of weight currently passing the scale, as well as the total accumulated weight that has passed the scale. This obviously allows our instruments to control processes such as shutting a control gate after a certain amount of material has passed, or closing or opening a control gate to achieve a desired flow rate," says Mike Upham of Business Development



The FloMetrix, seen here in its 2,000 bu version, allows flexible placement to capture data not previously available to the processing plant operator.

Services at Iowa State University, which helped develop the technology.

"Customers have stated a desire to monitor the flow coming from shellers and dryers, monitoring the fractions that are coming off the different partitions of density (gravity) tables and also at seed coaters, which allows the flow of seed coatings to be adjusted to match the flow of seed. Our instrument's small size allows installation at many locations such as sizers and even load-out stations."

The FloMetrix, manufactured by the Iowa-based FloMetrix Company, does this by accurately measuring total accumulated weight and current flow rates up to 36,000 pounds per hour. FloMetrix Company was founded by Manjit Misra and Yuh-Yuan Shyy, both employees of Iowa State University, in 2011 as a private company using technology licensed exclusively from ISU. "The leaders in the North American seed market have

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purchased our instruments, and our discussions with them indicate numerous applications within the seed plant. We have also built relationships outside the seed market, including retail seed coating and bulk grain handling,” adds Upah.

To be able to weigh seeds in real-time is something that appeals to those directly involved in the seed industry like Hennenfent. “It would be nice to have ideas of volume as we’re going,” he adds.

Efficiency in Seed Treatment

For Terry Schultz, president of the South Dakota-based Mustang Seeds and second vice president of IPSA, increasing efficiency is very relevant to his company’s seed treatment methods. Mustang Seeds provides small grain seed to area farmers, and Schultz says the On Demand seed treatment system from Bayer SeedGrowth has helped Mustang not only to become more efficient when applying seed treatments, but also enhance its customer service.

“The benefits it has brought are complete accuracy of seed treatment [application] to our customer. It guarantees them the highest accuracy of treatment on their soybean and corn seed that we treat, down to 1/100th of an ounce on a full truckload of seed,” he says. “It’s very clean, environmentally friendly. The seed treatments are all sealed in a keg system so there’s no mixing, no spillage, we know exactly what we’re putting on and the right amounts, and then putting polymers on for safety reasons to keep the treatment on the seed so it doesn’t get into the environment.”

Mustang uses the technology at all three of its locations, which range in size from 10,000 to 40,000 square feet. According to Bayer’s literature, a basic On Demand unit consists of six

“It guarantees them the highest accuracy of treatment on their soybean and corn seed that we treat, down to 1/100th of an ounce on a full truckload of seed.”

– Terry Schultz

15-gallon containers of product metered directly into the treater. “However, the system is flexible and can be expanded to include up to 12 containers. An available flex tank can be used for water rinsing, to adjust conditions of application, and/or to hold inoculants. The inherent flexibility of the On Demand process means seed retailers can formulate custom applications without developing multiple in-can formulations.”

A farmers’ cooperative, AG View FS in Illinois, employs an On Demand system from Bayer SeedGrowth to treat soybean seed. Mark Orr, general manager of AG View FS, says the system allows much faster processing of seed. He tells Bayer: “Quality control is just excellent—the seeds are treated in a



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very uniform manner with the On Demand system and that has greatly improved the quality of the product we're providing to our farmers. Then there's the environmental side—our employees don't have to handle the chemicals anymore. ... So it's a very seamless process today, whereas before it was much more hands-on. And, it flows so much better."

Schultz agrees. "It saves on over-treating and ensures the customer is getting exactly what they are ordering and paying for," he tells *Seed World*. "It does save on labor because there's no mixing—the product comes premixed for you, so it's a good safe system for the employee to the customer to the company that owns it."

As 2014 begins, Bayer is focusing on the promotion of the On Demand system to retail operations, Kerry Grossweiler, Bayer SeedGrowth equipment and coatings manager, recently told industry media. Some improvements are being made to the technology in 2014, according to Grossweiler, including the new ability to print barcodes.

Remote Sensing

The ability to watch how equipment is working from remote locations is also an emerging desire among seed producers. "That's something we would consider incorporating as well," says Hennenfent.

It's an ability offered by precision farming. A leader in the field is AGCO, a farming equipment company based in Georgia that offers telemetry-based tracking. AGCO is behind the AgCommand telemetry app that provides farmers, contractors and managers with instant access to a wide range of information

about equipment working in the fields while users are travelling or on the road. The app allows on-the-go system access so you can monitor machinery wherever you are and whenever you want, as well as use the history and report function to run analysis on a specific field, according to AGCO.

"We are seeing an increasing demand for AgCommand telemetry systems, especially by professional growers," Bernhard Schmitz, commercial manager of AGCO ATS Products, tells *Seed World*. "By adding additional functionalities and interfaces to telemetric applications, the adoption rate will increase not only for producers, but also business partners in agricultural enterprises."

AgCommand is part of AGCO's recently launched precision farming strategy Fuse Technologies, where AGCO aims for a "seamless connection of a farmer's crop cycle," says Schmitz. "As the strategy pursues an open approach, the data that is generated can be shared between the different entities that a farmer is dealing with. That means seed recommendations can be applied by the machine. With the AgCommand app, the farmer can track his fleet and the progress of the work in the field."

As farmers have online access to machine data, they can gather a quick overview of where the machines are and what the progress of the field work is, Schmitz adds, "so they pre-plan the next tasks quicker and manage the uptime more efficiently. If dealers track the service intervals for the machines of their customers, they can guarantee that service is always done in due time. The fuel truck can be directed to vehicles in the field in due time when an alert is sent to the fleet manager or fuel truck driver when a specific fuel level is reached." **Marc Zienkiewicz**

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A SYSTEMS APPROACH TO CORN AND SOYBEANS

Seed companies are changing the way they sell seed—because there's more to farmers' success than great genetics.

LARGE SEED COMPANIES are taking a page out of the smaller guys' book as they become much more invested in their customers' operations, developing programs and initiatives designed to provide agronomy and stewardship advice as an added benefit to their products.

"One of the biggest trends is focusing more on a systems approach," says John Chambers, corn technology lead at Monsanto Company. "The biotech traits are certainly important as a foundation, but it's also having excellent genetics, breeding traits, chemistry solutions, seed treatments as well as the agronomic practices that go together to form a system to help farmers be successful."

Monsanto's Integrated Farming Systems (IFS) platform is designed to help farmers get more from every acre by integrating the company's expertise in seed and field science with data analysis and precision equipment. "The IFS is where we're taking a look at a specific farmer's field and the characteristics of that field," says Chambers. "We take that information and match it up with data we have on our individual hybrids about how they perform in different environments, so we can provide the farmer with better recommendations for hybrid selection, as well as management."

The first product from the IFS platform is FieldScripts for corn, which was part of the company's 2013 Ground Breakers, a program that involves farmers in on-farm testing of new technologies prior to their commercialization.

FieldScripts was tested by 150 farmers across Illinois, Indiana, Iowa and Minnesota in 2013. They provided two to three years of historical yield and soil test data that was combined with many layers of information from Monsanto about its corn hybrid performance. The combined



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data was used to develop individualized hybrid corn recommendations and variable rate seeding prescriptions for each field. The process was offered through DEKALB dealers and delivered via an app on the farmer's iPad. Farmers will be able to purchase the FieldScripts system in 2014. An IFS program is being developed for soybeans as well.

Other large seed companies have similar programs. Bayer CropScience pioneered a program called Respect the Rotation, an initiative to promote herbicide diversity, as well as reinforce the principles of integrated weed management through rotation of crops, herbicide-tolerant traits, and using multiple modes of action.

DuPont Pioneer's IMPACT program focuses on providing localized solutions to growers. With so many products and options available in today's marketplace thanks to improved breeding and technology innovations, growers are much more likely to demand data about how those products will perform under local conditions on their farm. Local testing to help growers match the right product to the right acre is the rationale behind IMPACT (Intensively Managed Product Advancement, Characterization and Training). Participating farm customers allow pre-commercial trials of new DuPont Pioneer hybrids in their fields before they are commercially launched.

"We're testing and developing those products locally and when we do that we understand the best management practices for those in our customers' specific environments," says Reed Mayberry, DuPont Pioneer's senior corn marketing manager. "Through IMPACT testing and using DuPont's agronomy sciences, we can say to our customers that we've been literally right down the road testing these products. We know the right population, the timing, the row spacing, and we can put all those pieces together and increase profitability on the farm with Pioneer products. That's a pretty powerful tool."

A whole system's approach has been Syngenta's strategy for several years, says Ross Weikel, Syngenta's head of soybeans in North America. "A few years ago we integrated our crop protection and seed businesses because we saw this was the way of the future for agriculture, and that the agronomy and the interfaces between different technologies was going to be

critical. It was important for us to look at third-party technologies and integrate those into what we were doing and not take a product-focused view of the world. To help growers get to the next level of productivity, we are going to have to look at how our products work as part of the whole system."

An example is a program Syngenta initiated in the western U.S. Corn Belt three years ago which has drastically helped farmers reduce irrigation water use. "It's a holistic approach and involves Syngenta, irrigation manufacturers and

"A few years ago we integrated our crop protection and seed businesses because we saw this was the way of the future for agriculture, and that the agronomy and the interfaces between different technologies was going to be critical."

– Ross Weikel

agricultural retailers, and together we have created a system that has a meaningful impact on growers' ability to produce the same amount of corn with 25 percent less water," says Pat Steiner, Syngenta's corn portfolio head.

The company has also developed corn rootworm management recommendations to help growers take a broader approach to managing rootworm in their fields. "Corn rootworm is a situation to be managed, it's not a problem to be solved, and it requires a whole-farm look," says Jill Wheeler, Syngenta product lead, commercial traits. "Growers have to look at everything they are growing and how they are rotating their fields and what they are using on those fields each year. We have been promoting a broad-based management approach."

Collaboration Required

Taking a whole systems approach to address the complex needs of corn and soybean growers has necessitated more collaboration and cross-licensing between various companies of traits and technologies. That's providing more flexibility and options than ever before and is, in the end, better serving growers' needs, says Tony White, product development manager, soybean systems

for Monsanto. "It comes down to what the growers are looking for, and if there's value in other companies carrying a trait, then that's probably something we should continue to strive for, and that's the direction we're taking at this point in time," he says.

The multiple traits, genetics, chemistries and technologies available in corn and soybeans today have also meant that smaller, independent seed companies have more of an edge than they used to have, says Tim Welbanks, lead agronomist at Maizex Seeds. "Having access

to all the preferred traits and technologies has put us in an attractive position because we've got a broader offering with really good genetics," says Welbanks. "We're able to sub-license and have that access versus when you're in a brand, you are stuck with what you've got access to. A small company that's nimble, like we are, can roll that out and provide more options to our customers to improve their profitability."

With such a wide array of available products comes a certain amount of confusion, so growers are increasingly turning to seed companies for the information they need to make informed decisions about which products best fit their needs. "We sort through some of the confusion for our customers," says Randy Wilken, president of ProHarvest Seeds in Ashkum, Ill., an independent seed company that's been in business for over 50 years. A big part of the company's role these days is advising customers not just about specific products, but also about proper stewardship of them.

