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What role do you think advanced agricultural technologies have in achieving world food security?

First of all, let's be clear about what we mean by advanced agricultural technologies. While biotechnology has been one of the most advanced technologies impacting agricultural production systems over the past 20 years, a more diverse set of such technologies are now being brought to bear on agriculture than ever before. We have witnessed the age of chemistry, the age of mechanization, the age of biology. We are now entering an age of information, of data, as a primary source of innovation, but the interaction with and integration of the developments from the prior ages – partly through information generated from deployment of these technologies or better use of information in their deployment – is increasingly important.

Second, global food security requires more than just efficient use of inputs and increasing yields. Robust distribution systems, reduced waste and reliable markets, and technologies that enhance production are critical. Fortunately industry is creating technologies that affordably increase production for both developed and developing countries.

Third, the value of advanced agricultural technologies for world food security can be viewed through the deployment of these technologies globally, particularly in developing countries. Biotechnology has been one of the most broadly adopted technologies ever in agriculture. Biotech crops globally have contributed an additional 377 million tons of food, feed and fiber since 1996 ([ISAAA](#), 2014). Growers deploying biotech crops are not just in the developed world; instead, more than 90 percent of growers cultivating biotech crops are small, resource-poor growers in developing countries. Income growth in developing countries is critically dependent upon agricultural productivity, with experts estimating that agriculture accounts for 30-60 percent of developing country GDP ([USDA-ERS](#) and the [U.N.](#)).

Are there any sectors within agriculture where you would like to see more innovation? In your opinion what's ripe for disruption?

I see innovation in many sectors these days that is valuable for increased productivity and reduced environmental impact of agriculture. So I'm not sure I can point out any one area in which we specifically need more innovation.

However, we have a continued challenge with the rate of genetic gain for the major crops at the heart of our global food supply, including corn, soy, wheat, rice, etc. One strategy for accelerated improvement of genetic gain is the replacement of open pollinated breeding systems such as those used in wheat and much of rice still, through hybrid breeding systems. In fact, we still see many regions of the world still producing open pollinated varieties (OPV) of maize instead of hybrid maize, which DuPont Pioneer – pardon the pun – pioneered nearly 90 years ago. We are committed to enhancing genetic gain across crops through hybrid systems by leveraging our expertise in maize product development.

Another important opportunity to enhance genetic gain is through CRISPR technology that is now recognized as a much faster, more efficient and less expensive way to modify eukaryotic genomes than we've ever had at our disposal. In fact, the ability to modify genomes directly and by design has been a vision biologists have had since bacterial genomes were first edited in the 1980's. While the tools for this are being perfected, many other innovations will be needed to take advantage of the fundamental tools and thus become areas ripe for innovation.

Which types of agricultural technologies are currently generating the most interest amongst the investment community?

I would say that the areas that seem to be garnering the most interest amongst the investment community recently are those that can be developed with fewer regulatory constraints, and with a shorter time to market validation and adoption. So while industry needs new modes of action herbicides and herbicide tolerant crops as well as new modes of action for insect control, and these continue to be targets of major biotech seed companies like ours, we see a new focus on biologicals, and on internet-based decision support services like DuPont Pioneer Encircasm services.

What is the potential of big data in agriculture and how could the future look?

American agriculture is undergoing a technological revolution with the integration of decision agriculture and its data-driven tools. Many agricultural businesses and start-up companies have released their own solutions designed to help farmers drive on-farm efficiency and productivity by turning data into actionable farm management information. Increasingly, these data-driven services are being considered integral to the world's farmers being able to remain competitive and to sustainably meet the food demands of a growing population.

As we mentioned above, the DuPont Pioneer Encircasm suite of services, is an example of the application of big data for improvement in agricultural productivity and improved environmental outcomes. These services provide growers with information to help them make decisions that can improve average yields per acre and more efficiently use inputs such as nitrogen. So we expect to see further increases in productivity with reduced inputs through big data applications, and also further simplification of the management of large farming operations.

We are just on the cusp of wide-scale adoption of data-fueled tools and services in the United States and the establishment of a harmonized infrastructure is critical to keeping growers in charge. With more mouths to feed using less land and fewer resources, the use of on-farm data has the potential to be a game-changer for the world's farmers.

Where are we seeing most innovation in ag-biotech? What sub-sectors have the potential to take off in the next 5 years?

Innovation continues in mainstream biotech product categories, with new modes of action in development for insect control for example. But we are seeing a new wave of innovation that relies on technologies with a shorter experimental and development cycle, and no unusual regulatory constraints.

In your opinion what is the biggest challenge facing agriculture technology companies in taking their solutions to market?

