Crop Genetics and the Ethonol Industry of Tomorrow

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Following ten years of unprecedented growth, recent upheaval of the US ethanol industry has left many wondering exactly what the future holds for this alternative fuel source – and what role the crop genetics industry will play in its future. Looking across crop production agriculture, advances in biotechnology and the rapid adoption of value-added seeds by growers have driven industry consolidation and record investments in seed germplasm, research and market access. More recently the seemingly insatiable demand for corn, spurred by an expanding ethanol production base, along with continued strong demand from feed and export markets, caused a domino-effect on demand and prices for all grain markets and even competing crops. What comes next? Everything is subject to change today as US markets continue in a true state of flux. Seedsmen developing their crop plans are wondering where to go long, where to go short and where to invest for the future (product line and inventory management, after all, are still keys to a successful seed business). The future of crops to be used for ethanol feedstocks is one of those lingering questions.

A number of factors encouraged the growth of twenty-first century ethanol production including the rising costs of gasoline, concern about our dependence on foreign oil, and heightened environmental awareness. But no one reason has driven ethanol production increases more than the US Renewable Fuel Standard (RFS). Adopted originally in 2005 and revised as part of the Energy Independence and Security Act of 2007, the RFS mandates and subsidizes the use of 36 billion gallons of renewable fuels in the United States by 2022. Add to this the federal requirement to eliminate use of the chemical additive MTBE from motor fuel (methyl tertiary butyl ether – believed to be a possible human carcinogen), and it didn't take long to make things happen.

With the support of groups like the National Corn Growers Association and the Renewable Fuels Association, new investments in ethanol capacity happened at a dizzying rate. US producers built largecapacity production facilities to convert corn starch into fuel, and industry output exploded from less than 1.5 billion gallons produced ten years ago to a record nine billion gallons in 2008. Sold as E85 (85% ethanol) in Flex-Fuel vehicles and, mostly, as E10 (a 10% ethanol high-octane gasoline additive) in conventional automobiles, the industry replaced MTBE with ethanol and soon well-over half of the gas pumps in the US sold E10 gasoline. Today there are more than 170 ethanol biorefinery plants located across 26 US States using approximately 3.3 billion bushels of corn (27% of the total US crop) and providing more than 7% of the total US gasoline supply.

Corn Starch Ethanol

Expanding ethanol capacity created a substantial new market for #2 yellow corn and made a dramatic impact on corn prices and corn farming. On top of the prerecession protein-driven demand for US grains, and a rush of speculative investors in Chicago

corn futures, this new bull market encouraged commodity prices to begin a run that pushed corn plantings to more than 93 million acres in 2007, drove prices to a high of more than $8.00 per bushel and resulted in a 30-year low corn stocks-to-use ratio.

Ethanol produces less total energy than gasoline but it burns much cleaner, resulting in a significant environmental improvement over fossil fuels. But while ethanol seems to be a logical win for clean air, some significant challenges remain for this renewable fuel. The Food versus Fuel debate ("why are we burning food in our gas tanks?") and, most recently, the total energy and carbon footprint required to produce a gallon of ethanol from corn, including the use of energy, water, fertilizer, fuel, land (and even "indirect land use change"), are causing some to ask if we are doing more harm than good. The economics of corn ethanol is another big challenge. Ethanol production, albeit still subsidized, began to lose its profitability as a result of huge construction costs, out of control cost-of-goods-sold caused by buying corn on a spot market basis of $5, $6 and $7 per bushel, and a drop in oil prices (and ethanol revenues).

A large number of ethanol plants have since declared bankruptcy and sold for change on the dollar, with huge losses to initial investors and new balance sheets restructured to carry vastly reduced debt loads. These same businesses are now implementing procedures to finally hedge their grain costs, using corn hybrids with improved conversion rates, and begin to evaluate new process technologies that will allow them to use less water, handle cellulosic corn stover in addition to grain, or fractionate the grain and produce other value-added "co-products" in addition to ethanol and distillers grains. These new steps, in addition to rising oil prices, will hopefully allow profitability to return soon to the corn ethanol industry.