"These products have provided a huge value in terms of weed control and insect control since their introduction, and now we're starting to learn how to be vigilant in using all those technologies so we don't lose them," he says. **Angela Lovell**

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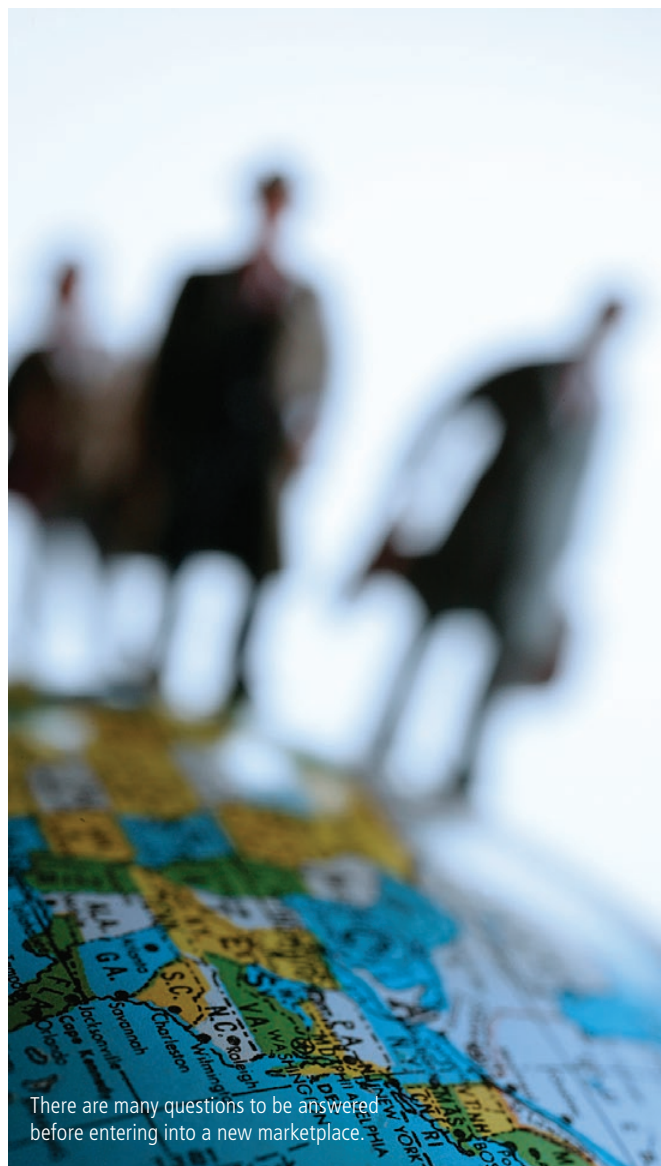
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REGIONAL COMPANIES find it necessary to not only compete with peer regional companies, but also well-established multinationals. Yet opportunities present themselves, not without challenges, to be explored and cultivated to expand beyond existing hard-earned markets. Simply expanding the business to sell into additional U.S. geographies or international markets might sound like an easy “fix”, but rest assured it is not likely to be that easy. Nor will success be assured!

Jumping into the international business arena is not for the faint of heart. However, to do so certainly would not suggest foolhardiness. Either the sour risk of failure or the sweet reward of success could prevail. Does your current business model have provisions to accommodate an international component? How hardy is your appetite for risk of failure? Consider the possibilities carefully and realistically.

Years of successful U.S. business experience partnered with a product line containing superior genetics and technology packages alone is likely to fall short as preparation for a sustained entry into the international arena. Boring into the inner core of one’s self and company perhaps would be a good first order of business. Next might be to consider the known external hurdles to be encountered. Then shift to a discovery mode to identify additional internal and external barriers. Ultimately, prepare to deal realistically with the economic feasibility aspects of potential business models that surface.

How might one identify and select a fitting global region or candidate country? Will it be a good fit with the current enterprise and worthy of in-depth investigation? What might draw you to a certain area? Could it be that a keen business sense, based on experience along with solid knowledge and sound information, suggests your product will fulfill unmet demand of an increasing middle class? Does the lure of a given people or



There are many questions to be answered before entering into a new marketplace.

region simply speak to you on a compassionate or romantic level? Maybe you’ve developed local contacts that appear to be “in the know” and whose assistance may provide some perceived advantage in the market? Issues such as these merit soul-searching at the very deepest personal level.

How will one go about collecting and interpreting needed in-country information about applicable governmental rules, laws, regulations, agencies and programs? Information transparency may be at a level lower than one has been accustomed to. Difference in language, social custom, cultural practice, business practice and the legal system may have to be overcome. Can an appropriate level of intellectual property rights protection

be attained? Long distances and differing time zones may create challenges.

Who will conduct the due diligence investigation? It's unlikely many could accomplish the myriad necessary tasks alone or even as a member of a U.S. experienced team. To expect the good fortune of identifying an individual having the knowledge, expertise and experience necessary to provide an accurate in-country picture set in a meaningful context for your company might be presumptuous. How many others, and in what disciplines, might be needed to help collect and interpret critical information about the country of interest? How much trust and faith need be placed in relatively new or casual acquaintances? At your inner core level, how much faith are you willing to place in others and what criteria would be used to select them? How prudent might this action be?

An often-cited hurdle, encountered when introducing new varieties or brands in non-U.S. countries, is not having a full grasp and solid understanding of applicable official variety acceptance or approval programs. Some programs may not be well coordinated with crop production or commerce cycles. Missing a simple deadline or failing to meet a vague eligibility requirement may delay the approval process. Delays could cascade over multiple sales cycles. Companies might be subject to multiple official programs as they may exist at a national, regional or local level. It is important to quickly learn which program(s) apply to given seed stock in order adjust plans accordingly. Rule waivers and exemptions to be granted simply to accommodate your business needs may be hard to come by.

Research will be required—much research! Don't focus solely on agronomic or market development issues within the geography being studied. Study the attitudes and aptitudes present within the company today and assess whether they will be an asset or liability in the future. New questions will surface and beg answers. Prepare to receive surprises.

If the goal might be to create retail awareness and farmer demand for named



Take your time and consider the risks and benefits.

varieties or branded seed products, would it be permitted in the country and would farmers be likely to accept the business model? Would a network of farmer dealers, retail outlets or lending institutions be accepted, practical and effective? What if the business plan is to simply focus on exporting seed to an in-country distributor, retailer or farmer? Might this be a better option than establishing an entirely new organization in a foreign country? What legal form of business can or should be established?

What makes a given potential market attractive? Is it presently underserved? Is it particularly lucrative? Is it growing? How large might it become over time? Might there be other new players contemplating entry into this market at this time, as are you? Will the market support you and other potential new entrants side by side with those companies already well established?

Gradually, the broad scope of the research phase will begin to narrow, thus allowing for a more refined and deep-probing final research effort. New ideas will surface. Dedicated business-planning activities can commence. Various business models will evolve and can be evaluated. Financial projections can be assembled. Economic feasibility studies can be performed.

Before launching an implementation plan, take one long final, look across the full range of reasons that seem to support a decision to delve into international business. Maintain a proper context while assessing the motivation to move forward. Fully consider the associated risks and rewards not only for the international venture but also the possible impact on the core domestic business enterprise. Consider the risks and rewards one by one. Consider them in the whole. The underlying core domestic business could become imperiled in the event the international enterprise places an overly burdensome claim on the total available human or financial capital. This could happen during a critical time in either the international or domestic business cycle.

Other things considered, how well might the key leadership team cope with the additional emotional stresses associated with a foray into the international arena? Economics and opportunity aside, is expanding business internationally really something you want to do and are capable of dealing with? It is neither for every company nor everyone.

Agriculture, particularly the seed industry segment, remains a dynamic and developing industry, ever-changing and constantly evolving. You play a vital role. Do it well!

protecting pollinators

SCIENCE AND STEWARDSHIP

Over the course of *Seed World's* Protecting Pollinators series, we have discussed the current state of honey bee health, the many stressors impacting honey bees, as well the different initiatives, both from the seed industry and non-industry, that are being undertaken to improve the health of honey bee colonies across the country. In the final installment of the Protecting Pollinators series we will examine the current initiatives aimed towards improving the relationship of honey bees and crop protection products.

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The relationship between the honey bee and commercial agriculture's chemical tools is an area where many stakeholders are collaborating in an attempt to investigate ways that will better allow these industry tools to be utilized concurrently without causing harm to beneficial insects or impacting production.

Apis mellifera, the honey bee, is inherently linked to agriculture through the dependence of many crops on the honey bee's pollination services. At the same time, commercial agriculture is very much dependent on crop protection products in order to achieve the quality and yields needed to feed an ever-growing world population.

In the public arena, commercial agriculture's chemicals tools have taken much of the blame for the decline in honey bee health. However, many scientist and regulatory authorizes throughout the country agree that bee health is impacted by a number of different factors that are culminating to cause a decline in health.

Furthermore, it has been stated by many researchers that the current state of knowledge on honey bee health is truly in its infancy and many of the world's leading research communities

QUICK FACT

The benefit of all other pollinators to U.S. agriculture is estimated between \$4.1 and \$6.7 billion annually.

are in the beginning stages of coming together to develop solutions to better the landscape for both these irreplaceable pollinators as well as the country's agricultural producers and beekeepers.

CURRENT RESEARCH INITIATIVES

Crop protectant products undergo extensive testing before being regulated for commercial use. However, Vicki Wojcik, research director with the Pollinator Partnership, the world's largest organization devoted exclusively to pollinator conservation, says that a major factor in this research area is that most of these products are not required to be tested in conjunction with each other, which is an enormous factor in understanding how they impact non-target organisms.

"In terms of the synergistic effect of crop protectants, there is definitely a deficit in our understanding and we as an industry are definitely at a starting point," says Wojcik. "These research avenues also intersect with regulation, which is sometimes difficult because much of the science in this area is inconclusive right now. It is a very difficult landscape, which makes finding these complex answers even more challenging."

QUICK FACT

Crop protectant products undergo extensive testing before being regulated for commercial use.

As challenging as the research may be, stakeholders continue to press forward, determined to find the answers and real-life solutions. “We need to know what the realistic conditions of these very low-level, chronic pesticide exposures are. How is that affecting [the bees’] pollination, their ability to find flowers and to reproduce,” adds Wojcik. “This research is certainly being done but it is a very slow and difficult process.”

ADVANCING TECHNOLOGIES

“Pollinators face the greatest threats from pesticides when they come in direct contact with the product or its residues, and the most common place that this interaction occurs is at a flower. Pesticides are never to be applied during bloom, but drift from an application site that is not in bloom onto adjacent areas that do have bloom can occur; this is the dominant cause of bee poisonings and kills. Having a seed that is treated as opposed to more traditional aerial modes of crop protectants should create a safer environment for pollinators because there is no spraying involved and exposure to drift and non-target effects should be reduced,” explains Wojcik.

Although neonicotinoid insecticides may get a bad rap,



Above: Blooming strips in front of the Bayer Bee Care Center in Monheim, Germany. Right: Bayer CropScience U.S. CEO Jim Blome cuts the ribbon at the opening of the bee health research facility in Clayton, NC.

many industry professionals see their use as having revolutionized the ability to control damaging pests in a more environmentally-friendly way compared to the alternatives.

Agriculture chemical companies are always searching for routes to improve and do away with any residual effects and neonicotinoids are no exception.

“There was an issue with the lubricant powder that helps the treated seed come out of the hopper. It was absorbing most of the crop protectant content and then causing it to become airborne,” says Wojcik. “Remedying this unintended circumstance is an urgent need as presently treated seeds are behaving much in the same way that aerial applications—and the



drift issues they were intended to remove—do.”

“Pollinators face the greatest threats from pesticides when they come in direct contact with the product or its residues, and the most common place that this interaction occurs is at a flower.”

