27th Annual Conference of the North American Agricultural Biotechnology Council

2-3 JUNE | STATE COLLEGE, USA

IN THE ROUND

**Dr Gregory Jaffe** is Director of the Project on Biotechnology for the Center for Science in the Public Interest and a recognised international expert on agricultural biotechnology and biosafety.

**Dr Michael Schechtman** is Biotechnology Coordinator for the US Department of Agriculture’s Agricultural Research Service, working as a senior biotechnology advisor with the office of the Secretary of Agriculture.

**Dr Steve Pueppke** is Associate Vice-President for Research and Graduate Studies at Michigan State University and serves as Director of Global and Strategic Initiatives in the College of Agriculture and Natural Resources.

**Dr Richard Roush’s** expertise is in pest management and designing systems to delay or prevent insects and weeds from evolving resistance. He is Dean of the College of Agricultural Sciences at Penn State University.

**Dr Nicholas Storer** is the Global Leader for Science Policy in the Biotechnology Regulatory Affairs group at Dow AgroSciences, based in the US.

**Gregory Loberg** is Manager of the West Coast Beet Seed Company in Oregon and vice-President (and incoming President) of the Oregon Seed Association.

**Lynn Clarkson** supplies identity preserved corns and soybeans as ingredients to food companies and feeders through Clarkson Grain, which has been a player in the organic markets since 1992.
The 27th Annual Conference of the North American Agricultural Biotechnology Council, entitled ‘Stewardship for the Sustainability of Genetically Engineered Crops: the Way Forward in Pest Management, Coexistence and Trade’, was attended by thought leaders from academia, government and the agricultural industry. In the second instalment of an exclusive two-part discussion, *International Innovation* hears from an eclectic mix of speakers from the event.

**Over reliance on specific crop varieties that carry genetically engineered (GE) resistant traits is a growing concern in the US. Why do these habits result in a significant rise in pest resistance? Are you able to provide any solutions for this trend?**

**GJ:** Farmers have adopted GE crops in record numbers because of the benefits they provide. Over 90 per cent of all corn, soybean, cotton and sugar beet acreage in the US is planted with a GE crop variety, with at least one, and up to seven, different engineered traits – primarily either pesticide producing *Bacillus thuringiensis* (Bt) toxins or herbicide tolerance.

However, with the adoption of GE crops, many farmers have stopped using best management practices designed to prevent the development of resistant weeds or insects. If a farmer grows the same crop in the same field for many years and uses the same pesticides (whether a chemical or a built-in engineered pesticide), resistant pests will develop. That is why there are populations of glyphosate-tolerant weeds and Bt-resistant corn rootworm insects on farms in the US.

The solution to stopping this trend is to use GE seeds with integrated weed and pest management. Farmers need to rotate the crops they grow in their fields and rotate between pesticides that have different modes of action. Those two best management practices are proven to decrease the likelihood of developing resistant weeds and insects. If farmers are not willing to do this voluntarily, then the Environmental Protection Agency (EPA) should require such practices when they register GE crops with built-in pesticides and herbicides used in conjunction with GE herbicide-tolerant seeds.

**LC:** I agree; rotation is the only mediating approach I see. Only the organic certification system has required at least a three-crop rotation. Voluntary stewardship does not seem to be working in conventional or non-GE production.

**GL:** The persistent overuse of successful technology is driven by its cost effectiveness. Farmers must compete with one another and find it difficult to rotate technologies when that increases costs, especially relative to another producer. Trait owners are offering better stewardship programmes with products on a case-by-case basis, but compliance typically depends on growers using best stewardship practices, and failure to do so is not a violation of law. Efforts to make stewardship mandatory are controversial. Education and outreach throughout the production and supply chain is critical and it must be ongoing, not a one-time box to complete on a checklist.

**SP:** Overreliance on any one pest control method imposes significant pressure on the pest to mutate and become resistant. This has begun to happen with insect and weed control strategies that are GE-based, just as it has long happened with pest control strategies that are based on fungicides or insecticides. Charles Darwin called this phenomenon natural selection.

Scientists have long recommended that farmers practise integrated pest management (IPM), i.e. mixing and matching a variety of different control strategies, thus minimising pressure for the pest to develop resistance to any one overused strategy. IPM is a key stewardship tactic, which
slows or even prevents the appearance of resistance. It’s not a golden bullet, but it is a viable, time-tested approach. Unfortunately, though, there are many economic and factors that often work against IPM and lead to overreliance on single pest control tactics. This situation is complex, and the solution will require careful integration of agronomic, economic and policy approaches.

After two decades, to what extent have safety considerations and national stewardship of genetically modified (GM) crops evolved?

MS: More than 20 years of experience in the evaluation and regulation of GE crops has led to increased familiarity with the crops and clarified the most relevant issues to be considered in evaluations. The initial conclusions from the National Academy of Sciences that the risks posed by GE crops are the same in kind as those posed by comparable non-engineered crops remain as valid today as when they were issued a quarter of a century ago.

It will be important moving forward for regulatory agencies to adapt their policies to draw on their accumulated experience of the last 20 years. Stewardship of these crops has also evolved and become more sophisticated over the past 20 years. This evolution has arisen from at least two factors: the need to safeguard the durability of useful new GE traits, and evolving marketplace realities. These realities include; process-based, formal pre-market regulatory procedures for GE crops different from those for conventional crops; diversification of the marketplace and the evolution of GE-sensitive markets; different rates of approval for GE traits by our trading partners; and the development of very sensitive detection technologies for the presence of particular traits.