Cellulosic Ethanol

While the corn-based ethanol industry has had a rough go lately, and continues to be questioned about its exact long term viability, there seems to be a true optimism for cellulosic biofuels. The RFS established something of a top-end for corn-based ethanol at 15 billion gallons, but cellulosic ethanol and other non-food crops expected to create "advanced" biofuels are forecast to produce an additional 21 billion gallons of ethanol per year and are clearly seen as the future of the industry. Cellulosic ethanol involves a process whereby the whole plant "biomass" is converted into fuel. Non-food plants like switchgrass, forage sorghum, miscanthus, and many more are often mentioned as having great potential as cellulosic fuel feedstocks without the added challenge of having to divert products from the food supply. But while enthusiasm for cellulosic ethanol is building momentum and investment, the fact is that we still have some major hurdles to leap before we succeed.

Processing technologies for cellulosic ethanol have not yet fully evolved. There are a number of inherent challenges involved to physically and chemically breakdown cellulose, hemi-cellulose and lignin found in plants. Many of these challenges, including the mechanical engineering and specific enzyme production needed to achieve efficient and low-cost conversion, are gaining significant attention and advancement right now – but they are a long way from a perfected process.

Also, while many crops have potential as biomass feedstocks, it is far too early to determine the winners and losers. This is an area where seed companies will have a vested interest through germplasm research & advancement, technology integration, and expertise in identitypreserved production. No one feedstock will be the silver bullet. Cellulosic feedstocks will need to have high yield, harvest & transport economically, breakdown efficiently, and give ethanol producers a raw product they can rely on 24 hours per day, 7 days per week, 365 days per year. Summer crops, winter crops, municipal wastes, wood residues, and even crop residues like corn stover and wheat straw may all be a part of the cellulosic ethanol portfolio – with production areas shifting to meet the crops.

Future of the Industry

So where is all of this heading? Whatever we embrace as a revised energy policy in this country will no doubt contain the principals of more renewable energy and more efficient use. Not a new idea, but the fact is that we simply cannot keep doing what we are doing now, and more oil does not appear to be the whole answer. The market opportunities are huge, so large sums of government and private research dollars are being invested today in advanced genetics, next generation biofuels and a number of new biotechnologies in addition to other worthwhile renewable energy strategies.

The ethanol industry of the future may not look a lot like the industry we have today. The United States uses approximately 145 billion gallons of gasoline annually, and farmers are certain that they can play a part in satisfying this fuel need. Of course the real trick in the successful evolution of advanced biofuels, beyond the challenges listed above, probably lies in a word that we tend to throw around rather lightly these days – sustainability. Unlike petroleum, crops can be produced and reproduced year after year, but can this be accomplished in a cost effective, highoutput, "managed" inputs, and environmentally-friendly manner? And can we do all of this while managing the challenge of maintaining appropriate crop residues (organic matter) on our lands?

Crop production agriculture realizes that biofuels produced from plants hold great promise for helping meet our energy needs. The fact is that green plants are arguably the most efficient machines in the world for capturing the endless energy of the sun (counting the whole photosynthetic process). Corn-based ethanol will continue to have an important role in biofuels but its rate of growth will slow considerably. Good news for corn is that, although not a fan of corn-based ethanol, President Obama said recently that the transition to advanced generation biofuels "will be successful only if the first-generation biofuels industry (corn) remains viable in the near-term" and the EPA is currently asking for public comment on a petition to raise the limit on ethanol blending from E10 to E15 (15%). Cellulosic ethanol, from its many possible feedstocks, will eventually play a role as big or bigger than corn – but in what crops? Answers to these issues will clearly define the future of US ethanol.

Seedsmen, plant breeders and biotechnology companies are experts at crop genetics and crop production. It is what we do. As a part of a strategic business plan, Verdant Partners advises every crop genetics company to look downstream, beyond the grower, to the end users of its products, like ethanol. There are many details to be resolved in our quest for sustainable biofuels, and the crop genetics industry is better suited to answer the sustainable feedstocks questions than anyone. We can succeed in our efforts to realize ethanol as one component of our overall energy plan, but we must embrace technology and we must move forward with a holistic perspective and a spirit of cooperation that keeps all eyes focused on the bigger goals.

Verdant Partners LLC is a leading investment banking and consulting firm specializing in the global crop genetics sector. With over 300 years of combined experience in all crops and in all phases of the international crop genetics industry, as well as in other sectors of agribusiness, Verdant's investment banking and consulting skills are sharply focused and experience-based. Each of Verdant's principals has senior management experience in leading agribusiness companies. Together, Verdant has initiated and managed transactions and alliances valued in excess of U.S. $1.5 billion. ■