— Vicki Wojcik

Seed lubricant powders such as talc and graphite are commonly added to facilitate an even flow of seeds through the planter, and this can increase the total amount of dust inside the planter. Honey bees may potentially contact seed dust particles when the planter-emitted dust is airborne or after deposition on vegetation or other surfaces.

The Pollinator Partnership recently awarded a grant to the Corn Dust Research Consortium to enlist its expertise in researching this issue. “Beekeepers in Ohio and across the country have been hit by colony losses. Many factors have contributed to those losses—diseases, mites, and nutrition—

but insecticidal seed treatment dust emanating from planters has the potential to increase colony loss,” explains Reed Johnson, assistant professor from Ohio State University. “The research by the CDRC will help us understand how bees in Ohio come into contact with this potentially deadly dust and allow us to identify management practices that could reduce bees’ exposure.”

The initial goal of this study is to develop a greater understanding of the use by bees of flowering cover crops and weeds in and around cornfields during spring planting season, and how this is influenced by vegetation management practices. Through this study, participants are also working to develop recommendations for best management practices that growers can follow in order to minimize exposure for foraging honey bees to seed dust while maintaining as much forage for honey bees as possible.

Researchers will also be evaluating the effectiveness of a new seed lubricant product from Bayer CropScience, by measuring deposition levels for pesticide dust in and around fields when commercially available neonicotinoid-treated corn seed products are planted using this new product in comparison to the industry’s standard lubricants.

“We are working to develop a replacement for the talc and



Several research projects are underway to better understand the habits of pollinators and how they might come in contact with crop protection products.

graphite used by growers in pneumatic planters,” says Bill Hairston, director of product development with Bayer CropScience. “These current lubricants help reduce friction and improve uniformity of planting, but they can increase the amount of dust released from planter exhaust and raise the potential for unwanted exposure of seed treatment product to honey bees.”

The new Bayer fluency agent, which is made of a polyethylene wax substrate, was shown in lab testing to significantly decrease dust emissions from planters

during planting. Throughout the creation process, Bayer conducted large-scale field studies, covering more than 40,000 acres throughout North America with growers and in collaboration with major planter manufacturers in the United States and Canada. Through this study, it was noted that there was a 90 percent reduction in total dust emissions versus the currently used talc agent. In comparison to the graphite agent, there was a 60 percent dust emission reduction.

Bayer CropScience, like many ag companies, has been working

QUICK FACT

it was noted that there was a 90 percent reduction in total dust emissions versus the currently used talc agent

to improve dust control for a number of years through product formulations, modification of seed drillers, and continuous testing of various application techniques in order to find the best practices for limiting dust-off. "We have been working with planter manufacturers and hope to introduce this product for the 2014 planting season," says Hairston.

PRODUCT STEWARDSHIP

Along with product development and searching for improved science, a number of initiatives are underway in the areas of best management practices and product stewardship.

"We are seeing a number of initiatives coming forward from all different stakeholders addressing stewardship and best management," continues Wojcik. "We always stress critically assessing the need to apply the product first, but we also understand the complex interplay between protecting and promoting beneficial insects and preventing crop damage from pests. Although answers may not be coming to light as quickly as some would like, there is certainly no doubt that the industry is advancing on a number of fronts towards solutions that will better honey bee health and at the same time allow farmers the ability to produce yields that are demanded by our world's growing population.

TACKLING HONEY BEE HEALTH

Bayer CropScience has an inherent interest in promoting and preserving bee health and they truly understand the important role honey bee pollination plays in sustainable agriculture.

To further its commitment to assisting the industry in improving honey bee health, Bayer will open a North American Bee Care Center in 2014 in Research Triangle Park, N.C. The 6,000 square-foot facility will bring together significant technological, scientific and academic resources to promote honey bee health through research and collaboration.

"The Bayer Bee Care Center is just the latest example of Bayer's 25-year commitment to bee health," says Robyn Kneen, who leads Bayer CropScience's North American Bee Care program. "As pollinators, honey bees play a critical role in sustainable agriculture and the new center will be used to conduct research into the multiple causes affecting bee health including parasites like the Varroa mite, as well other predators, diseases and environmental stressors."

Bayer's new North American Bee Care Center is the second established by the company to promote bee health. In 2012, Bayer CropScience established its global Bee Care Center at the company's headquarters campus in Monheim, Germany.

Under the Bayer Bee Care program, the company has established partnerships and collaborations with key scientific institutes and research centers in many countries around the globe. Bayer believes that an ongoing dialogue with industry partners is essential to establish sustainable solutions to enhance bee health.

The new Bee Care Center will serve as a scientific and communication platform to consolidate existing and future bee health projects and will also foster information sharing and provide a setting for discussion and new ideas.

"We are proud to open our Bee Care Center, which will help ensure that the hard-working, beneficial honey bee can continue to thrive and provide pollination for foods that we enjoy each day," says Dick Rogers, apiarist and manager of Bayer's North American Bee Care Center.

"Through this facility and Bayer's Bee Care Program, we are committed to educating the public on the vital role bees play in our backyards, our communities, our crop fields and in our world. Healthy pollinators are incredibly important in creating and maintaining a nutritious and sustainable food supply, and we are excited about the stride that Bayer will and is already making in protecting global bee health."

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Seed Testing: Ensuring It is What You Say It Is

SEED TESTING IS A VALUABLE TOOL FOR PROTECTING FARMERS' SEED INVESTMENTS AND IS RAPIDLY BECOMING ONE OF THE MOST IMPORTANT RESOURCES AVAILABLE TO GROWERS. SEED RETAILERS NEED TO ENSURE THEY'RE SPREADING THIS MESSAGE TO THEIR CUSTOMERS.

JUST ASK ANY seed technologist or seed lab worker and they will tell you why seed testing is one of the most important tools in a seed retailer's toolbox today.

WHY IS SEED TESTING IMPORTANT

"Seed testing is more important than ever before because the price of seed corn, as an example, is so high. Seed companies want accurate information on that seed bag so they can make sure the farmer they sell the seed to is getting what they paid for," says Neal Foster, president of the Society of Commercial Seed Technologists.

"For many years seed testing has been critical to customers—farmers, seed companies, greenhouses, etc.—to know what they are purchasing. It is important to seed companies to identify which seed lots are of high quality and hopefully of high vigor. I think seed testing is more important than ever before because even more is riding on the seed being high quality and being of the proper genetics," says Michael Stahr, manager of the Iowa State University Seed Laboratory. "In the case of corn, for instance, farmers pay a lot of money for the protection given by the several biotech traits of



An analyst evaluates a small seeded species on rolled paper towels.

SmartStax and also for the superior genetics that improves yield, protects against drought, prevents lodging and helps in a number of other ways. It is not just justifying the cost of these superior seed products, but also making best uses of other inputs such as fertilizer, fuel, seed treatments and herbicides."

"There is no question that seed testing is becoming more important," says Beni Kaufman, secretary general of the International Seed Testing Association. "We need to ensure the quality of the seeds farmers are putting in to the ground. Therefore seed testing is a critical part of the seed industry's challenge of feeding the world."



KNOW YOUR TESTS

Seed testing can answer a variety of questions and retailers need to know which tests are available depending on the growers' needs.

“SEED TESTING IS A CRITICAL PART OF THE SEED INDUSTRY’S CHALLENGE OF FEEDING THE WORLD.”

—BEN KAUFMAN

BACK TO THE BASICS

With the increased incidence of drought and flooding in recent years—environmental factors farmers can't control—seed testing gives farmers one aspect they can control. Although the seed testing methods used are continuously evolving, industry professionals agree the vigor test is still one of the most important tests farmers should consider.

According to a technical bulletin from the Oregon State University Seed Laboratory, vigor testing does not only measure the percentage of viable seed in a sample, it also reflects the ability of those seeds to produce normal seedlings under less than optimum or

QUESTION	RECOMMENDED TEST
Is the seed of the right variety?	Varietal ID tests
Is it genetically pure?	Genetic purity tests
Does it contain the right traits?	Trait purity tests
Is there adventitious presence of unintended GM seed?	AP/GMO tests
Is it physically pure (free from debris or inert matter)?	Purity tests
Is the seed free from disease and pathogens?	Seed health tests
Is the seed vigorous?	Cold test, accelerated aging test
How well will it germinate?	Warm test, tetrazolium test



Two vigor levels of corn in a tray cold test.

adverse growing conditions similar to those which may occur in the field.

“Seeds may be classified as viable in a germination test which provides optimum temperature, moisture and light conditions to the growing seedlings; however, they may not

be capable of continuing growth and completing their life cycle under a wide range of field conditions. Generally, seeds start to lose vigor before they lose their ability to germinate; therefore vigor testing is an important practice in seed production programs,” states the bulletin. “Testing for vigor





A seed technologist plants corn on a tray for herbicide bioassay testing of corn that is supposed to be LibertyLink.

becomes more important for carryover seeds, especially if seeds were stored under unknown conditions or under unfavorable storage conditions. Seed vigor testing is also used as [an] indicator of the storage potential of a seed lot and in ranking various seed lots with different qualities.”

IMPACT ON FARMERS

The biggest beneficiary of seed testing is the farmer-customer. One of the best-selling features a seed retailer has is being able to say that the product they are selling is what they say it is, and that it’s going to perform the way they say it is.

“SEED TESTING VERIFIES THAT SEEDS ARE WHAT IS LISTED ON THE BAG, WHETHER A 50-POUND BAG OF SOYBEANS OR A SMALL PACKET OF VEGETABLE SEEDS.”

—MICHEAL STAHR

The recent development of high-speed seed counters, some of which also have imaging capabilities, is having a huge impact on growers today. The imaging capabilities have the potential for determining the breakdown of sizes of seeds electronically in addition to traditional methods and refuge-in-a-bag (RIB) products that may be used to determine the percentage of refuge product in a sample.

“For corn farmers, RIB corn has already impacted farmers. Seed companies have done a good job ensuring that the proper amount of refuge corn is present in each bag or bulk bin of RIB corn, but since this there is now RIB corn that is farmer-



returned or otherwise carried over, seed testing allows seed companies to ensure that both portions of RIB corn maintains high quality and vigor," says Stahr.

With the rapid release of new traits in the marketplace, seed testing is keeping up with the technology and adopting new methods that allow for more efficient and accurate testing. "The use of single nucleotide polymorphism, or SNP testing, and even newer high-tech methods, allows seed companies to detect even more aspects of seeds and in a more efficient manner which allows seed companies to provide farmers with even more traits, biotech and otherwise," says Stahr.

Another payoff for the farmer is that by knowing the quality of the seed they intend to put in the ground, they can determine the proper seeding rate to get the uniform plant stand that they desire. Uniform plant stand is beneficial for a number of reasons:

- It will result in an even, thick canopy which will compete with weeds, thereby helping with weed control.
- A heavier stand means decreased tillering which means crop flowers and heads out uniformly allowing for better management of herbicide and fungicide applications.
- Proper timing of these applications is critical to their success, most particularly with fungicides.

By encouraging farmers to spend a few dollars now, retailers can potentially help them save or gain thousands of

dollars in crop by reducing crop inputs or at least ensuring the best chance of success by applying at proper and even staging, and gain yield from a thick, even, healthy crop stand.

SHARING THE MESSAGE

What should seed retailers be telling their farmer customers about seed testing today? Stahr says it's a pretty simple message.