Ag technologies positively contribute to food and animal feed production in many ways. Technologies that are deployed as biotech traits usually trigger regulatory oversight. Good regulations should be proportionate to potential risks of a product but often the tendency is to over-regulate and focus on the techniques used in developing the product as opposed to the product itself, which can delay delivery of products or solutions to growers. It can be challenging for regulations to keep pace with advancements and developments in technologies that result in new crop varieties such as gene-editing tools to specifically modify a plant's own genome, without introducing foreign genetic material.

Such innovations in ag technologies are often developed by small technology companies; however, the investment needed to meet the regulatory requirements make it nearly impossible for small companies to bring crops with biotech traits to the market. For example, it's estimated to take \$136 million and 13 years to get a new biotech product to market. At DuPont Pioneer, we estimate that we conduct more than 75 different studies in the regulatory science phase alone for each new product, even those that are comprised of traits that have been tested and proven safe thousands of times over since their introduction nearly 20 years ago.

For biotech products, the uncertain length of time and cost of the regulatory approval processes in diverse geographies critical to international trade are a significant challenge as well. Ultimately, these Ag technologies contribute to food security and stronger political will support growth of developing countries as well as facilitate reliable grain trade amongst major producer and consumer countries.

How does your company specifically approach the challenge of taking advanced technologies to commercial scale?

It can be tempting for innovators to focus on the most interesting aspect of a technology instead of the aspects that represent the greatest potential risk to success. It is our philosophy to identify early on in the development process the most critical challenges for technology adoption and then focus on solving for those challenges both internally and with stakeholders in the value chain. As an example, the challenge of bringing Plenish® High Oleic soybean oil to market has certainly not been about technology or our ability to produce the product at commercial scale, but about securing global regulatory approvals.

In your view, which countries/regions are poised to transform into hubs for agricultural innovation? Where do you see the next wave of new technologies emerging?

Since agricultural innovation draws on more diverse sets of expertise than 20 years ago, innovation hubs must be able to draw more diverse talent than ever before. The United States remains a very strong source of agricultural innovation, but agricultural innovation is increasingly found globally. Clearly China is investing heavily in agriculture and for good reason, trying to achieve self-sufficiency in the production of some crops, and with expertise in everything from software to engineering to biotechnology and genomics, it is poised to compete strongly.

What is the single most important thing that a government can do to stimulate the adoption of advanced agricultural technologies?

For products that use biotechnology in their production, whether resulting in a biotech crop or not, we need inter-governmental regulatory harmonization especially for food/animal feed commodities traded globally. Food/feed safety should be universal based on CODEX and other international scientific instruments, and this should be the basis towards mutual recognition of data acceptance and safety evaluations centered on humans, animals and the environment. This could also drive acceptance of low level presence (LLP) in countries which have yet to approve new products. Zero tolerance and duplication of data generation as well as burdensome review processes involving multiple agencies causes asynchrony thereby delaying adoption. In some cases, fourth hurdles involving non-scientific criteria are being considered in the review process and this can cause further delays in adoption.

Of course there are many other advanced technologies we've discussed. In general, the reduction in uncertainty about the regulatory treatment of new products may be the single most critical issue broadly, whether we are discussing new "biologicals", new breeding technologies, new hybrid systems or new data-sharing products. Other than that, support for an innovation environment is critical to overall success, including appropriate tax or credit incentives for research by small companies, grant support, support for alliances between academic institutions that often initiate innovations with small companies that take the initial risk of developing innovative products.

How do you as a company identify potential partners or collaborators in the agri-tech space?

First and foremost, we are guided by our core values – safety & health, highest ethical behavior, respect for people and, environmental stewardship. A shared set of high standards in these four areas is the most critical factor that guides our selection and relationship with potential collaborators. Our unwavering commitment to our core values also encourages small companies to recognize and seek out DuPont Pioneer. Second, we look to either identify needs of our organization or select entities that are solving significant scientific challenges that could bring value to our customers/growers. Third, we look to identify entities with common goals and expectations in the development of the technology. Fourth, we identify and work with venture funds or other vehicles for sourcing technologies and potential deals. Finally, we look for collaborators with complementary strengths so that the resulting effort will be as strong and robust as possible, both as to the technology approaches and resources available.

If you had to name a company as "one to watch" over the next 12 months, who would it be?

We see some emerging companies deploying emerging technologies of interest, but that's one we'll keep to ourselves – for now!

*Hear Neal discuss these issues in more depth at the **World Agri-Tech Investment Summit**, taking place in San Francisco on March 3-4, 2015.*

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