RR: Unfortunately, despite abundant growth in evidence for the safety of GE crops, including in Europe, excessive concerns and regulations over food safety and environmental impact remain. National stewardship of GE crops is much advanced in Australia, with practical systems for resistance management in place for both herbicide and insect resistance. The US is fairly strong on insect resistance, but lacking for herbicide resistance, while other countries are largely lacking for both.

NS: Human health and environmental safety have always been the number one priority of the agricultural biotechnology industry. These crops are tested for safety more exhaustively than any other component of the food chain. There has never been a single case of confirmed harm attributed to a product of agricultural biotechnology. In the early years of the technology, such testing made sense as there was uncertainty and lack of familiarity with the products. However, after this 20-year track record of safety, governments and policy makers need to look closely at the regulatory barriers their testing requirements present, especially to smaller developers and more specialised traits and crops.

SP: I also don’t know of any credible evidence that GE crops pose safety risks, but there have been some unintended consequences of their widespread adoption and this is where the landscape continues to evolve. Few, if any, anticipated that GE crops could become barriers to international trade or that GM-free would be used as a marketing tool for foods. These issues are complex and evolving, because they have strong political and ideological overtones and attract people with equally strong opinions on how to respond. We’ve also seen examples of GE seeds and GE plants showing up where they are not supposed to be.

GL: Unfortunately, many Americans don’t understand biotechnology or the agencies with oversight. Worse yet, there seems to be a great distrust of government, perhaps greater than ever. Education and outreach tends to stall at the stakeholder level. We need to reach consumers with simple, succinct explanations of agricultural technology. I find myself conveying too much information at times and I’m working on that.

In what capacity have you witnessed the collaboration of academia and the agricultural industry work to improve the efficiency of GE crops and other biotechnologies?

RR: As an academic, I have worked closely with Monsanto, Dow and other biotechnology companies, especially in 1993-2007, to design and promote resistance management strategies for Bt crops. I think the collaboration across all academics has diminished since then, with weaker resistance management strategies now being promoted for corn, but resistance management for Bt crops is otherwise very successful.

LC: I have seen pockets of innovative creativity and efforts from a small number of academics scattered across North America. Some still focus strictly on the question of safe science while others are now focusing on overall efficiencies of production, consumer benefits and social concerns going beyond safety.

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**GL:** My strongest experience in this area has been as a member of the 2014 Oregon Governor’s Task Force on GE Crops. Although the state legislature passed crop pre-emption in 2013 and limited regulation to state government, the question of the role of state government remained. The Governor asked for help in identifying challenges to coexistence, areas of agreement and disagreement, and what, if any, other models of coexistence were available, while stating that no crops should be banned. Following about a dozen meetings a thorough report addressing these objectives was released. The report was not intended to make policy or recommend legislation. The 12 citizen members came from Oregon State University, Oregon Farm Bureau, food processing, farming – including organic and vineyard production – organic food, and lobbying interests. The Oregon Department of Agriculture attended ex officio. Communications among task force members of diverse positions and opinions strengthened throughout the process and became one of the strong lasting outcomes, one which will support collaboration for years to come.

**NS:** Academia frequently devises important enabling technologies that are then licensed or adopted by industry in order to develop practical innovations in agriculture. Many of the recent important technologies for gene editing, for example, which are now being utilised by industry to develop new crop varieties, were developed by academic scientists. In addition, ongoing international efforts, often funded by philanthropic foundations to enable the use of GE technologies to address critical crop production constraints for subsistence farmers in developing countries, often involve academic researchers who deploy proprietary technologies donated by industry for that specific purpose.

**MS:** Collaboration between the public and private sectors on stewardship topics such as resistance management has been, and continues to be, valuable. A considerable amount of field, lab and theoretical research conducted by the academic community has helped develop our shared understanding of the resistance risks associated with GE crops and shaped the resistance management strategies now employed. Public sector scientists’ perspectives are frequently sought out by industry when developing new products and strategies.

**SP:** The public and private sectors have a long history of collaboration, one that predates the introduction of GE crops by many decades. We in the land grant universities produce much of the talent that the agricultural industry employs, and many fundamental agricultural advances are discovered in the public sector and then commercialised by the private sector. The appearance of GE crops changed the details but not the fundamental relationships.

A specific example is that for the past three years, I have co-Chaired the Advisory Committee for Monsanto’s Corn Insect Management Knowledge Program. Monsanto is making funds available on a competitive basis to teams of public sector scientists, who have novel ideas to unravel the biology behind management of economically important insect pests. This started out as the Corn Rootworm Knowledge Program, coincident with the first reports of unexpected damage by corn rootworm in fields of Bt corn. This is an important stewardship issue; more research was needed, and industry figured out a way to engage academic talent to get the job done collaboratively.

The cultivation of GE crops has been controversial over the last 20 years. While they are used widely in the US, earlier this year nine EU countries opposed their use entirely. Amidst the debate, many argue GE cultivation is necessary in order to feed a growing world population, do you agree?

**GJ:** The adoption of GE crops is not a panacea for addressing food insecurity or feeding the world’s growing population. Under proper conditions, GE crops could help farmers in developing countries address specific agricultural constraints and increase their production. However, farmers need suitable GE varieties of crops they grow, education about their proper use, and credit to purchase fertiliser, pesticides, and other products that maximise productivity with those GE varieties. At that same time, providing conventional technologies, such as irrigation equipment, quality seeds, post-harvest storage facilities, and roads to help get crops (GE or not) from farms to cities, could also greatly increase farmer yield and income in developing countries. As with many other technologies, the benefits and impacts GE crops have to be judged on a case-by-case basis. Society’s goal should be to maximise benefits and minimise impacts.