"Seed testing verifies that seeds are what is listed on the bag, whether a 50-pound bag of soybeans or a small packet of vegetable seeds," he says. "Before soybeans with biotech traits came along, my father-in-law used to test soybean seeds harvested the previous fall into a wet dish towel for a few days to see how well they sprouted. This met his needs back when seed beans were pretty inexpensive, but nowadays soybeans with tolerance to herbicides and with improvements such as higher linolenic acid are much more expensive. Therefore, the farmer and the seed company want more accurate information about the seed lot."

Stahr says testing has become extremely specialized and farmers need to know what their options are. "In the case of native species it takes a highly skilled purity analyst to know the difference between 400 or more species of seeds that might be in a seed sample. In addition to seed company seed labs, which generate accurate data, there are also private labs and official labs which are not affiliated with any seed company," he says.

DID YOU KNOW?

According to Stahr, a number of things about today's seed testing techniques would likely surprise farmers and should be better communicated to them.

"In addition to planting on paper towels—not kitchen paper towels—some species can be planted on crepe cellulose paper, which is pretty much large sheets of disposable baby diapers," he says. "It may sound strange, but this product allows for higher throughput and is friendlier to some species than other substrates."

Stahr says seed companies and seed labs are very concerned with seed lots being properly sampled. "Four hundred seeds planted in a warm germination test or 200 seeds planted in a cold test has been statistically determined to well represent thousands of pounds of seeds if the sample was properly obtained," he says. "Something else that farmers might not know is that a purity analyst typically handles 2,500 seeds for a purity test and 25,000 seeds for a noxious weed exam. Although examination of some grass species can be aided by using a seed blower, it takes a highly skilled purity analyst to correctly identify the thousands of seeds in a sample."





NOW MORE THAN ever, consumers are asking questions about farming and food. What is the role of technology and innovation? How do I know the food I'm consuming is safe? Are farmers and food companies putting profits ahead of public interest?

Mistrust is the norm and global issues loom large—resource scarcity and waste, food security and global trade, among others. Consumers are particularly leery of large companies, believing that mass production creates more opportunity for error, that industrialized food production is inherently impersonal, and that big companies will put profits ahead of public interest.

Today's skeptical consumer simply wants authentic transparency—and to know that companies share their values. That's reflected in our long-term research

Breaking Through Growing Consumer Skepticism

New Research Offers Roadmap for Trust-Building Transparency



Charlie Arnot, CEO of The Center for Food Integrity

and emphasized in our early 2013 focus groups conducted in Los Angeles, Boston and Minneapolis where we asked participants specifically about biotechnology.

After learning that genetically modified foods have been on grocery store shelves for nearly two decades, a woman from Los Angeles responded, “This is beyond scary to me. I feel like I’ve been deceived. Why weren’t they providing more information all along about what I’m eating?”

Her comment is not unusual. Today’s environment is one where shoppers face more angst in the aisles—fretting over how to spend their food dollars. Which foods have been genetically modified? Is organic safer and healthier than conventionally raised food? Should I buy foods with ingredients I can’t pronounce?

We see consumer alienation from agriculture and the food system expressed through concerns about nutrition, food safety, affordability, environmental sustainability, wellbeing and other issues.

The stakes are higher than ever before, even though some argue that building and maintaining public trust is a worthy goal, but not relevant to success in business.

This outdated notion fails to recognize the financial benefit of maintaining the trust of stakeholders who can determine the level of social license or social control an organization enjoys. A social license is the privilege of operating with minimal formalized restrictions (legislation, litigation, regulation or market mandates) based on maintaining public trust by doing what’s right.

Every organization, no matter how large or small, operates with some level of social license. Organizations are granted a social license when they operate in a way that is consistent with the ethics, values and expectations of their stakeholders.

Once lost, either through a single event or a series of events that reduce or eliminate stakeholder trust, social license is replaced with social control—or regulation, legislation, litigation or market mandates designed to compel the organization to perform to the expectations of its stakeholders.

Operating with a social license means more flexibility and lower cost. Operating with a high degree of social control increases costs, reduces operational flexibility and increases bureaucratic compliance.

The survival of the agriculture and food industries boils down to building trust. In earlier research, consumers told us they trust farmers, but aren't sure they trust farming. To maintain social license, we have to transfer the trust of individuals to the systems we use in food and agriculture.

Trust-Building Transparency

CFI spent several years researching the elements of trust and how each element contributes to building trust. Our peer-reviewed and published model for building trust shows that communicating shared values is three to five times more important to consumers than demonstrating technical skills. We can't continue to rely on simply educating the public using science and economics—our longtime go-to strategy. It's about changing the dialogue and demonstrating to our stakeholders that we share their values and are doing the right things for the right reasons.

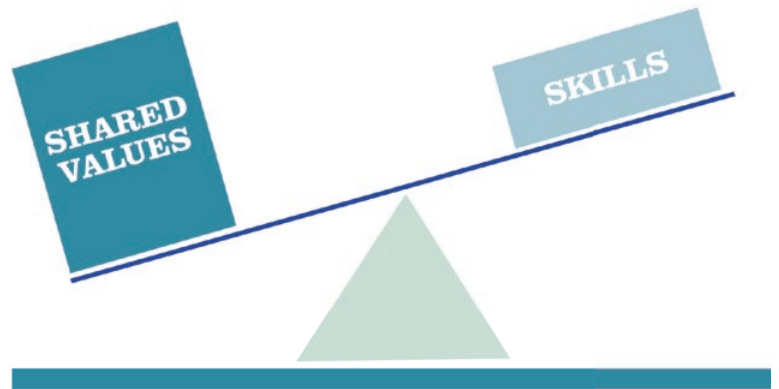
It boils down to authentic transparency—reducing the fear of the unknown and creating a platform for building trust. But what constitutes authentic transparency? CFI's 2013 research defines Trust-Building Transparency and provides a roadmap for the agriculture and food industries.

It helps to first understand when and how we lost the trust of the consuming public—how the agriculture and food industries got to a place where they're forced to defend the business of putting safe, affordable food on families' tables.

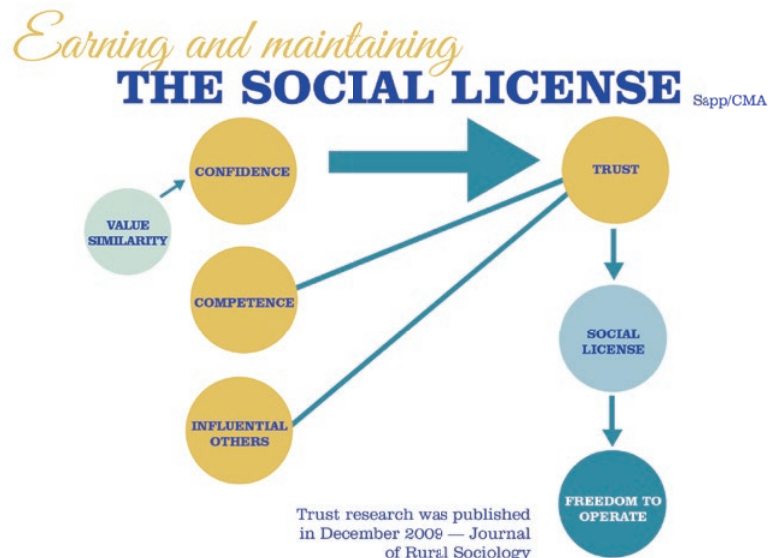
Consumer attitudes have changed dramatically over the past 45 years. Since the late 1960s, events ranging from the Vietnam War, assassinations and political scandals to oil spills and the financial industry meltdown have contributed to an American mindset of mistrust of institutions.

During that same period, consolidation, integration and technological advances have increasingly resulted in food being viewed as an institution. The change in size and scale of today's farms, the use of advanced technology and non-family labor all contribute to the perception that farms are "big business" and perhaps not worthy of the trust historically enjoyed by farmers. More of today's farms are "corporate farms"

WHAT DRIVES CONSUMER TRUST?



The change in size and scale of today's farms, the use of advanced technology and non-family labor all contribute to the perception that farms are "big business" and perhaps not worthy of the trust historically enjoyed by farmers.



Source: The Center for Food Integrity | 2013 Consumer Trust in the Food System Research



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or “factory farms,” according to public surveys, and the public doesn’t like it. Ask them to define those phrases and the answers are all over the map, but perception is reality.

While the application of science and innovation have made food safer, more affordable, and more available than ever before, these same advancements now fuel the cultural tide of mistrusting “big food” and the science that comes with it.



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Consumers have been asking for more transparency as an important step to overcoming the “big is bad” bias, but up until now transparency hasn’t been well defined.

Defining Transparency

In our 2013 research, opinion-leading consumers and those most concerned about food issues have provided clear direction on exactly what we can do to overcome their bias and skepticism. Effectively implementing this new model will help companies and organizations build trust with their stakeholders and consumers.

CFI identified seven elements of its Trust-Building Transparency model and tested 33 attributes of the seven elements in the 2013 survey.

The results show that CFI’s definition of Trust-Building Transparency rings true with the public. More than half the respondents gave ratings of eight to 10 on a 10-point scale on all 33 attributes. More importantly, women and early-adopting opinion leaders, who drive public discussion of food and farming issues, rated the elements of Trust-Building Transparency higher than others.

The seven elements of trust-building transparency are:

1. Motivation—Act in a manner that is ethical and consistent with stakeholder interests.
2. Disclosure—Share all information publicly, both positive and negative.
3. Stakeholder Participation—Engage those interested in your activities or impact.
4. Relevance—Share information stakeholders deem relevant.
5. Clarity—Share information that is easily understood and easily obtained.
6. Credibility—Share positive and negative information that supports informed stakeholder decision-making and have a history of operating with integrity.
7. Accuracy—Share information that is truthful, objective, reliable and complete.

The steps themselves are simple. Implementing them may be more of a challenge for some companies who are not comfortable putting it all on the table. But in this day and age, with social media and cell phone videos, anyone can watch—and report—what you do any time.

And groups out to undermine the agriculture and food industries are often well-funded, well-organized and eager to fuel the fire to capture headlines. They’re pursuing litigation, pressuring branded food companies and initiating legislation to change how the system operates.

Agriculture and food should own the ethical high ground, but the only way to reclaim that in today’s society is to be more transparent. That doesn’t mean you throw open the doors to anyone whenever they want to come in. We need to manage the process to be more accessible and provide information that’s relevant if we are going to build trust in today’s environment. **Charlie Arnot**





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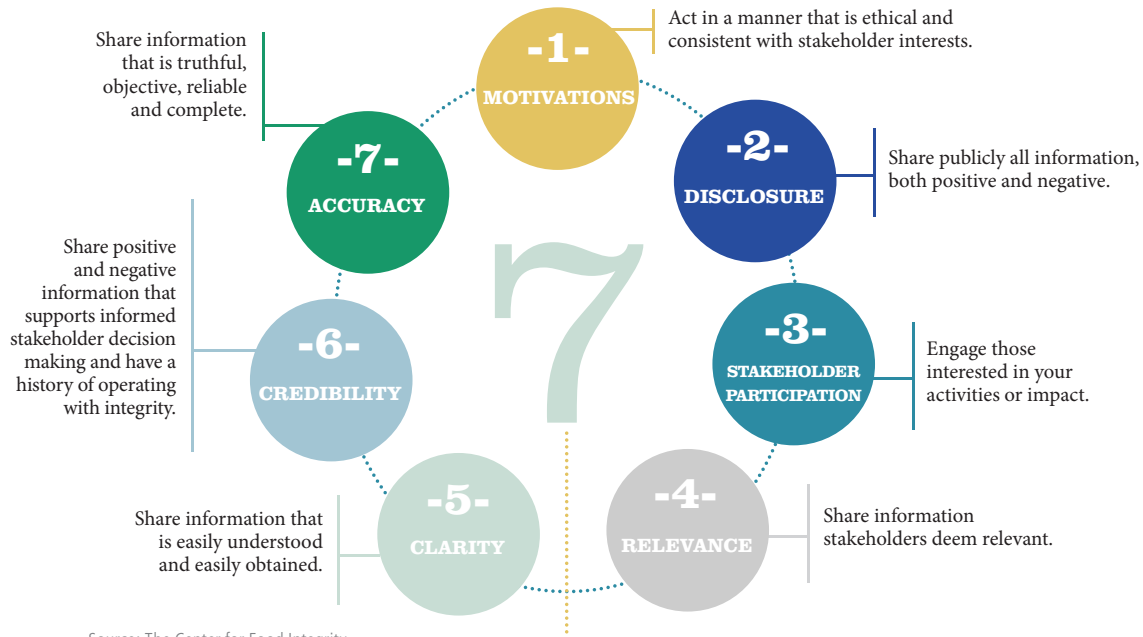


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Elements of Trust-Building Transparency



Source: The Center for Food Integrity

TOP-RATED ATTRIBUTES OF TRUST-BUILDING TRANSPARENCY

1. Motivations

- Ethical principles seem to guide the behavior of the company.
- The company is interested in the well-being of people like me, not just itself.
- The company wants to be accountable to people like me for its actions.
- The company does not intentionally mislead people like me.
- When making decisions, the company takes public interest into consideration rather than only considering profit.

2. Disclosure

- The company is forthcoming with information that might be damaging to the company but important to me.
- The company makes it easy to find the information people like me need.
- The company provides information that is useful to people like me for making informed decisions.
- The company provides information that is written in a way to make it easy to understand.
- The company provides information in a timely fashion to people like me.

3. Stakeholder Participation

- The company takes the opinions of people like me into account when making decisions.
- The company acknowledges input from people like me.
- The company explains why it makes decisions that affect people like me.
- The company explains how it makes decisions that affect people like me.
- The company asks the opinions of people like me before making decisions.
- The company offers an easy way for me to provide input on decisions that affect people like me.

4. Relevance

- The company provides information that is relevant to people like me.
- The company provides information that is meaningful to people like me.
- The company demonstrates it understands what information is relevant to people like me.
- The company involves people like me to help identify the information I need.

5. Clarity

- The company provides information that is easy for people like me to understand.

6. Credibility

- The company is willing to take responsibility when it makes mistakes.
- The company freely admits when it makes mistakes.
- The company is willing to share plans for corrective action.
- The company is willing to apologize when it makes mistakes.
- The company demonstrates it genuinely cares about issues important to people like me.
- The company is willing to engage critics in developing corrective action plans.
- The company presents more than one side of controversial issues.

7. Accuracy

- The company provides accurate information.
- The company provides information that is reliable.
- The company provides information that is complete and does not leave out important information.



The CFI Consumer Trust in the Food System Research report is available at www.foodintegrity.org/research.

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CEREAL STOCKS RECOVER

Food commodity markets are becoming more balanced and less price-volatile than in recent years thanks to improved supplies and a recovery in global inventories of cereals, according to the United Nations' Food and Agriculture Organization's *Food Outlook* report published in November.

"THE PRICES FOR MOST BASIC FOOD COMMODITIES HAVE DECLINED OVER THE PAST FEW MONTHS. This relates to production increases and the expectation that in the current season we will have more abundant supplies, more export availabilities and higher stocks," said David Hallam, director of FAO's Trade and Markets Division. The sharp increase in 2013 cereal production mostly stems from a recovery of maize crops in the United States and record wheat harvests in CIS countries. World rice production in 2013 is expected to grow only modestly.



SIZING UP CROP PROTECTION

With growth of 6.2 percent, **THE U.S. CROP PROTECTION CHEMICAL INDUSTRY IS PROJECTED TO BECOME AN \$11-BILLION MARKET** at the distributor cost of goods sold level during 2013, according to the recently published report *Leading Distributors in the U.S. Crop Protection Industry: A Strategic Market Analysis* by global consulting and research firm Kline & Company. By tracking the leading 17 distributors, the report covers more than 96 percent of total crop protection chemical sales within the United States. Sales reported include both private-label crop protection chemicals and adjuvants, which include surfactants, oils, water conditioners and drift control agents. Factors shaping the value of the 2013 industry include: slight increases in corn, soybean, and wheat acres planted; growing biotechnology through seed and traits; and consolidation.

REMOTE CONTROLLED CROP TOOL

Rothamsted Research in the United Kingdom has obtained a high-performance, camera-equipped radio remote controlled device called an octocopter, thanks to funding from Britain's Biotechnology and Biological Sciences Research Council. The custom-built equipment will enable high-throughput collection of data from experimental crop plots at each of the Institute's sites as well as at collaborating organizations' trials. Collection of data with this method will give unique perspectives on crop growth and plant functioning, and will vastly extend capabilities for screening crops of different genetic background for performance, nutrition, stress, pathogen and disease responses, according to a BBSRC spokesperson. The octocopter is an eight-rotor, battery-powered, unmanned aerial vehicle that's typically used in the film industry. Four cameras have been added, two of which provide live feeds to monitors on the ground. One camera, which can shoot videos and still pictures, points forward on a fixed mounting and is used to identify where the octocopter is flying and control its direction. The remaining cameras are a high-definition RGB camera, a thermal infrared camera and a hyperspectral camera, all mounted on a stabilized platform that can be tilted remotely via a transmitter. A BBSRC spokesperson stated, "world-leading bioscience needs state-of-art equipment. **THIS NEW OCTOCOPTER WILL OFFER UNPRECEDENTED INFORMATION ON CROP GROWTH,** helping to keep the U.K. at the forefront of agricultural research."



“WE HAVE TO FIND WAYS TO REDUCE FOOD LOSS DURING CROP PRODUCTION ITSELF AND POST-HARVEST STAGES OF THE FOOD CHAIN.”

PREVENTING FOOD LOSS

In November, about 230 representatives of the international horticulture value chain and industry experts gathered at Bayer CropScience's Horticulture Symposium in Germany to discuss key challenges facing the horticulture value chain. “Bayer CropScience has an important role to play in reducing food loss at the beginning of the value chain,” said Hartmut van Lengerich, head of Crop Strategy and Portfolio Management for Cereals, Rice and Fungicides at Bayer CropScience. “We have to find ways to reduce food loss during crop production itself and post-harvest stages of the food chain, mostly in developing countries. Besides, more research is needed in the field of food loss associated to the international trade, as many food products are produced, stored, transported, processed and consumed in different parts of the world.”

FOCUS ON NUTRITION

“It is clear that the ways in which food is managed today are failing to result in sufficient improvements in nutrition. The most shocking fact is that over 840 million people still suffer from hunger today, despite the fact that the world already produces enough food for all, and wastes one-third of it,” said José Graziano da Silva, director-general of the United Nations Food and Agriculture Organization, at a recent technical meeting put on by FAO and the World Health Organization. “But that is only part of the story,” he continued. “Today, over half of the world's population is affected by some form of malnutrition, be it hunger, micronutrient deficiencies or excessive consumption.”

“The total amount of food produced but not consumed would be enough to feed an additional two billion. The truth of the matter is that today, consumers are not receiving the right signals from current policies about how to eat healthily. That is what we need to address,” said Graziano da Silva. FAO statistics show that while 842 million people are chronically hungry, many more die or suffer the ill effects of inadequate nutrition. Around two billion people are affected by micronutrient deficiencies. Close to seven million children die before their fifth birthday every year, 162 million children under age five are stunted, while at the same time 500 million people are obese.



Food and Agriculture Organization
of the United Nations

THE GREAT LABEL DEBATE

According to a recent Reuters article on the recent GM labeling battle in Washington state, the Grocery Manufacturers Association, which represents more than 300 food companies, is funding efforts in 25 states to defeat labeling measures. The group is pushing for a “federal solution that will protect consumers by ensuring that the Food and Drug Administration, America's leading food safety authority, sets national standards for the safety and labeling of products made with GMO ingredients,” GMA CEO Pamela Bailey said in a statement. The article stated that officials at Monsanto, which spent more than \$5 million to kill the Washington measure, say labeling supporters are trying to create the false impression that biotech foods are harmful. “We absolutely support the consumer's right to know,” said Robb Fraley, chief technology officer at Monsanto, in the article. “But we can't support misleading labels that infer there is something unsafe about biotech products.”



“WE CAN'T SUPPORT MISLEADING LABELS THAT INFER THERE IS SOMETHING UNSAFE ABOUT BIOTECH PRODUCTS.”

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1915

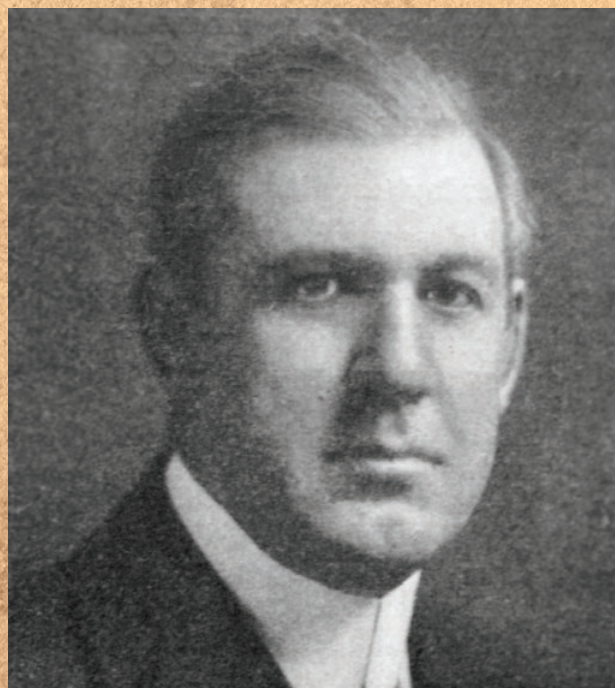
Handling Seed by Modern Methods

Old-timers in the seed trade remember when clover seed was handled in barrels, as sugar is handled today. At that period other methods of handling field seeds were laborious and crude compared to the highly efficient ones which are in use in the modern plants today. In modern plants the matter of handling is reduced to a science. Some of the big establishments have developed matters to a degree where even Henry Ford might be able to learn something of keeping the product moving and doing something to it at every step in the process. The average seed dealer, however, would not have a practical use for so elaborately equipped a plant as one of these. Yet there is every reason in the world why he should seek to adapt to his own plant all of the methods and devices used in a big plant, where he can possibly do so.

That is what one of the seed concerns in a Middle Western city has recently done, and its plant, though not an elaborate one nor a mammoth one, is pretty nearly ideal in many respects. To begin with, the building is four stories in height, with a full basement, with both front and rear entrances, one opening on the street and the other on a courtyard, from which an adequate alley leads. A location on a railroad switch would have been preferable, but that was not possible without giving up other and superior advantages possessed by the building in question.

To house the fanning equipment a room of sufficient capacity was constructed on the floor of the big room. It is entered from the main floor by a wide door and just outside are arranged the various sets of screens which are employed. At each side of the door, in small chambers which are themselves screened, are installed the electric motors used to operate the fanning mills. The blower shafts, one to each machine, extend up and through the roof, where they are protected from the weather by hoods.

The chute through which the clean seed is transported extends through the second floor into the ground floor, with a gate on the second floor, and the cleaned seed, when desired, may be collected at the cleaning mills themselves. This



Lester L. Morse, president of American Seed Trade Association in 1915.

arrangement expedites handling of the various kinds of seed which are stocked.

All seeds are carried either in cotton sacks or jute bags, as is customary, the character of the sack being determined by the nature of the contents. The several floors enable the company to store those seeds which "prefer" dark corners all on the same floor, where the windows can be readily darkened by shades, electricity supplying light when needed. Each grade of each kind of seed is piled in a heap by itself, a tag attached to a wire hook being fastened to one of the bags at the front of the pile, removed to another when the pile is reduced. Practically all the seed goes through the cleaning process, except that which comes from the cleaning stations and is known to be pure.

Altogether the plant and the methods used reduce handling costs.

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- ◆ Attend a pre-conference Seed Business 101 workshop conducted by UC Davis.

Accommodations at the Hyatt Regency Monterey are limited so register now at www.amseed.org.



1940

The Seed Trade's Interest in Soil Conservation

By R.M. Evans

The seed business is highly important to the daily life of our nation. The service and cooperation of the American seed industry in supplying adapted seed of soil-conserving crops which must be processed, and of garden seeds, has been of real help to our present national conservation program. Today I want to talk with you about the need for soil conservation.

As to the need of conserving our soil, I can do no better than repeat a statement I made the other day in speaking to a group of farmers in Kentucky. I said "Land is not inexhaustible. It has taken Americans a long time to realize this fact. We have taken soil fertility for granted, have destroyed and sold it off as though it were as inexhaustible as the air. We financed the building of America by trading soil capital for Old World money capital. It was a costly trade. We did not realize this until it hit our pocketbooks. Now we have examples—plenty of them—of what a farm can be like when the supply of soil fertility has run too low. Within a couple of generations many farms have passed through the destructive cycle from virgin soil to ruin."

"For the United States as a whole, we have lost more than one-fourth of our soil covering. We have been living on our soil principal and on all too many farms have come to the end of it. For 100 years we have put the nation's soil fertility on the market auction block and sold it off most of the time at bargain prices. As a nation we now realize that the exploitation of agriculture must end. The era of conservation is here."

I believe that seedsmen as well as farmers and the general public benefit directly through a more stable and diversified agriculture. Certainly you will agree that the loss through erosion and extractive farming of 100 million acres of farm land once used in profitable production has removed that area from the potential market of the seedsmen. Unless soil conservation is pushed forward even more in the future than it has been in the past, we stand to lose another 100 million acres from profitable production within a few score more years. This would be another decrease amounting to nearly 25 percent of the cultivated land areas being served by the seed trade.

1987

Detectives Zero in on Sick Plants

Recently developed techniques in viral detection have enabled University of Missouri-Columbia researchers to stop many plant diseases before they spread.

Om Sehgal and Fathi Mohamed, University of Missouri plant pathologists, have developed viral detection methods that are considered so sensitive they detect infection even before plants show symptoms.

1940



Better Plan Now to Attend the Pacific Coast Convention


The accompanying picture should certainly be an inducement for seedsmen everywhere to make plans to attend the coming convention of the Pacific States Seedsmen's Association. A more picturesque setting for a convention than the one shown here can hardly be imagined. This is the St. Catherine Hotel at Santa Catalina Island, where the convention of the Pacific States Seedsmen's Association will be held on May 27-29.

One method involves grinding up a piece of leaf tissue from a plant suspected to be infected, and then adding an antiserum to determine the virus. "Once we have identified the virus, we can either control it or try to control the insects or other vectors that spread the virus," explains Mohamed.

In tests with soybeans, garden beans, kidney beans, tobacco and potatoes, the researchers have experimented by isolating a virus from an infected plant and then injecting a rabbit with that virus. The rabbit then produces antibodies against the virus. Sehgal and Mohamed take blood from the rabbit to make serum.

According to the scientists, the technique works on viral samples as small as one billionth of a gram. Sehgal explains how the technique works in an example of bean pod mottle virus.

"First, we take a small amount of juice from the leaf and put a drop of that sap on a nitrocellulose membrane. The virus attaches to this membrane," explains Sehgal. The researchers drop anti-serum on the spot. If the serum contains antibodies specific to that virus, the antibodies will bind to the virus.



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An in-depth overview on the global seed industry.

From a newly developed tomato variety in Argentina to progressive workshops on safety assessment of genetically modified crops in India.



STATUS ARGENTINA

ARGENTINE researchers working with the National University of Rosario in Santa Fe province, Argentina, recently created a new hybrid tomato breed. The new hybrid tomatoes hold good weight, firmness, increased post-harvest life, and good flavor and color, among other attributes.

By analyzing a myriad of data, researchers identified genetic profiles of various tomato strains that had the above-mentioned qualities. Subsequently, selected plants were then genetically crossed to create varieties that hold all of the desired features.

“We evaluated 2,570 fruits and over 180 plants,” says Guillermo Pratta, researcher and director of the specialization in bioinformatics department at the National University of Rosario.

Two of these new varieties are currently enrolled in the National Registry of Cultivars National Seed Institute under the names Gemma and Cherub.

To create these varieties, the researchers from the Department of Genetics made crosses between a tomato variety from Argentina and a

wild tomato species collected in Peru, whose most dominant feature was improved post-harvest life.

“Utilizing the wild tomato species to prolong the post-harvest life of the fruit, rather than the techniques of genetic modification, is one of this research group’s original focuses [since it] began working in the mid-1990s. This approach also enables the ability to produce a greater variety of tomatoes for the local and international markets,” said Pratta.

—Agencia CyTA - Instituto Leloir (Science and Technology News / Buenos Aires - Argentina)

STATUS INDIA

THE INTERNATIONAL Crops Research Institute for the Semi-Arid Tropics and Biotech Consortium India Limited in New Delhi recently organized a workshop on safety assessment of genetically modified crops at the ICRISAT headquarters in Patancheru near Hyderabad, India.

In view of the increasing role of scientists and officials at state level in the development and evaluation of GM crops, BCIL has initiated communication and outreach

activities through agricultural research institutions and state agricultural universities. The workshop was organized by BCIL in partnership with ICRISAT as part of this initiative. It was conducted parallel with the ongoing international workshop on Genetic Engineering Applications in Grains and Legume Crops organized by ICRISAT.

Participants of the workshop included scientists from various public and private sectors engaged in the development of GM crops. Research institutions engaged in food safety assessment as well as those conducting confined field trials also nominated scientists to participate.

In his keynote address, Ananda Kumar, director of the Institute of Agri-Biotechnology at Andhra Pradesh Agricultural University, spoke on the “Role of GM crops: Beyond Bt cotton.” According to Kumar, several GM crops are at various stages of research and development in India. He emphasized on the need to streamline regulations so that technologies can be taken forward.

“The phenomenal success of Bt cotton has clearly shown



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the need for GM technology to deal with problems being faced by [the] Indian agriculture sector," he said. "Biosafety concerns can be clearly addressed by scientific institutions in the country as effective capabilities are available to us."

Vibha Ahuja, chief general manager with BCIL, introduced the objective of the workshop, highlighting the need for extensive capacity-building efforts in the area of safety assessment and of confined field trials using state-of-the-art guidelines.

B. Sesikeran, former director with the National Institute of Nutrition and chairman of the Review Committee on Genetic Manipulation, spoke on science and safety issues with emphasis on food safety.

"Indian food safety standards are based on best international practices, and are in accordance with the principles and guidelines of Codex Alimentarius," he says. He continued to explain the key issues involved in food safety assessment such as toxicity, allergenicity, and compositional analysis, noting that India's food safety standards provide sufficient information for the safety assessment of GM products.

Rajeev Varshney, research program director of grain legumes with ICRISAT, says that the Platform for Translational Research on Transgenic Crops at ICRISAT is regularly involved in the conducting of awareness workshops to promote scientific and factual information on biotechnology products to the stakeholders.

At the workshop, BCIL introduced an e-learning module on Compliance Management of Confined Field Trials as a useful tool for Trial-in-Charges, for members of various committees at center and state levels, scientists from various public and private sector institutions, and other stakeholders engaged in the development of GM crops.

S.J. Rahman from Acharya N G Ranga Agricultural University explained in detail the procedure for the conducting of confined field trials. There was also a session focused on ongoing research and development efforts in various institutions. Various presentations were also given by scientists from the Directorate of Rice Research, the Directorate of Sorghum Research and ICRISAT.

—International Crops Research Institute for the Semi-Arid Tropics

STATUS GERMANY

GERMANY'S FIRST

career portal specifically for the agricultural sector was launched this month. The www.agrar-jobportal.de website is a new platform and the latest offering from the Agricultural Information Centre Proplanta, a spin-off of the University of Hohenheim in Stuttgart, Germany.

Besides the latest job opportunities from across the agricultural sector, the portal provides comprehensive information on subjects like agricultural studies to green jobs and internships. The site also features agricultural career advice and events and news from around the world.

"With the new career portal, we complement our established site with agricultural employment news and the accompanying online journal for more information about jobs and careers in the green zone," says Jörg Mehtens, CEO and founder of Proplanta. "This virtual campus shows today's variety of agricultural programs and assists in the search for majors. This portal is ideal for those with questions, comments, seeking campus news as well as a tool to connect our facility to the agriculture community that is beyond our borders."

Today the university's portal has a recorded 1.8 million monthly visitors. It includes, among other things, daily agricultural news, agricultural weather forecasts for Germany, Austria and Switzerland, market and price information, an agricultural technology exchange and virtual crop consultants.

"The agricultural job portal provides answers to those looking for what follows agricultural programs, and thus facilitates entry into professional life. Interested parties can also stay up-to-date via [an] RSS job feed and users can establish direct contact with employers by registering."

—The Proplanta Agricultural Information Centre



NATIONAL

DAS RECEIVES U.S. PATENT FOR ENLIST CORN

Dow AgroSciences LLC has announced the issuance of U.S. patent number 8,598,413 for the company's lead 2,4-D herbicide tolerance event in corn. The corn event is based on one of DAS' highly anticipated Enlist herbicide-tolerant traits, and provides robust tolerance to broadleaf and grass herbicides, including 2,4-D and the FOP family of herbicides. Pending regulatory approvals, DAS expects to launch Enlist corn in 2015 in the U.S. The patent application also covers stacking the event with other traits. "Our U.S. patent for Enlist corn reinforces our leadership in trait technology as we work to provide farmers with innovative solutions to challenging weed control issues," says Rolando Meninato, vice president of Seeds, Traits, and Oils at DAS. "The Enlist Weed Control System will help farmers control broadleaf weeds and grasses in corn, and will move farming forward at a critical time in modern agriculture."

ICIA RECEIVES BQMS RECOGNITION

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service, Biotechnology Regulatory Services has recognized that Illinois Crop Improvement Association Inc. has voluntarily established a Biotechnology Quality Management System to enhance compliance with the regulatory requirements for certain genetically engineered organisms. "It is no small achievement and we are proud to have passed the BQMS audit," says ICIA CEO Doug Miller. "Preserving and assuring the integrity of seeds, plants and information is what we do." By voluntarily adopting a BQMS, an organization can improve the management of regulated imports, interstate movements, and field releases through the establishment of document and record control, effective training and continuous improvement.

DAS RECEIVES REGISTRATION FOR NEW CORN TRAIT

Dow AgroSciences LLC has announced a new corn trait technology, POWERCORE, which has just received registration from the U.S. Environmental Protection Agency. According to DAS, this innovative trait technology will provide the latest aboveground insect protection in corn via three different modes of action. POWERCORE Refuge Advanced will be launched as early as the 2015 growing season. It will be offered as a refuge-in-a-bag product for planting convenience and refuge compliance, and will be stacked with the latest in herbicide-tolerant technology, pending regulatory approvals. Corn growers can expect to see POWERCORE in future demonstration plots.

DAS READIES FOR LAUNCH OF ENLIST SYSTEM

Dow AgroSciences LLC is focusing on training and learning opportunities for the Enlist Weed Control System, a new herbicide-tolerant trait technology from DAS, as the technology awaits regulatory approvals. "We want to prepare the industry for the introduction of this new technology so that when it's available, farmers, retailers and seed sellers can hit the ground running and

get the most out of the technology while using it responsibly," says Damon Palmer, U.S. commercial leader for the Enlist Weed Control System. "In-field demonstrations and learning opportunities are an important step in that preparation." Growers, retailers and seed sellers will have more opportunities to learn about the Enlist system, including in-person and online training sessions, says Palmer. Pending regulatory approvals, DAS expects to launch Enlist corn and soybeans in 2015, with cotton to follow.

FBSCIENCES RECEIVES REGISTRATION OF NEW TECHNOLOGY

FBSciences Inc., an emerging leader in plant health innovation, has announced that the key active ingredient in their technology platform has been granted U.S. Environmental Protection Agency registration for use as a plant growth regulator. Complex polymeric polyhydroxy acids are a broad-spectrum plant growth regulator for use on field and greenhouse crops. According to the company, the patented CPPA technology represents a novel chemistry that serves as a versatile product development platform to improve germination and seedling development, stimulate root and shoot growth, and improve the plant's ability to withstand stress. The first commercially available product utilizing CPPA is designed for use as a seed treatment in 2014.

INTERNATIONAL

SYNGENTA LAUNCHES NOVEL SEED TREATMENT

Syngenta has announced the registration in Argentina of Fortenza, a novel seed treatment insecticide, for use on soybeans, corn and sunflowers. Further registrations are pending in multiple countries for both seed treatment and foliar uses across all major field crops. "The Fortenza product family will help give crops the best possible start by providing growers with powerful new tools against pests, above and below the ground. Data from more than 1,000 multi-year field trials demonstrate long-lasting protection and unrivalled yield benefits across multiple crops," says Syngenta CEO John Atkin.

KWS STOPS DEVELOPMENT OF RR SUGAR BEET IN EU

KWS SAAT AG has withdrawn its application for approval of cultivation of Roundup Ready sugar beets in the European Union. Given the political and social situation in Europe, KWS has announced that the company has decided not to put any further resources into product development in this area. Consequently, the application submitted to the EU Commission in 2008 for approval to grow RR sugar beets in the EU has been withdrawn. KWS will continue its long-term biotechnology projects with sugar beets, such as the development of winter beet and virus resistance and the use of yield genes, with undiminished efforts.

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EA/EOU

BASF CHALLENGES EU RESTRICTION OF INSECTICIDE USE

BASF has filed legal action with the General Court of the European Union challenging the EU Commission's decision to restrict major seed treatment uses of the insecticide fipronil in the EU. BASF remains convinced that the decline of bee populations is caused by multiple and complex factors and that the ban on fipronil use will not contribute to protecting the pollinators. "Prior to the decision, we reached out to the EU Commission, but unfortunately our valid scientific studies and evidence were not properly taken into account," says Jürgen Oldeweme, senior vice president of global product safety and regulatory affairs, BASF Crop Protection. "This is why we have taken this step. Fipronil is an important technology in modern agriculture that growers count on."

CHINA LAUNCHES CAMPAIGN AGAINST SEED COUNTERFEITING

The Chinese government has launched a specialized campaign against seed counterfeiting, the toughest one of its kind in recent years. In announcing the campaign, Chinese officials noted that "although seed quality has been improving for the past few years,

infringements upon seed variety rights and the production as well as sales of counterfeit seeds in some places are still prominent, which causes damage to the farmers and breeders, violates the market order and restricts the innovation of the whole industry." As a result, corn and rice seeds, the major categories on the market, will be scrutinized and those involved in illegal seed counterfeiting will face legal action and have their business licenses revoked.

AUSTRALIA TO TRIAL GM WHEAT

Australia's Gene Technology Regulator has issued a license for DIR 122, authorizing the limited and controlled release in field trials of wheat lines that have been genetically modified for enhanced yield stability. The release is authorized to take place at one site per growing season in the area of Horsham, Victoria, between November 2013 and March 2016. The purpose of the trial is to assess the effect of the genetic modifications on yield under field conditions. The GM wheat will not be used for human feed or animal feed.

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Seed Technology Education Program

PEOPLE NEWS

Syngenta has announced the retirement of **Antonio Carlos Guimarães**, regional director of Latin America, effective December 31, 2013, after 14 successful years at Syngenta. **Karsten Neuffer**, who is currently global head of Seedcare, will succeed Guimarães as regional director for Latin America and will relocate to São Paulo in the first quarter of 2014. He will lead a region that encompasses important emerging markets, more than 4,000 employees across more than 30 countries and reported sales of \$3.7 billion in 2012.

AgriThORITY LLC, an integrated agricultural science consultancy and field research and development company, has hired **Bennie Oosthuizen**, an agricultural industry marketing and business development specialist from Johannesburg, South Africa, as an associate. In his new role, Oosthuizen will provide consultation services for clients

with interests throughout Africa, further enhancing the company's footprint in the region. Oosthuizen brings more than 40 years of experience managing the marketing, sales and product development of crop protection products.

The **U.S. Biotech Crops Alliance** has announced that **Michael Phillips** has been selected as its first secretariat to spearhead collaborative efforts to improve the environment for technology innovation and the market for U.S. crops produced through modern biotechnology. Phillips is president of MJ Phillips and Associates LLC, an agricultural consulting firm that specializes in agricultural biotechnology issues. Phillips will be the focal point of the group's efforts to further advance the reach, work and wide range of activities of the alliance.

Brian Reed has joined **Burrus Hybrids** as sales manager for southern Illinois.

Reed will have overall responsibility for Burrus' regional sales managers in that area and development of customer relation management tools. Previously with Cargill for five years, Reed held sales and sales recruiting positions, receiving numerous awards in those areas.

Illumina Inc. has appointed **Francis deSouza** to the role of president. DeSouza will lead Illumina's business units and the core functions responsible for envisioning, developing and producing the company's products. He will also become part of Illumina's executive management team, which is responsible for directing all aspects of company strategy, planning and operations.

The **American Seed Trade Association** has hired **Janice Tolley Walters** as the new director of communications for the association. Walters will work closely with senior staff, as well as ASTA leadership, to promote the seed industry's regulatory and legislative positions, as well as its many initiatives to support seed education and research, careers in the seed industry, and the quality management, movement and stewardship of seed.

Jim Schweigert has been named president of **Gro Alliance**, the nation's largest, independent contract seed corn producer. Schweigert had been serving as the vice president of business development for Gro Alliance and has been a leader in improving seed quality and efficiency through the use of innovative technology and information sharing strategies. Jim takes the reins from his father, **Lou Schweigert**, who has guided the company since 1977. In the industry, Jim founded the American Seed Trade Association's Future Seed Executives initiative in 2004 and has served on the ASTA board of directors as the regional vice president to Canada since 2009. He was also honored as the 2009 recipient of *Seed World* magazine's Future Giant award.

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NorthStar Genetics has announced that **Lyle Marcus** has joined the company as its product manager for both corn and soybeans. Marcus comes to NorthStar with over 25 years of seed experience and will support NorthStar sales throughout the upper Midwest United States.

PRODUCT NEWS

Bayer CropScience and **Cargill** are introducing L156H—an **InVigor Health** hybrid with a high oleic oil profile. Bayer will produce and package the seed and sell it only through Cargill Specialty Seeds and Oils authorized dealers. “L156H gives farmers the agronomic performance they can count on from InVigor, plus the opportunity to sell at a contract premium,” says Tom Schuler, strategic business lead for seeds and traits at Bayer. L156H is the fourth new InVigor canola hybrid introduced by Bayer CropScience for the 2014 growing season.

The **Agrisure Viptera 3110** trait stack from **Syngenta** has received United States Environmental Protection Agency approval for control of true armyworm—an industry first. In addition to true armyworm, the Agrisure Viptera 3110 trait stack delivers broad-spectrum control of aboveground lepidopteran insects and can be part of an effective insect management strategy for growers who do not need to manage for corn rootworm. Syngenta hybrids with the Agrisure Viptera 3110 trait stack are available for the 2014 planting season.

DuPont Pioneer is introducing a new class of hybrids featuring a pyramid of insect protection traits to help control the lepidopteran family of insects.

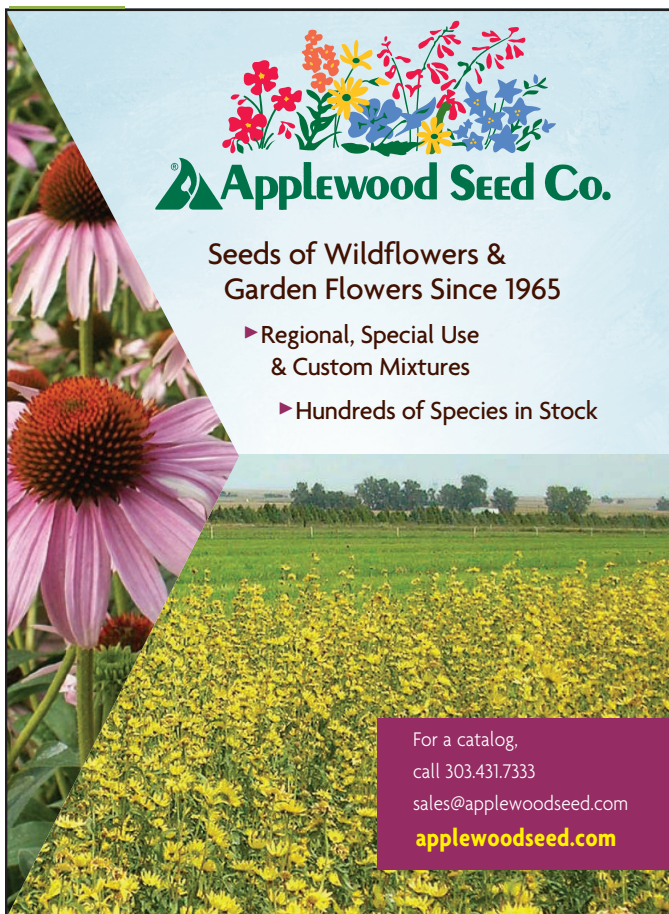
Optimum Leptra hybrids combine three traits to provide multiple modes of action and superior protection from a broad spectrum of aboveground corn pests. Pioneer is introducing six new Optimum Leptra products in limited volumes for

sale in 2014. Optimum Leptra hybrids also offer flexible weed control options with tolerance to both glyphosate and glufosinate herbicides.

BUSINESS NEWS

Monsanto Company has added to its hybrid corn and rapeseed production plants at several sites in **Europe**. The increase in Monsanto’s seed processing capabilities in Romania, Hungary and Turkey is part of a decade-long, \$680 million investment in Europe that will include further investments in France, Ukraine and Russia, more than double the company’s seed production and reinforce strategic partnerships with subcontractors throughout Europe. The company is at the halfway point in the current expansion.

Arcadia Biosciences Inc. and **DuPont Pioneer** have announced their intention to collaborate to develop enabling



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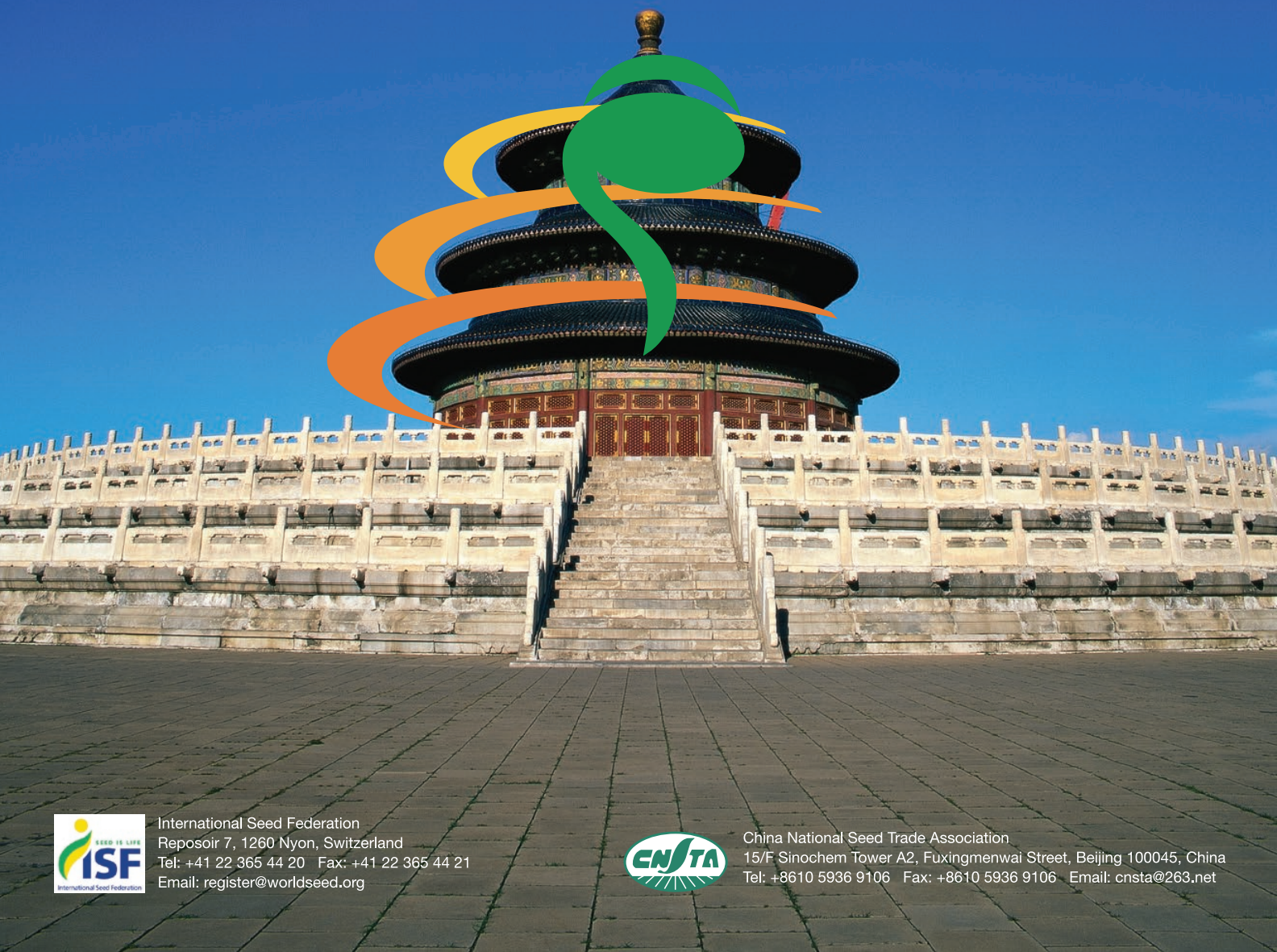
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technology to help manage pollen flow in sorghum. This technology will help facilitate the development and deployment of agronomic and quality traits in the crop. Under the agreement, Arcadia receives exclusive global rights to develop specified Pioneer technology for use in grain, forage, sweet and biofuel sorghum types. The potential exists for numerous agronomic performance and quality traits to be developed and commercialized in sorghum.

Land O'Lakes Inc. has acquired **Geosys**, a global technology firm that provides satellite imaging and insights to agribusiness. The acquisition caps a multi-year relationship between Geosys and Land O'Lakes through its WinField division, which utilizes select Geosys technologies in the United States. "This purchase demonstrates Land O'Lakes' leadership in helping to build the farm of the future with cutting-edge concepts and technologies. These industry-leading

technologies give farmers the tools to make critical decisions to improve yields while reducing their environmental footprint," says Land O'Lakes president and CEO Chris Policinski. Geosys will continue to develop its customer base and continue its expansion into the U.S. and international agricultural markets.

Monsanto Company and **Novozymes** have announced a long-term strategic alliance to transform research and commercialization of sustainable microbial products that will provide a new platform of solutions for growers around the world. The BioAg Alliance will allow the companies to leverage employees, technologies and commercial assets in their agricultural biologicals portfolios. The BioAg Alliance brings together Novozymes' commercial BioAg operations and capabilities within microbial discovery, development and production with Monsanto's microbial discovery, advanced biology, field testing and

commercial capabilities. The result will be a comprehensive research, development and commercial collaboration to help farmers meet the challenge of producing more with less in a sustainable way.

NewLeaf Symbiotics Inc., an agricultural biotech company, has acquired **Intuitive Genomics Inc.**, a leader in the design and implementation of custom bioinformatics solutions. The acquisition of Intuitive Genomics' elite computational and bioinformatics capabilities complements NewLeaf's research and development efforts and product pipeline and positions the company as a top player in the burgeoning biologicals category. NewLeaf Symbiotics is researching and commercializing naturally beneficial plant bacteria for crop health and protection.

Bayer CropScience has entered into an agreement to purchase the startup company **FN Semillas S.A.** based in

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Buenos Aires, Argentina. FN Semillas S.A. specializes in the breeding, production and marketing of improved soybean seeds in Argentina. This acquisition ratifies the commitment of Bayer in Argentina and marks the company's entrance into the national soybean seed market in this country. For Bayer, the acquisition is another step in building a global soybean seed platform. The acquisition will be filed for clearance before the Antitrust Authority in Argentina.

corn. Knocking out this gene has enabled Pioneer to produce corn plants that are male-sterile, a powerful tool for hybrid seed production.

The **United States Department of Agriculture's National Institute of Food and Agriculture** has announced nearly \$9 million in grants for research into issues affecting plant breeding and production, leading to improvements in plants that are critical to the sustainability and competitiveness of American agriculture. The awards were made under the Agriculture and Food Research Initiative foundational program priority area of plant breeding for agricultural production. The funded projects focus on classical breeding to include cultivar development, prebreeding and germplasm enhancement, related species introgression and novel approaches to phenotyping, among other areas. AFRI is NIFA's flagship competitive grants

program and was established under the 2008 U.S. Farm Bill.

Harvesting existing cropland more frequently could substantially increase global food production without clearing more land for agriculture, according to a new study from the **Institute on the Environment (IonE) at the University of Minnesota**. The study tracked global harvest trends of 177 crops between 1961 and 2011. Deepak Ray, lead author of the study, introduced the concept of harvest gap—the difference between actual per-year harvest frequency and the maximum potential frequency. They found that Africa, Latin America and Asia have the highest concentration of potential harvest gaps. Closing the gap would boost crop production on existing croplands without resorting to further clearing for agriculture. Worldwide, the researchers found that closing harvest gaps could theoretically boost production more than 44 percent.

INDUSTRY NEWS

Precision BioSciences Inc. and DuPont Pioneer have announced that *The Plant Journal* has published an article detailing collaborative, cutting-edge research to generate male-sterile corn plants. Researchers at Pioneer used Precision's advanced genome engineering technology, called DNE, to knock out or disable the function of the ms26 gene in



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What's New at IPSA?



This January's *Giant Views of the Industry* article in *Seed World* provides a timely opportunity to outline what's new at IPSA—the Independent Professional Seed Association. But first, let's take a look back in time.

IPSA is celebrating its 25th anniversary during 2014, with a reception being held at IPSA's Annual Conference in St. Louis, Mo. on Jan. 14, 2014. Twenty-five years is a great feat for any group or company, and I look forward to celebrating this milestone with our IPSA friends in St. Louis. The reception will include memories from several past IPSA leaders and founding members, as well as the chance to enjoy conversation with current industry and association leaders.

So back to the task at hand—what is new for IPSA and its regional, independent seed company members? The quick answer is that much is new and exciting as IPSA begins the next chapter in its history. Here are a few details:

- **Annual Conference**—Recognized by members as one of the association's highest priorities, the IPSA Annual Conference also has its own long history. Held in mid-January each year (January 14 to 16, 2014), the conference focuses on educational programming and business management tools that benefit our regional seed company members. The conference also hosts a trade show and provides ample time for interaction between vendors and attendees.

What is new is the depth of programming and quality of speakers—each year IPSA's Business Development Committee strives to offer a stronger conference agenda with added relevancy to our members than in the past. Topics on the 2014 agenda include executive coaching, digital communications and marketing trends, how to reach tech-savvy growers and how to market to multiple generations of growers.

- **Agronomic Research**—For years, IPSA has offered a variety of agronomic research programs to its members, including disease screening and inbred/hybrid characterization studies. More recently, agronomic research at IPSA has evolved to include head-to-head trials of industry-leading seed treatment and seed enhancement products, providing members with a source of unbiased, third-party data to make product and marketing decisions.

For 2014, the IPSA Member Services Committee is investigating a research protocol comparing the impacts of a variety of weed control systems on hybrid corn performance. More details on this new program will be released at the 2014 IPSA Annual Conference.

- **Educational Programming**—Historically, IPSA has offered a wide range of educational programs to its members, with topics addressing sales training, professional development and human resource needs, to name a few. These programs are delivered in a variety of ways—the annual conference being one obvious source, as well as through webinars and other Internet-based technologies.

For 2014 and forward, IPSA's Education Committee is taking a more targeted approach to educational programming in three areas of focus—younger employees, mid-management positions, and CEO/senior management roles. The committee intends to address programming efforts in each category that provide tangible benefits to IPSA member companies, and hopes to partner with others in the industry in this new endeavor.

- **Precision Ag/Data Management**—A topic that garners more attention each day, IPSA's Member Services Committee has grabbed the bull by the horns and assembled a task force to investigate realistic solutions to assist member companies and their grower customers in assimilating, quantifying and utilizing any of a variety of tools that improve data use and efficiency. The task force has a daunting job on its plate, but is also energized by the challenge and looking forward to making progress on behalf of the association.

IPSA has had a storied past. During the past quarter-century, the seed industry has seen tremendous changes such as the advent of biotechnology, a consolidation of seed brands, and the larger role that seed plays today in modern agricultural practices.

While I do look forward to celebrating IPSA's rich history, I must admit that the future for the association is what I get extremely excited for. IPSA is comprised of seed brands that are simultaneously celebrating their rich histories with an eye on the future needs of their customers. The seed industry is a dynamic business filled with great people, and IPSA is looking forward to making the next 25 years even more memorable.

Greg Ruehle, CEO, Independent Professional Seed Association



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